

**SUSTAINABLE FACILITIES
MANAGEMENT
WITH THE SUPPORT OF
BUILDING INFORMATION
MODELLING**

GIULIA CARBONARI

A thesis submitted in partial fulfilment of the
requirements of the University of Greenwich
for the Degree of Doctor of Philosophy

February 2018

DECLARATION

“I certify that the work contained in this thesis, or any part of it, has not been accepted in substance for any previous degree awarded to me, and is not concurrently being submitted for any degree other than that of Doctor of Philosophy being studied at the University of Greenwich. I also declare that this work is the result of my own investigations, except where otherwise identified by references and that the contents are not the outcome of any form of research misconduct.”

Sign.....(Student)

Date.....

Sign.....(Supervisor)

Date.....

ACKNOWLEDGEMENTS

This Ph.D has been a journey and I would like to thank all the amazing people that have supported me through these years.

Firstly I would like to thank my supervisors, Dr. Spyridon Stravoravdis and Dr. Kostis Evangelinos and my former supervisor Dr. Nicola Callaghan. I would also like to thank the University of Greenwich for providing me a funded opportunity to conduct my research and complete my PhD. A special thanks goes to Professor Keith Jones who believed in me and gave me the opportunity to do this research and to the Postgraduate Research Support Team, in particular to Hifzah and Susanne, for always been there when I needed support and advice.

I would like to thank everyone who participated in the data collection, in particular Tracy, Laura, Georgina and all my GVA colleagues. I would also like to take this opportunity to thank Martyn Hayward who is an incredible mentor, constantly providing me with advice and guidance, and Christine Gausden, who is always available to bounce ideas around, helping me with the development of my research.

I am extremely grateful to my fellow Ph.D and friend Mohammad for always being there, to Maira for believing in me and to Rosie for all the encouraging words. You (and Karl) have made my long days in the library enjoyable. I cannot thank you all enough for the support you gave me at every step of this journey.

A special mention goes to Tom for providing me with the music that helped me focus, to Aisha and Amanda for the moral support, to Davide for reading everything over and over again, and to everyone over the years that has given me support and repeated in the last months “you are almost there”, “it is the final push” or “you haven’t submit yet?”

Grazie a Matteo, perché nonostante siamo entrambi in grado di fare cose da soli, farle insieme rende tutto migliore.

Infine vorrei ringraziare con tutto il mio cuore la mia famiglia, in particolare mia mamma e mio padre. Quello che sono lo devo a voi e spero di avervi reso orgogliosi. Tutto questo non sarebbe stato possibile senza il vostro supporto e non potrò mai ringraziarvi abbastanza.

ABSTRACT

The building sector can potentially support the mitigation of the effects of climate change as buildings worldwide have, both directly and indirectly, a major impact on emissions and resources usage. Among all the phases of the building life-cycle, operations have the biggest environmental impact. However, facilities managers often operate on the edge of sustainable compliance and do not implement initiatives to enhance sustainability. The aim of this research is to develop a sustainability measurement system specific to facilities management and a new methodology to support the implementation of building information models for existing buildings in order to achieve better sustainability performance in facilities management with the support of Building Information Modelling. A mixed methods approach, which included a literature review, interviews, analysis of secondary data, workshop, questionnaire surveys and a focus group interview, was used to reach the research aim. The results of the research have several contributions to knowledge, more specifically the development of a sustainability performance and reporting tool aimed at achieving better sustainability performance during building operations, and the RetroBIM framework which was created to support the development of information models for existing buildings.

Through the interview of facilities managers it was found that at operational level the financial aspect is currently the main driver of sustainable FM and that the focus for the implementation of sustainable initiatives is on few specific aspects such as the reduction of CO₂, carbon emissions and waste. The interviews highlighted a lack of targets linked with sustainable FM and the literature confirmed the absence of practical tools for supporting sustainable FM. This research attempts to fill this gap by developing a tool for the evaluation of sustainable performance in FM, which includes specific performance indicators and a measurement tool that facilities managers can use to assess their sustainable performance and verify the effectiveness of the initiatives they have developed.

Part of the tool developed includes the use of Building Information Modelling (BIM), which is currently used to support different phases of the building life-cycle but has a limited impact of FM. Through a focus group interview aimed at understanding the

benefits and barriers of integrating BIM and FM it was found that implementing BIM for existing buildings is a key issue, stopping facilities managers from engaging in BIM. The results were confirmed through a questionnaire survey which showed that, among the 753 responses collected, only 3% of the respondents work for companies that create models for existing buildings. This is due to a series of limitations of the processes currently available for developing information models for existing buildings, including complexity of the process, skills required, time and cost.

To extend the benefits of BIM into FM this research presents a new approach called RetroBIM which supports the development of information models for existing buildings and provides facilities managers the opportunity to create models tailored to their building, management strategy and users.

The research concludes with a partial test on three case studies of the tool for the evaluation of sustainable performance and the RetroBIM which confirmed that the two tools are not only beneficial but also practical.

TABLE OF CONTENTS

DECLARATION.....	II
ACKNOWLEDGEMENTS	III
ABSTRACT.....	V
TABLE OF CONTENTS	VII
LIST OF TABLES	XII
LIST OF FIGURES	XVII
PUBLICATIONS	XXIII
CHAPTER 1 INTRODUCTION.....	1
1.1 Building performance	2
1.2 Sustainable facilities management	4
1.3 Statement of research problem.....	6
1.4 Research aim and objectives.....	7
1.5 Outline of the thesis.....	7
CHAPTER 2 RESEARCH METHODOLOGY	9
2.1 Research philosophies.....	9
2.1.1 Ontology	10
2.1.2 Epistemology	11
2.1.3 Axiology	12
2.2 Research approaches	12
2.2.1 Inductive research approach.....	13
2.2.2 Deductive research approach	13

2.2.3	Abductive research approach	14
2.3	Research methods	14
2.4	The adopted research philosophy, approach and methods.....	16
2.4.1	Research objective 1 – Critical review of sustainable FM in practice with a view to ascertaining the underlying problems and challenges.....	19
2.4.2	Research objective 2 and research aim 1– Establish the aspects that define sustainability in the facilities management industry and develop a tool to enable facilities managers to evaluate sustainable performances in their practices.....	24
2.4.3	Research objective 3 – Investigate the FM relationship with BIM, exploring the benefits and barriers of integrating BIM into FM.....	27
2.4.4	Research aim 2 – Develop a framework for the implementation of building information models for existing buildings.....	31
2.4.5	Research objective 4 – Verify the applicability of the sustainability tool and BIM framework	32
 CHAPTER 3 SUSTAINABILITY AND FACILITIES MANAGEMENT		34
3.1	Sustainability vision, mission and policy	35
3.1.1	Sustainability policy and facilities management	36
3.2	Sustainability in facilities management at an operational level.....	38
3.2.1	Interview findings.....	40
3.2.2	Discussion of the interview findings.....	44
 CHAPTER 4 SUSTAINABILITY PERFORMANCE AND REPORTING TOOL		46
4.1	Performance improvement	48
4.1.1	Balanced Scorecard.....	48
4.2	Sustainability performance and reporting tool	50
4.2.1	Phase 1 – Strategy review	52
4.2.2	Phase 2 – Objectives evaluation and reporting.....	52
4.2.3	Phase 3 – Strategy map	75
4.2.4	Report feedback.....	79
4.3	Sustainability performance and reporting tool validation.....	81
4.4	Conclusion.....	83

CHAPTER 5	BUILDING INFORMATION MODELLING	85
5.1	The BIM model.....	86
5.2	Developing a building information model.....	88
5.2.1	The eight pillars of BIM.....	89
5.3	BIM uses.....	95
5.3.1	BIM applications during design.....	97
5.3.2	BIM applications during construction	99
5.3.3	BIM applications during operations.....	100
5.4	Benefits of implementing BIM.....	101
5.5	BIM adoption in the UK.....	102
5.6	Resistance to BIM adoption	105
5.6.1	Limited investment in technology.....	106
5.6.2	BIM interoperability issue.....	107
5.6.3	BIM client’s needs and user requirements.....	107
5.6.4	BIM training and new roles.....	108
5.6.5	BIM legal issues	108
CHAPTER 6	BUILDING INFORMATION MODELLING AND FACILITIES MANAGEMENT	109
6.1	FM and technology.....	109
6.2	FM and building information models.....	110
6.3	BIM and FM focus group interview	114
6.3.1	Focus group findings – Benefits of implementing BIM for FM.....	116
6.3.2	Focus group findings – Barriers to implementing BIM for FM.....	121
6.3.3	Discussion focus group findings	125
6.4	Building information modelling use in facilities management	126
6.5	Questionnaire survey.....	127
6.5.1	Response rate.....	128
6.5.2	Questionnaire section 1 – Profile of respondents	128
6.5.3	Questionnaire section 3 – BIM awareness, knowledge and use	131
6.5.4	Discussion of questionnaire findings.....	151

6.6	Conclusion.....	151
CHAPTER 7 RETROBIM FRAMEWORK FOR EXISTING BUILDINGS		153
7.1	Building information modelling for existing buildings.....	153
7.2	RetroBIM framework.....	155
7.3	RetroBIM information implementation.....	156
7.3.1	Implementation per opportunity.....	157
7.3.2	Implementation per need.....	158
7.3.3	Implementation per evaluation.....	159
7.3.4	Implementation per inefficiency	160
7.4	RetroBIM applications	174
7.5	RetroBIM validation.....	175
7.6	RetroBIM and the sustainability performance and reporting tool.....	178
7.7	Conclusion.....	179
CHAPTER 8 CASE STUDIES.....		180
8.1	65 Gresham Street.....	180
8.1.1	Sustainability performance and reporting tool	181
8.1.2	RetroBIM.....	191
8.2	Belmont House.....	194
8.2.1	Sustainability performance and reporting tool	195
8.2.2	RetroBIM.....	205
8.3	The Dreadnought Library.....	208
8.3.1	Sustainability performance and reporting tool	208
8.3.2	RetroBIM.....	217
8.4	Case studies feedback	219
8.5	Conclusion.....	220
CHAPTER 9 CONCLUSIONS		222
9.1	Achievement of research aims and objectives	222

9.2	Contribution to knowledge	226
9.3	Limitations of research.....	227
9.4	Recommendations for future research	228
	REFERENCES.....	229
	APPENDICES.....	246

LIST OF TABLES

Table 2-1: Ontology – Differences between Objectivism and Subjectivism (Saunders et al., 2012)	11
Table 2-2: Epistemology – Differences between Positivism and Constructionism (Potter, 2006)	11
Table 2-3: Differences between Deductive and Inductive Approaches to Research (Saunders et al., 2007)	12
Table 2-4: Differences between Qualitative and Quantitative Research Methods (Kumar, 2011).....	15
Table 2-5: Summary Thesis Chapters, Methods and Objectives.....	18
Table 2-6: Sustainability in FM Interviews Questions	20
Table 2-7: BIM and FM Focus Group Questions	28
Table 2-8: BIM and FM Questionnaire Survey Sections and Type of Questions	30
Table 2-9: Case studies feedback questions.....	33
Table 3-1: Sustainability in FM Interviewees.....	40
Table 4-1: Comparison of Topics Covered in Environmental Assessment Methods for Existing Buildings (BREEAM, 2016; U.S. Green Building Council, 2009; Pettersen, 2000; BEAM Society, 2016).....	47
Table 4-2: Sustainability Performance and Reporting Tool – Strategic Review Questions.....	52
Table 4-3: Policies Analysed per Company.....	54
Table 4-4: Policies Mentioning Each Sustainable Theme	57
Table 4-5: Sustainability Performance and Reporting Tool – Participants	59
Table 4-6: Sustainability performances and reporting tool Building group	60
Table 4-7: Sustainability performances and reporting tool Business Ethics group	64

Table 4-8: Sustainability performances and reporting tool Client group	65
Table 4-9: Sustainability performances and reporting tool Community group	65
Table 4-10: Sustainability performances and reporting tool Employees group	66
Table 4-11: Sustainability performances and reporting tool Innovation group	69
Table 4-12: Sustainability performances and reporting tool Operation group	69
Table 4-13: Sustainability performances and reporting tool Supply chain group	74
Table 5-1: BIM Activities at Different Life-Cycle Stages (RICS, 2015)	97
Table 6-1: BIM and FM Focus Group Interview Participants	115
Table 6-2: Questionnaire – Number of Valid Responses to Question 1	129
Table 6-3: Questionnaire – Number of Valid Responses to Question 2	130
Table 6-4: Questionnaire – Number of Valid Responses to Question 3	131
Table 6-5: Questionnaire – Number of Valid Responses to Question 17	132
Table 6-6: Questionnaire – Number of Valid Responses to Question 18	133
Table 6-7: Questionnaire – Number of Valid Responses to Question 19	134
Table 6-8: Questionnaire – Number of Valid Responses to Question 20	135
Table 6-9: Questionnaire – Number of Valid Responses to Question 21	136
Table 6-10: Questionnaire – Number of Valid Responses to Question 22	137
Table 6-11: Questionnaire – Number of Valid Responses to Question 23	138
Table 6-12: Questionnaire – Number of Valid Responses to Question 24	139
Table 6-13: Questionnaire – Number of Valid Responses to Question 25	140
Table 6-14: Questionnaire – Number of Valid Responses to Question 26	141
Table 6-15: Questionnaire – Number of Valid Responses to Question 27	142
Table 6-16: Questionnaire – Number of Valid Responses to Question 28	143

Table 6-17: Questionnaire – Number of Valid Responses to Question 29.....	143
Table 6-18: Questionnaire – Number of Valid Responses to Question 30.....	144
Table 6-19: Questionnaire – Number of Valid Responses to Question 31.....	145
Table 6-20: Questionnaire – Number of Valid Responses to Question 32.....	146
Table 6-21: Questionnaire – Number of Valid Responses to Question 33.....	147
Table 6-22: Questionnaire – Number of Valid Responses to Question 34.....	147
Table 6-23: Questionnaire – Number of Valid Responses to Question 35.....	148
Table 6-24: Questionnaire – Number of Valid Responses to Question 36.....	150
Table 7-1: RetroBIM Framework – FM Tasks for Inefficiency Analysis.....	161
Table 7-2: RetroBIM Framework – Additional FM Tasks for Inefficiency Analysis	163
Table 7-3: RetroBIM Validation Participants.....	175
Table 8-1: Case Study 1 – Strategic Review of Sustainability Performance and Reporting Tool.....	181
Table 8-2: Case Study 1 – Very High Priorities of Sustainability Performance and Reporting Tool.....	183
Table 8-3: Case Study 1 – High Priorities of Sustainability Performance and Reporting Tool.....	184
Table 8-4: Case Study 1 – Strategy Map Objective 1.....	187
Table 8-5: Case Study 1 – Strategy Map Objective 2.....	188
Table 8-6: Case Study 1 – Strategy Map Objective 3.....	188
Table 8-7: Case Study 1 – Strategy Map Objective 4.....	188
Table 8-8: Case Study 1 – Strategy Map Objective 6.....	189
Table 8-9: Case Study 1 – Strategy Map Objective 7.....	189

Table 8-10: Case Study 1 – Strategy Map Objective 8.....	190
Table 8-11: Case Study 1 – Strategy Map Objective 9.....	190
Table 8-12: Case Study 2 – Strategic Review of Sustainability Performance and Reporting Tool.....	195
Table 8-13: Case Study 2 – Very High Priorities of Sustainability Performance and Reporting Tool.....	196
Table 8-14: Case Study 2 – High Priorities of Sustainability Performance and Reporting Tool.....	197
Table 8-15: Case Study 2 – Strategy Map Objective 1.....	200
Table 8-16: Case Study 2 – Strategy Map Objective 2.....	200
Table 8-17: Case Study 2 – Strategy Map Objective 3.....	200
Table 8-18: Case Study 2 – Strategy Map Objective 4.....	201
Table 8-19: Case Study 2 – Strategy Map Objective 5.....	201
Table 8-20: Case Study 2 – Strategy Map Objective 6.....	202
Table 8-21: Case Study 2 – Strategy Map Objective 7.....	203
Table 8-22: Case Study 2 – Strategy Map Objective 8.....	203
Table 8-23: Case Study 2 – Strategy Map Objective 9.....	204
Table 8-24: Case Study 2 – Strategy Map Objective 10.....	204
Table 8-25: Case Study 3 – Strategic Review of Sustainability Performance and Reporting Tool.....	209
Table 8-26: Case study 3 – Very High Priorities of Sustainability Performance and Reporting Tool.....	210
Table 8-27: Case Study 3 – High Priorities of Sustainability Performance and Reporting Tool.....	210
Table 8-28: Case Study 3 – Strategy Map Objective 2.....	213

Table 8-29: Case Study 3 – Strategy Map Objective 3.....	214
Table 8-30: Case Study 3 – Strategy Map Objective 4.....	214
Table 8-31: Case Study 3 – Strategy Map Objective 5.....	214
Table 8-32: Case Study 3 – Strategy Map Objective 6.....	215
Table 8-33: Case Study 3 – Strategy Map Objective 7.....	215
Table 8-34: Case Study 3 – Strategy Map Objective 8.....	215
Table 8-35: Case Study 3 – Strategy Map Objective 9.....	216
Table 8-36: Case Study 3 – Strategy Map Objective 10.....	216
Table 8-37: Case Study 3 – Strategy Map Objective 11.....	216
Table 8-38: Case Study 3 – Strategy Map Objective 12.....	216
Table 9-1: Research aims and objectives and outcomes.....	225

LIST OF FIGURES

Figure 1-1: Total Anthropogenic GHGs Emissions by Economic Sector (IPCC, 2014)	2
Figure 2-1: Dimensions of Research Philosophy.....	10
Figure 2-2: The Inductive Research Approach (Danermark, 2002)	13
Figure 2-3: The Deductive Research Approach (Danermark, 2002).....	13
Figure 2-4: The Abductive Research Approach (Danermark, 2002).....	14
Figure 2-5: Research Philosophies Area.....	16
Figure 2-6: Summary of Research Methods	17
Figure 2-7: Objective 1 research methodology.....	20
Figure 2-8: NVIVO example of coding.....	23
Figure 2-9: NVivo nodes analysis.....	24
Figure 2-10: Objective 2 and Aim 1 research methodology.....	25
Figure 2-11: Objective 3 research methodology.....	27
Figure 2-12: Focus Group Stages (Morgan & Scannell, 1998)	28
Figure 2-13: Aim 2 research methodology	31
Figure 2-14: Objective 4 research methodology.....	32
Figure 3-1: Hierarchy of Strategic Intent (adapted from: Miller, 1998).....	35
Figure 3-2: Sustainable FM Strategy Alignment with the Business.....	36
Figure 3-3: Influences in Driving Sustainability (Shah, Davies, & Brogan, 2016).....	37
Figure 4-1: Balanced Scorecard (Kaplan & Norton, 2001)	49
Figure 4-2: Strategy Map (Kaplan & Norton, 2001)	50
Figure 4-3: Sustainability Performance and Reporting Tool.....	51

Figure 4-4: Sustainability Performance and Reporting Tool – Objectives Evaluation	53
Figure 4-5: Distribution of Sustainability Themes across Company Policies	55
Figure 4-6: Sustainability Performance and Reporting Tool – Strategy Map	75
Figure 4-7: Sustainability Performance and Reporting Tool – Strategy Map Graphical Representation.....	77
Figure 4-8: Sustainability Performance and Reporting Tool –Strategy Objectives/Goals Correlation.....	78
Figure 4-9: Sustainability Performances and Reporting Tool – Strategy Map Goals/Objectivess Correlation	79
Figure 4-10: Sustainability Performances and Reporting Tool – Phase 2 Feedback...	80
Figure 4-11: Sustainability Performances and Reporting Tool – Phase 3 Feedback...	80
Figure 5-1: Representation of Objects in BIM (RICS, 2015).....	87
Figure 5-2: BIM Maturity Diagram (BSI, 2013)	88
Figure 5-3: The Information Delivery Cycle (BSI, 2013)	91
Figure 5-4: Information Delivery Cycle for Asset Management (BSI, 2014).....	92
Figure 5-5: Soft Landing Process Map (NBS, 2013).....	94
Figure 5-6: BIM Development through RIBA Stages (RIBA, 2013).....	98
Figure 5-7: MacLeamy Curve (Eastman et al., 2011)	99
Figure 5-8: Construction Industry View on Support Provided by BIM towards Industry Targets (NBS, 2017b).....	101
Figure 5-9: Construction Industry: BIM Awareness and Use (NBS, 2017b).....	103
Figure 5-10: Construction Industry: Understanding of BIM (NBS, 2017b).....	104
Figure 5-11: Overview of BIM Standards and Publications Utilised by the Construction Industry (NBS, 2017b).....	105

Figure 5-12: Construction Industry Investment in Technology Compared to Other Industries (NBS, 2016b)	106
Figure 6-1: Graphics and Data Needs over Building Life-Cycle (IFMA, 2013).....	111
Figure 6-2: Uses of BIM Models in the Construction Industry in the Last 12 Months (NBS, 2016a)	112
Figure 6-3: Workshop Findings – Benefits from Implementing BIM for FM	116
Figure 6-4: Workshop Findings – Barriers to Implementing BIM for FM.....	121
Figure 6-5: Respondents’ Jobs in the NBS BIM Report (NBS, 2016a)	126
Figure 6-6: Uses of BIM from BIM4FM Survey (BIM4FM, 2013).....	127
Figure 6-7: Questionnaire Results – Distribution of Respondents by Job Role	129
Figure 6-8: Questionnaire Results – Distribution of Respondents by Market.....	130
Figure 6-9: Questionnaire Results – Distribution of Respondents by Organisation Type	131
Figure 6-10: Questionnaire Results – Personal BIM Awareness.....	132
Figure 6-11: Questionnaire Results – Knowledge of BIM Uses for Design	133
Figure 6-12: Questionnaire Results – Knowledge of BIM Uses for Construction	134
Figure 6-13: Questionnaire Results – Knowledge of BIM Uses for FM.....	135
Figure 6-14: Questionnaire Results – Company Awareness of BIM	136
Figure 6-15: Questionnaire Results – Company Knowledge of BIM Uses for Design	137
Figure 6-16: Questionnaire Results – Company Knowledge of BIM Uses for Construction.....	138
Figure 6-17: Questionnaire Results – Company Knowledge of BIM Uses for FM ..	139
Figure 6-18: Questionnaire Results – BIM Applications for FM.....	140

Figure 6-19: Questionnaire Results – Respondents That Have Used BIM	141
Figure 6-20: Questionnaire Results – Organisation’s Approach Regarding BIM.....	142
Figure 6-21: Questionnaire Results – Number of Years Used BIM.....	143
Figure 6-22: Questionnaire Results – Level of Experience using BIM.....	143
Figure 6-23: Questionnaire Results – Percentage of Projects Using BIM.....	144
Figure 6-24: Questionnaire Results – Frequency of Models Created for Existing Buildings.....	145
Figure 6-25: Questionnaire Results – Uses of BIM Created for Existing Buildings.	146
Figure 6-26: Questionnaire results – Frequency of Model Handover after Construction	147
Figure 6-27: Questionnaire Results – Handover Models Used for FM	147
Figure 6-28: Questionnaire Results – Handover Models Uses for FM	148
Figure 6-29: Comparison Uses Models Created for Existing Buildings and Models Handed Over	149
Figure 6-30: Questionnaire Results – FM Awareness and Use of BIM Standards ...	150
Figure 7-1: RetroBIM Framework.....	155
Figure 7-2: RetroBIM Framework – Implementation per Opportunity.....	157
Figure 7-3: RetroBIM Framework – Implementation per Need.....	159
Figure 7-4: RetroBIM Framework – Implementation per Evaluation	159
Figure 7-5: RetroBIM Framework – Implementation per Inefficiency	161
Figure 7-6: IFC Data Schema Architecture with Conceptual Layers (BuildingSMART, n.d.).....	165
Figure 7-7: IFCBoiler Hierarchy (BuildingSMART, n.d.).....	167
Figure 7-8: IFC Boiler Property Sets.....	168

Figure 7-9: RetroBIM Framework – Inefficiency Implementation Process	169
Figure 7-10: Implementation plan graphical representation	170
Figure 7-11: Implementation plan areas	170
Figure 7-12: Example: Inefficient Tasks and Information Required Map	172
Figure 7-13: Example: Inefficiency Implementation Plan.....	172
Figure 7-14: Questionnaire Results – Most Efficient FM Tasks	173
Figure 7-15: Questionnaire Results – Most Inefficient FM Tasks	174
Figure 8-1: Case Study 1 – GVA.....	181
Figure 8-2: Case Study 1 – Priority of Objectives of Sustainability Performance and Reporting Tool.....	182
Figure 8-3: Case Study 1 – Priorities Analysis of Sustainability Performance and Reporting Tool.....	185
Figure 8-4: Case Study 1 – Strategy Map.....	187
Figure 8-5: Case Study 1 – RetroBIM Base Model.....	191
Figure 8-6: Case Study 1 – RetroBIM Inefficiency Analysis.....	193
Figure 8-7: Case Study 1 – Implementation Plan RetroBIM.....	193
Figure 8-8: Case Study 2 – Belmont House.....	194
Figure 8-9: Case study 2 – Priority of Objectives of Sustainability Performance and Reporting Tool.....	196
Figure 8-10: Case Study 2 – Priorities Analysis of Sustainability Performance and Reporting Tool.....	198
Figure 8-11: Case Study 2 – Strategy Map.....	199
Figure 8-12: Case Study 2 – Retrobim Base Model	205
Figure 8-13: Case Study 2 – RetroBIM Inefficiency Analysis.....	206

Figure 8-14: Case Study 2 – Implementation Plan RetroBIM.....	207
Figure 8-15: Case Study 3 – Dreadnought Library.....	208
Figure 8-16: Case Study 3 – Priority of Objectives in Sustainability Performance and Reporting Tool.....	210
Figure 8-17: Case Study 3 – Priorities Analysis of Sustainability Performance and Reporting Tool.....	211
Figure 8-18: Case Study 3 – Strategy Map.....	213
Figure 8-19: Case study 3 – RetroBIM Base Model.....	217
Figure 8-20: Case study 3 – RetroBIM Inefficiency Analysis	218
Figure 8-21: Case study 3 – Implementation Plan RetroBIM	218

Publications

Carbonari, G., Stravoravdis, S., & Gausden, C. (2018) Improving FM task efficiency through BIM: a proposal for BIM implementation. *Journal of Corporate Real Estate*, volume 20, issue 1.

Carbonari, G., Stravoravdis, S., & Gausden, C. (2016). Building information model implementation for existing buildings for facilities management: RetroBIM framework. *Journal of 3D Information Modelling*, 5(1).

Carbonari, G., & Stravoravdis, S. (2016) Inefficiency in FM, can BIM help? In *Proceedings of the 15th EuroFM Research Symposium*, Milan 7-9 July 2016.

Carbonari, G., Stravoravdis, S., & Gausden, C. (2015). Building information model implementation for existing buildings for facilities management: Framework and two case studies. *Building information Modelling (BIM) in Design, Construction and Operations*. Southampton: WIT Press.

Carbonari, G., Ashworth, S., & Stravoravdis, S. (2015). How Facility Management can use Building Information Modelling (BIM) to improve the decision-making process. *Journal für Facility Management*, Issue 10

Carbonari, G., & Jones, K. (2014). Sustainable Facilities Management through Building Information Modelling. In *Proceedings of the 13th EuroFM Research Symposium*, Berlin 4-6 June 2014.

Chapter 1 Introduction

There is scientific evidence that the effects of climate change will disrupt the environment (Alló & Loureiro, 2014), society and economy (HM Government, 2012), with effects that will last for decades (European Commission, 2012). It has been estimated that without major changes taking place, the impacts of climate change will cause at least 5% loss in global gross domestic product (GDP) each year, with peaks over 10% in some of the poorest countries (Stern, 2008).

Until a decade ago, global warming and climate change were considered to be just a hypothesis (Yau & Hasbi, 2013), but analysis of the scientific literature shows that there is consensus that humans are causing changes in the global climate (Tol, 2014). Although it is very likely that the emission of greenhouse gases (GHGs) at the current rate will cause global warming and climate changes larger than that observed during the 20th century (IPCC, 2014), owing to a lack of historical data and literature, especially for developing countries (IPCC, 2007c), it is not possible to predict and evaluate the long-term impacts. Nevertheless, there is a need to tackle the issue and reverse the trend as nature is exploited beyond the limits of regeneration (Ramskov & Balslev, 2016), and the current strategies for sustainability are insufficient (IPCC, 2013).

In 2007, the Intergovernmental Panel on Climate Change (IPCC) identified the building sector as the economic sector with higher CO₂ mitigation potential compared to energy supply, transport, industry, agriculture, forestry and waste (IPCC, 2007b). As indicated in the report on residential and commercial buildings (IPCC, 2007a), the opportunities to reduce GHGs emission from buildings and therefore mitigate the effects of climate change can be achieved by:

- reducing embodied energy and all forms of energy consumption;
- enhancing the use of low-carbon fuels and renewable energy; and
- controlling other non-CO₂ emissions.

1.1 Building performance

The building sector has, both directly and indirectly, a major impact on global GHGs emissions during all stages of a building life-cycle. In 2010, buildings worldwide accounted for 32% of global energy use and 19% of GHGs emissions (Chalmers, 2014). In Europe, 40-45% of energy consumption can be attributed to buildings, together with a large amount of CO₂ emissions (United Nations Environment Programme, 2009). Moreover, the building emission footprint is expected to increase further, as population growth is predicted to occur by 2050 (CIOB, n.d.).

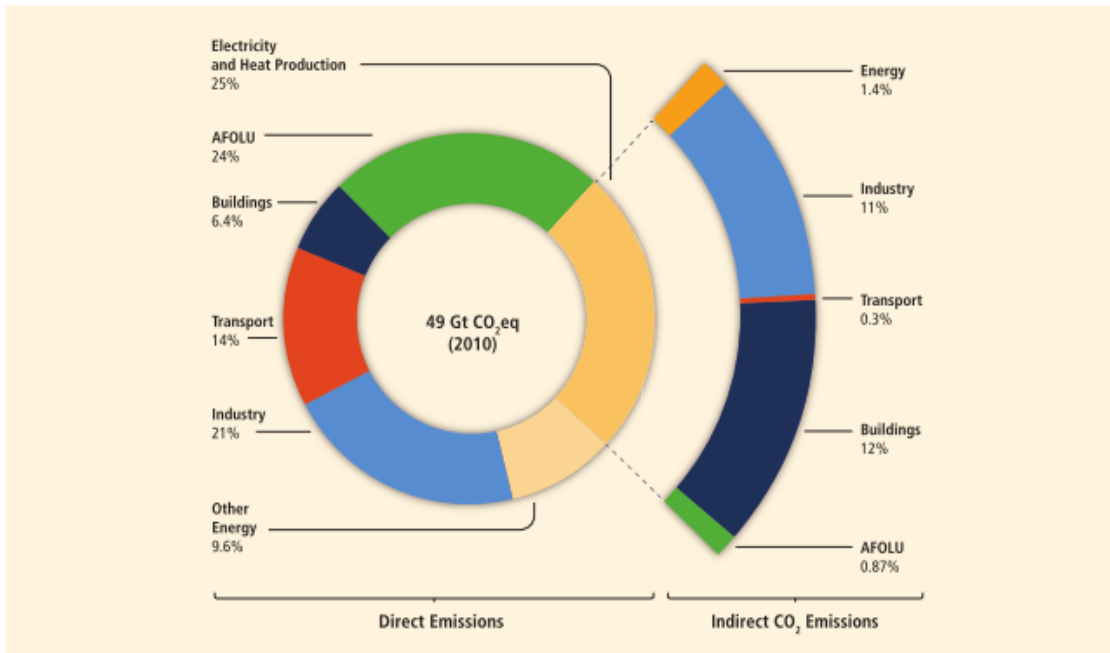


Figure 1-1: Total Anthropogenic GHGs Emissions by Economic Sector (IPCC, 2014)

In the UK, 37% of GHGs emissions are caused by buildings, with the commercial and public sector accounting for 36% of the total emissions. Half of the emissions are directly produced through the use of fossil fuels while the other half is from electricity-related consumption (Committee on Climate Change, 2014). In 2011, the UK business sector was responsible for approximately 174 Mt of CO₂ (28.5% of the UK's total emissions) (Department of Energy & Climate Change HM Government, 2014), the vast majority of which resulted from the consumption of energy to provide space heating/cooling, lighting and other support services, in order to maintain comfortable conditions for the users. Over a third of global CO₂ emission can be attributed to the combustion of fossil fuels to meet the energy demands in buildings

(Lee & Yik, 2004), confirming that the construction industry has an important role to play in the mitigation strategies for climate change (de Melo, Jannuzzi, & Ferreira Tripodi, 2013).

Even though the construction industry has been described as motivated only by profit and generally uncaring (Ding, 2008), in recent years sustainability has become a mainstream concern (UK Green Building Council, 2011), and there has been an implementation of sustainable practices aimed at minimising the negative impacts of construction on the environment. These practices are mainly influenced by government policies and regulations, top-management commitment and stakeholders, all of which require improvement regarding environmental performances (Akadiri & Fadiya, 2013).

Much research has been carried out in recent years on different sustainability opportunities and aspects at various stages of the construction process (Wang, Wei, & Sun, 2014), and sustainability is considered now to be one of the principal objectives of building projects. The main focus of such research has been on sustainability for design and construction (Reineck, Poltermann, May, & Pelzeter, 2011). However, little attention has yet been paid to facilities management (FM) (Aaltonen, Määttänen, Kyrö, & Sarasoja, 2013), even though the operation phase can make the biggest contribution towards achieving sustainability goals (Wood, 2006; Shah, 2007). In addition, with the Climate Change Act in 2008, the UK Government established the aim to achieve a reduction of GHGs emissions by at least 80% below 1990 levels by 2050. Achieving such a reduction of CO₂ emissions in line with these targets will require buildings to perform much more efficiently.

However, whilst improved energy performance of new buildings can be driven through green certification or changes to Building Regulations, the same instruments cannot easily be applied to existing buildings. Given the current rate of new buildings in the UK, it is estimated that approximately 85% of the buildings that will exist and be in use in 2050 will have already been built today (CIOB, 2011) and 40% will be pre-1985 (Stafford, Gorse, & Shao, 2011). Moreover, because over 80% of GHGs emissions (United Nations Environment Programme, 2009) and 90% of energy (Boyle, 2005) consumed during a building life-cycle take place during the operation

phase, and as “we do not have the luxury of replacing all existing buildings with new, green construction overnight” (Miller, Pogue, Saville, & Tu, 2010), the involvement of FM in the sustainable agenda is necessary. Only by extending sustainability to building operations there will be a complete incorporation of sustainability within the built environment (Reineck et al., 2011), with FM providing an active contribution towards sustainability and adding value to organisations and customers (Elmualim, Valle, & Kwawu, 2012).

1.2 Sustainable facilities management

FM is a discipline that appeared in the 1970s in the United States of America (Alexander, 1996), and integrates people, place, processes and technology to ensure functionality of the built environment (IFMA, n.d.) while meeting the primary business objectives of an organisation. As such, FM includes a variety of responsibilities, which may vary from company to company, and may include: maintenance management, space management, project management for the refurbishment of new buildings, premises management and administration of support services (Hinks & McNay, 1999). The differentiation of activities involved within FM and the growing building complexity, together with climate changes, governments pressure for carbon reductions and environmental consciousness (Baharum & Pitt, 2009), means that innovative FM practices are called for (Pitt & Hinks, 2001), as well as an increased engagement with sustainability (Elmualim et al., 2012). Sustainable FM is defined as “the process which enables and enhances the capacity of organisations to become more sustainable, while simultaneously strategically improving their ability to achieve their main objectives by optimising environment, financial and social factors” (Koukiasa, 2011).

FM has the potential to greatly contribute towards the sustainable agenda and, in recent years, FM professionals have increasingly engaged in green practices within business organisations (Hodges, 2005; Roper & Beard, 2006). However, there is still a need for FM to develop and implement sustainable solutions that integrate people, places, technology, products, values and services to achieve a more sustainable operating environment (Lee & Kang, 2013), while ensuring that any new sustainable practices do not adversely affect the ability of primary business units to effectively perform their primary function (Nielsen, Jensen, & Jensen, 2009). Currently, a lack of

tools, a need for accurate data, the impossibility of making informed decisions (BIFM, 2015), the need for understanding current performance and forecasting future behaviours, together with inadequate professional and scientific training (Ikediashi, Ogunlana, Oladokun, & Adewuyi, 2012), are obstacles to the implementation of sustainability practices in FM.

In recent years, the construction industry has started using Building Information Modelling (BIM) to simulate buildings during design and construction phases. The system comprises a virtual model of a building, which designers, constructors and clients can manipulate to explore a wider range of design solutions beyond those that would typically be available through computer aided design (CAD) alone (Kivits & Furneaun, 2013). The projects can be virtually built and tested numerous times before construction begins (Bryde, Broquetas, & Volm, 2013).

In the UK, the use and awareness of BIM has been influenced by the Government Construction Strategy (SmartMarket Report, 2014) published in 2011. The UK Government recognises the competitive edge and considerable growth opportunities linked with the construction sector and uses the ‘Construction 2025’ strategy to set out ‘how industry and Government will work together to put Britain at the forefront of global construction over the coming years’ (HM Government, 2013). The strategy includes a series of targets for the industry that should be achieved by 2025:

- 33% reduction in the initial cost of construction and whole life cost;
- 50% reduction in time from inception to completion of a new building and refurbishment;
- 50% reduction in GHGs emissions in the built environment; and
- 50% reduction in trade gap between exports and imports from construction products and materials.

One of the strategic priorities included in the document is the implementation of BIM technology aimed at the delivery of more sustainable buildings, the improvement of productivity and lower costs by supporting information flow and collaboration. To support the achievement of the strategy the UK Government has mandated BIM for all centrally procured Government contracts from April 2016, pushing the construction industry to change their approach to projects.

The Government mandate had and still has a direct impact on design and construction practises but whilst the design/construction phase of BIM is advanced, the operational and FM phases are not. When managing a building, facilities managers have to be aware of different aspects that influence the performance of buildings in use (for example, end users, business requirements and building structure). The opportunity to integrate organisational, operational and end-user data into BIM offers the potential to enable facilities managers to manage their buildings more efficiently and effectively whilst supporting the delivery of sustainable FM.

1.3 Statement of research problem

FM is a discipline that deals with the management, operation and running of services of buildings and has the potential to improve the sustainability of buildings and that of the company in general. Nevertheless, sustainable FM practices are currently not fully understood, owing to, among other obstacles, a lack of specific tools and knowledge, which prevent a full integration of sustainable practices into building operations. For many years, it has been clear that to achieve sustainable FM, new tools are necessary (Alexander, 2004) that will support facilities managers in evaluating their sustainable performance – not only from an environmental perspective, but also from social and economic perspectives, which are not specifically addressed (Balslev Nielsen, Sarasoja, & Galamba, 2016).

The design and construction phases of the building life-cycle currently benefit from using BIM as a unique data source and model during a building project. The opportunity to evaluate different scenarios and analyse alternatives have made BIM a powerful tool, which can also provide support to the implementation of sustainable initiatives. However, the use of BIM during FM is still limited, with research focussing mainly on recently completed buildings where models were available rather than buildings completed without information models (Volk, Stengel, & Schultmann, 2014).

1.4 Research aim and objectives

This research aims at developing a sustainability measurement system specific to facilities management and a new methodology to support the implementation of building information models for existing buildings in order to achieve better sustainability performance in facilities management with the support of Building Information Modelling.

To achieve the aim, a series of objectives have been developed for the research:

- 1) Critically review sustainable FM in practice with a view to ascertaining the underlying problems and challenges.
- 2) Establish the aspects that define sustainability in the facilities management industry.
- 3) Investigate the FM relationship with BIM, exploring the benefits and barriers of integrating BIM into FM.
- 4) Verify the applicability of the sustainability tool and BIM framework.

1.5 Outline of the thesis

The thesis comprises 9 chapters, as well as appendices that include relevant supportive information.

Chapter One presents an overview of the research and defines the research background, defining the problem and presenting the research aim and objectives.

Chapter Two focuses on the research methodology, and presents the adapted research philosophy, approach and methods used in this research.

Chapter Three investigates sustainability and FM, focussing in particular on sustainability at the operational level, which was investigated through a series of interviews with facilities managers.

Chapter Four presents a new tool for the evaluation of sustainability performances, based on the Balanced Scorecard. The chapter also includes the validation of the tool through expert review.

Chapter Five investigates the current use of BIM during the different stages of a building life-cycle through a literature review.

Chapter Six presents the results of a focus group interview and a survey questionnaire aimed at understanding the relationship and the use of BIM for FM.

Chapter Seven presents the framework created for the implementation of building information models for existing buildings. The chapter also includes the validation of the framework through expert review.

Chapter Eight documents the implementation of part of the sustainability tool and the BIM framework on three case studies, demonstrating the applicability of the two tools.

Chapter Nine summarises the research process and discusses the results of the study, verifying that the research aim and objectives were met, explaining the contribution of this study to knowledge, recognising the limitations of the research and providing recommendations for future research.

Chapter 2 Research Methodology

Research, as defined by Martin and Guerin (2006), is a “systematic inquiry into an issue to investigate or resolve a problem.” The primary catalysts for research are problems, in that the need for research rises when the existing knowledge is not sufficient to solve a problem. Establishing the problem is fundamental for the definition of every aspect of the research that will lead to the resolution of the problem and an increase in knowledge (Fellows & Liu, 2008). Hence, the appropriate research methodology and the overall design of the research process are conventionally directed by the research problem (Thiétart, 2001). Any research involves the utilisation of suitable research methods to fulfil the aims, followed by effective data collection and analysis in order to create meaningful research output and contribute to the existing knowledge.

2.1 Research philosophies

Research is a systematic and systemic process of analysis used to produce new knowledge through suitable and appropriate methods, techniques and approaches. (Naoum, 2013). The research philosophy, or paradigm, underpinning a research is the sum of belief and assumption that guides the researcher and influences his/her interpretation of reality (Creswell, 2013; Denzin & Lincoln, 2011). Research philosophy has a major impact on shaping the research problems and questions (Creswell, 2013) and, according to Amaratunga, Baldry, Sarshar and Newton (2002), an understanding of the research philosophy is essential prior to beginning research. As part of the process, the researcher makes a series of assumptions (Burrell & Morgan, 1979), which shape the research, methodology and interpretation of the findings (Crotty, 1998). The initial assumptions define the research philosophies and consider the nature of reality (ontology), the nature of knowledge (epistemology) and how values influence the research (axiology) (Potter, 2006) and can be represented as three separate dimensions (Figure 2-1).

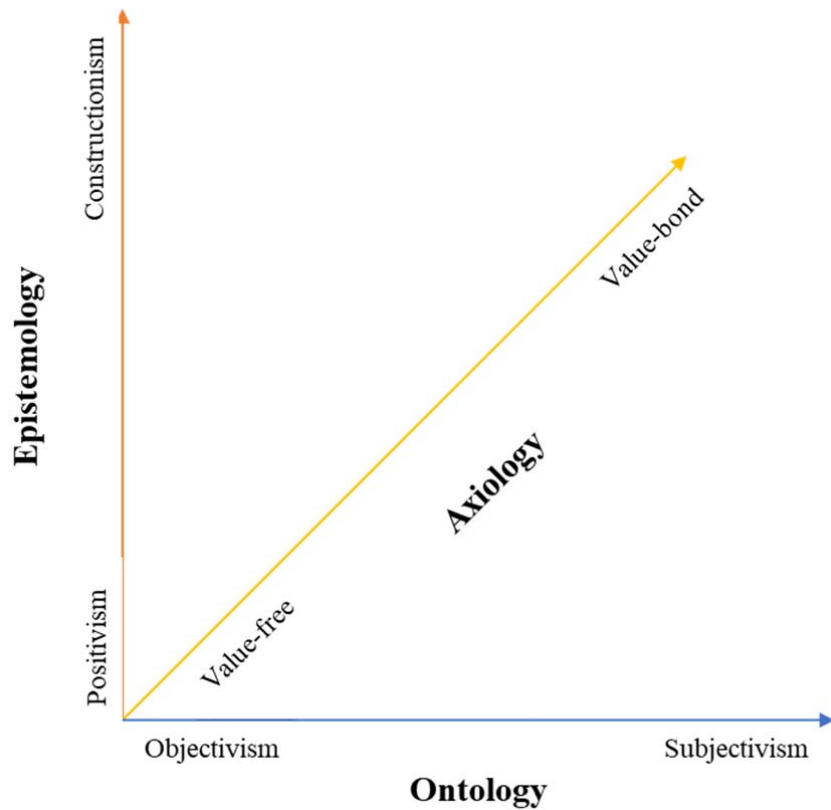


Figure 2-1: Dimensions of Research Philosophy

2.1.1 Ontology

Ontology addresses the questions related to the nature of the world (Potter, 2006) and the commitment to particular views (Saunders, Lewis, & Thornhill, 2012). The question related with ontology that researchers should ask is “what is the nature of reality?” (Creswell, 2013). Ontology comprises two antithetical aspects: objectivism and subjectivism. Objectivism is the view that social entities exist in reality external to social actors, while subjectivism deals with social phenomena, created from the perception and the actions of social actors (Saunders et al., 2012). Saunders et al. (2012) identify the following differences

Table 2-1) between meaning and reality, and research implications of the two aspects.

Table 2-1: Ontology – Differences between Objectivism and Subjectivism (Saunders et al., 2012)

	Objectivism	Subjectivism
Meaning	Based on external environment	Based on personal experience
Reality	Determined by a set of laws	Determined by the people; a set of laws does not exist
Research implication	Researcher provides further understanding of reality	Meaning is found through the work of the researcher

2.1.2 Epistemology

The second assumption, epistemology, considers what kind of knowledge is acceptable, valid and legitimate as part of the research (Bryman, 2012; Mingers, 2003) and how knowledge is communicated (Burrell & Morgan, 1979). According to Creswell (2013), to understand the epistemological position of the research, the question to answer should be “what is the relationship between the researcher and that being researched?”. There are two epistemology paradigms: positivism and constructionism, which is also identified as antipositivism (Burrell & Morgan, 1979) or interpretivism (Bryman, 2012). In positivism, knowledge is established from a verified hypothesis, whilst in constructionism, knowledge is constructed from experience and iteration (Potter, 2006). Table 2-2 summarises the differences between positivism and constructivism (Potter, 2006).

Table 2-2: Epistemology – Differences between Positivism and Constructionism (Potter, 2006)

Positivism	Constructionism
Regards the world as objectively “out there,” real and completely separate from human meaning-making	Claims that the only world we can study is a world of meanings, represented in the signs and symbols that people use to think and communicate
Assets there is only one true, objective knowledge that transcends time and cultural location	Accepts that there are types of multiple knowledge, and that knowledge is highly contingent on time and cultural location
Views knowledge as based on facts that are “out-there-in-the-world” waiting to be discovered	Views knowledge as constructed through people’s meaning-making
Asks of knowledge “is it true?”	Asks of knowledge “what does it

	do?”, “how can it be used, by whom, and to what ends?”, “whose interest does it serve?”, “what does it make possible?”
--	--

2.1.3 Axiology

Axiology is the third dimension of the philosophical assumptions and it focuses on recognising values and ethics within the research process (Mingers, 2003). The questions that can be asked about axiology is, what is the role of values? (Creswell, 2013). The two paradigms that comprise axiology are positivism and interpretivism (Lincoln & Guba, 1985). The former believes inquiry is value-free, and depends upon the selected research methodology, while the latter is value-bond, as the researcher influences with his/her values the philosophical assumptions and the research settings.

2.2 Research approaches

Following the definition of the research philosophies, the researcher should focus on the research approaches. The research approaches can vary from inductive to deductive (Creswell, 2013). Saunders, Lewis & Thornhill (2007) summarised the differences between the two approaches (Table 2-3), as presented below.

Table 2-3: Differences between Deductive and Inductive Approaches to Research (Saunders et al., 2007)

Deductive	Inductive
Scientific principles	An understanding of the meanings humans attach to events
Moving from theory to data	A close understanding of the research context
The need to explain causal relationships between variables	The collection of qualitative data
The collection of quantitative data	A more flexible structure to permit changes of research emphasis as the research progresses
The application of controls to ensure validity of data	A realisation that the researcher is part of the research process
The operationalisation of concepts to ensure clarity of definition	Less concern with the need to generalise
A highly structured approach	
Researcher independence of what is being researched	
The necessity to select samples of sufficient size in order to generalise conclusions	

The two approaches are often indicated as in antithesis, incompatible with each other. However, a third approach introduced more recently, the abductive research approach, provides an amalgamation of inductive and deductive. (Saunders et al., 2012).

2.2.1 Inductive research approach



Figure 2-2: The Inductive Research Approach (Danermark, 2002)

According to Bryman and Bell (2011), inductive logic uses the findings as a mechanism of theory generation. The inductive approach is based on the observation of the empirical world and the formulation of concepts to explain the observation, placing emphasis on how the world is socially constructed and understood (Blaikie, 1993). Inductive research is predominantly based on qualitative data in order to explain the social phenomenon (Goering & Streiner, 1996; Strauss & Corbin, 1998): rather than trying to quantify the information, qualitative researchers try to understand a phenomenon and the context in which it exists (Myers & Avison, 2002). The data obtained by studying a phenomenon is then analysed to identify themes and develop a conceptual framework (Saunders et al., 2012). Typically, the inductive researcher begins with the analysis of a particular case, moves to the creation of general facts based on the observations and data collected, and finally develops theories based on the findings from the particular context researched (Spens & Kovács, 2006).

2.2.2 Deductive research approach



Figure 2-3: The Deductive Research Approach (Danermark, 2002)

The deductive research approach is a theory testing process, aimed at understanding whether an established theory or generalisation can be applied to specific instances (Kenneth, 2000). According to Saunders et al. (2012), the deductive approach begins with theory development, based mainly on a literature review, followed by a selected research strategy employed to investigate the theory. The goal of deductive research is to create generalisable laws by identifying statistical relationship within a sample population (Ackroyd, 2004). In the deductive approach, the presence of a hypothesis,

which the researcher translates into measurable research objects to test, is indispensable (Bryman & Bell, 2011), and requires the use of quantitative data, standardised measures and statistical techniques (Bryman & Bell, 2011). The researcher using a deductive approach is required to set preconceptions aside and identify objective facts based on empirical observations (Myers, 1997).

2.2.3 Abductive research approach



Figure 2-4: The Abductive Research Approach (Danermark, 2002)

Charles Sanders Peirce (Suddaby, 2006) described the abductive approach as a combination of deductive and inductive, which aims to produce new knowledge by encouraging creativity or intuition in research. The aim of the abductive research process is to suggest new theories (Andreewsky & Bourcier, 2000) and understand new phenomena (Alvesson, 2009). During the process, data collection and theory building happen simultaneously, with a “back and forth” direction between theory and empirical study (Spens & Kovács, 2006).

2.3 Research methods

The research methodology allows to achieve the research aims and objective (Brewerton, 2001) through systematic data collection and analysis (Collis, Hussey, & Hussey, 2003). The methodological choice requires the researcher to identify the structure of data collection and data analysis (Thiétart, 2001). The rationale behind the chosen research methods guides the research process and how the findings are accumulated (Franz & Robey, 1987). There are two types of research methods: qualitative and quantitative. Qualitative research methods include an “array of interpretive techniques which seek to describe, decode, translate, and otherwise come to terms with the meaning, not the frequency, of certain more or less naturally occurring phenomena in the social world” (Van Maanen, 1979), whilst quantitative methods provide a precise measurement of a phenomenon (Bryman & Bell, 2011). The differences between quantitative and qualitative research are summarised in

Table 2-4 (Kumar, 2011).

Table 2-4: Differences between Qualitative and Quantitative Research Methods (Kumar, 2011)

	Quantitative research	Qualitative research
Underpinning philosophy	Rationalism: “That human beings achieve knowledge because of their capacity to reason” (Bernard, 1994)	Empiricism: “The only knowledge that human beings acquire is from sensory experiences” (Bernard, 1994)
Approach to enquiry	Structured/rigid/predetermined methodology	Unstructured/flexible/open methodology
Main purpose of investigation	To quantify the extent of variation in a phenomenon, situation, issue, etc.	To describe variation in a phenomenon, situation, issue, etc.
Measurement of variables	Emphasis on some form of either measurement or classification of variables	Emphasis on description of variables
Sample size	Emphasis on greater sample size	Fewer cases
Focus of enquiry	Narrows focus in term of extent of enquiry, but assembles required information from a greater number of respondents	Covers multiple issues but gathers required information from fewer respondents
Dominant research value	Reliability and objectivity (value-free)	Authenticity but does not claim to be value-free
Dominant research topic	Explains prevalence, incidence, extent, nature of issues, opinions and attitude; discovers regularities and formulates theories	Explores experiences, meanings, perceptions and feelings
Analysis of data	Subjects variables to frequency distribution, cross-tabulations or other statistical procedures	Subjects responses, narratives or observational data to identification of themes and describes these
Communication of findings	Organisation more analytical in nature, drawing inferences and conclusions, and testing magnitude and strength of a relationship	Organisation more descriptive and narrative in nature

Although qualitative and quantitative methods are antithetical, researches can include multiple data collection techniques, combining both qualitative and quantitative methods (Saunders et al., 2012). The mixed methods research (Bogdan & Biklen, 2003; Tashakkori & Teddlie, 1998), or triangulation (Frankfort-Nachmias & Nachmias, 1996), improves the reliability and validity of the research outcomes by combining various research methodologies in the study of the same observable fact.

(Burns, 2000). The mixing of methods overcomes the different weaknesses and problems related to a single method by combining multiple theories, methods and empirical material (Fellows & Liu, 2008).

2.4 The adopted research philosophy, approach and methods

Defining the research strategy ensures that the research aims can be achieved whilst being epistemologically and ontologically commensurate. Therefore, it is important to design a research process suited to the research aims and objectives. By using the three-dimensional (3D) representation of the research philosophies, it is possible to identify an area in which the research project is located (Figure 2-5), as choosing a precise position on each of the three axes is unrealistic (Saunders et al., 2012).

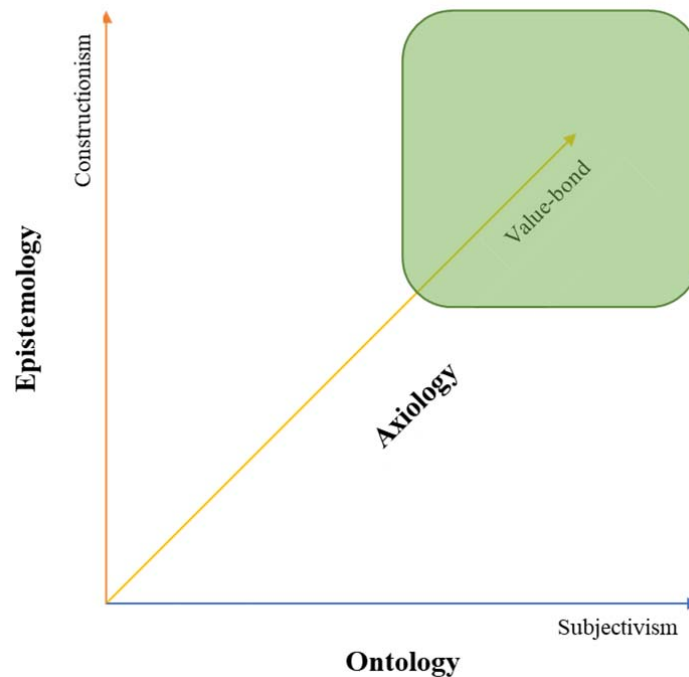


Figure 2-5: Research Philosophies Area

As the research focusses on “the world as we (humans) know it” (Potter, 2006), and does not aim in providing a further understanding of reality (

Table 2-1), the ontological paradigm of this research leans more towards subjectivism rather than objectivism. The epistemological paradigm adopted is constructionist, as there are no “laws of nature” that could be refined with the research, but rather the intention is to construct new knowledge through observation and interpretation (Potter, 2006). Lastly, regarding the third dimension, the axiological approach leans towards a value-bound approach, as the researcher does not seek objective knowledge, and the “understanding is highly subjective and is filtered through his own understanding which modifies and evolves as more understating is accumulated over time” (Easterby-Smith, Thorpe, & Jackson, 2012).

The research focused on fairly new topics without adequate guiding theories related to the research issue, hence an inductive research approach was utilised, aimed at developing conceptual frameworks based on the study and an analysis of a phenomenon (Saunders et al., 2012). To enhance the reliability and validity of the data collection process, the research was conducted using a mixed methodology approach, which provided a more holistic understanding of the topic (Creswell, 2013). The research was developed following a sequential multi-phase design with a partially integrated mixed methods research approach (Saunders et al., 2012) as the data collection was conducted in multiple separate phases and quantitative and qualitative methods were utilised together only for one of the research stages (see paragraphs 2.4.1-2.4.5). Figure 2-6 provides a summary of the different qualitative and quantitative methodologies utilised during the resesarch to fulfill the Research aims and Objectives (blue): with the exception of objective 4, literature review (in red) was conducted for all aims and objectives, objectives 1, 2 and 4 were met using qualitative methods (in green) whilst for objective 3 both qualitative and quantitative methods (in purple) were used.

Objective 1	Objective 2 Research aim 1	Objective 3	Research aim 2	Objective 4
Literature review	Literature review	Literature review	Literature review	Case study
Interviews	Policies analysis	Focus group interview	Questionnaire survey	
	Workshop	Questionnaire survey		
	Questionnaire survey			

Figure 2-6: Summary of Research Methods

Figure 2-6 also shows that due to the novelty of the topics the literature review followed the progress of the thesis overtime and the different areas of focus of the research (facilities management, sustainability, building information modelling) as they evolved during the research period. To reflect this approach and create a clearer link between the different areas of research it was decided to include part of the literature review at the beginning of each chapter and not in a single initial chapter.

Following the initial literature review, which was used to identify the research aim and objectives, the first research objectives was met through interviews with facilities managers to investigate sustainability during building operations. The results of the interviews were used together with the analysis of sustainability policies and a workshop (objective 2), to develop a tool to support the delivery of sustainable FM (research aim 1). As part of the tool developed included the use of BIM, the research continues with an investigation on the benefits of and barriers to implementing BIM for FM through a focus group. Following the focus group, a questionnaire survey was developed to understand how the FM industry uses BIM, and to verify some of the results of the focus group. The purpose of of the focus group and the questionnaire survey was to investigate the relationship between FM and BIM and explore the benefits of and barriers to their implementation (objective 3). The results were used to meet the second research aim and develop a framework for creating an information model for existing buildings, which was tested, together with the tool for sustainable FM, on three case studies, to meet objective 4.

Table 2-5: Summary Thesis Chapters, Methods and Objectives

Chapter	Research Methods	Research Objectives	Research aim
1 – Introduction	Literature review		
2 – Research Methodology	Literature review		
3 – Sustainability and FM	Literature review Interviews	1 – Critically review sustainable FM in practice with a view to ascertaining the underlying problems and challenges	
4 – Sustainability	Literature	2 – Establish the	1 - Develop a tool to

performance and reporting tool	review Policies analysis Workshop Questionnaire survey	aspects that define sustainability in the facilities management industry	enable facilities managers to evaluate sustainable performances in their practices
5 – BIM	Literature review		
6 – BIM and FM	Literature review Focus group interview Questionnaire survey	3 – Investigate the FM relationship with BIM, exploring the benefits of and barriers to integrating BIM into FM	
7 – RetroBIM framework for existing buildings	Literature review Questionnaire survey		2 - Develop a framework for the implementation of building information models for existing buildings
8 – Case studies	Case studies	4 – Verify applicability of the sustainability tool and BIM framework	
9 – Conclusion			

For clarity, the methodology developed as part of the first research aim to evaluate sustainable performances can be applied as is to any organisation and building, hence it has been defined as a tool. However, the methodology developed for the implementation of building information models is defined as a framework as it serves as a guide and should be tailored to each organisation and building’s requirements. As the evaluation tool includes the use of Building Information Modelling, this is presented first as part of the thesis (Chapter 4), followed by the identification of the issue of developing information models for existing buildings and the framework aimed at solving this problem (Chapter 7).

2.4.1 Research objective 1 – Critical review of sustainable FM in practice with a view to ascertaining the underlying problems and challenges

The initial part of the research project was carried out to understand sustainable FM and how it is implemented as part of the FM role. As the objective was to critically

review sustainable FM in practice, the focus was on facilities managers’ experiences on sustainability matters. Interviews were deemed to be an appropriate tool for data collection as they allow access to honest and open responses whilst potentially broadening the conversation through the interaction between interviewer and respondent (Saunders et al., 2012), and cover concepts and themes that the researcher might not have considered.



Figure 2-7: Objective 1 research methodology

2.4.1.1 Research objective 1 – Interviews

Of the different types of interviews (structured, semi-structured and unstructured), the researcher opted for a semi-structured approach, which allowed the interviewer to cover pre-defined questions and conduct additional probing based on the conversation with the interviewee. The questions used for the interviews are presented in Table 2-6, together with the rationale for each question. Before the first interview, the questions were reviewed by a team of academics to verify the clarity of the questions and ensure that the questions were not biased in the way they were phrased. The questions used during each interview were:

Table 2-6: Sustainability in FM Interviews Questions

Question	Purpose
1. Could you please tell me your experience in FM?	Provide an overview of the respondents’ profile
2. Could you please describe the facilities you manage (e.g. type of buildings, sqm.)	
3. Does your company have a sustainability policy and how does FM align with it? Do you have a sustainable FM policy? If yes what is the goal?	Verify how the corporate sustainability vision is translated into FM goals and what is the support provided by FM to the corporate sustainability vision
4. How is the policy translated into operation? How do you pass along	Verify if and how the sustainability policy is applied at operational level.

the sustainability requirement to the staff and supply chain?	Establish the involvement of staff and supply chain in achieving sustainability targets and what type of initiatives/requirements are in place for them.
5. How do you apply sustainability in your job? How do you deal with sustainability in the day-to-day operation?	Establish how sustainability impact the day-to-day role of facilities managers.
6. Do you have sustainability targets? What can be measured in sustainable FM? 7. If so, do you have processes to achieve the targets?	Establish if facilities managers have formal targets that needs to be meet in terms of sustainability. Establish which aspects of sustainability are actively measured by facilities managers.
8. How important do you think sustainability is for FM?	Provide an understanding of the interviewee's view on sustainability and what is the perception of sustainability in the FM industry.
9. What do you think are the challenges or critical factors of implementing sustainable FM in your company and in the industry?	Establish what are the barriers that are preventing the implementation of sustainability practices in FM
10. Do you have any formal requirements in the contract with your client?	Verify if facilities managers have any contractual requirement that need to be meet from their clients Establish how much clients impact the implementation of sustainability in FM.

As the insight provided through interviews is influenced by the data collection process and analysis (Patton, 2002), sampling remains a key aspect that needs to be addressed during the research design. Non-probability sampling techniques were used for interviews, and although qualitative data collection should continue until data saturation is reached (Saunders et al., 2012), owing to time limitations the researcher limited the sample size to 20, which is in line with the minimum sample size indicated in literature (Saunders et al., 2012). The interviewees were identified through snowball and self-selection sampling techniques.

Where possible, the interviews were conducted face-to-face, but where a meeting in person was not a viable option, the interviews were performed over the telephone. All interviews were recorded with the agreement of the interviewees to facilitate the analysis process.

All interviews were then transcribed and coded to identify recurrent themes and provide an overview of how sustainability is delivered by facilities managers. The transcription of the interviews can be found in Appendix 1. The coding process followed the template analysis approach (King, 1998), where a set of codes are identified prior to the analysis (priori codes) from the theoretical background, and additional codes (post priori codes) are developed during the analysis of the interviews. The coding process was conducted using QSR NVivo to efficiently manage the transcription and simplify the coding process. The transcription were reviewed using the process of inductive coding (Thomas, 2006) :

1. Preparation of raw data files in a common format – each interview was transcribed and imported in NVivo
2. Close reading of the text to familiarise with the content
3. Creation of codes – initial upper-level (priori codes) derived from the aims of the review followed by lower-level (post priori) derived from the reading of the raw data. Sustainability policy, sustainability goals and targets, sustainable initiatives, sustainable requirements for the supply chain and from clients, sustainability in the FM industry, barriers to sustainability were used as priori codes, which were then integrated with three additional post priori codes. Figure 2-8 shows the coding process through NVIVO: where relevant, the text of the transcription was linked to a specific node. In the image the text was coded against the Sustainability policy and sustainability goals and targets nodes.

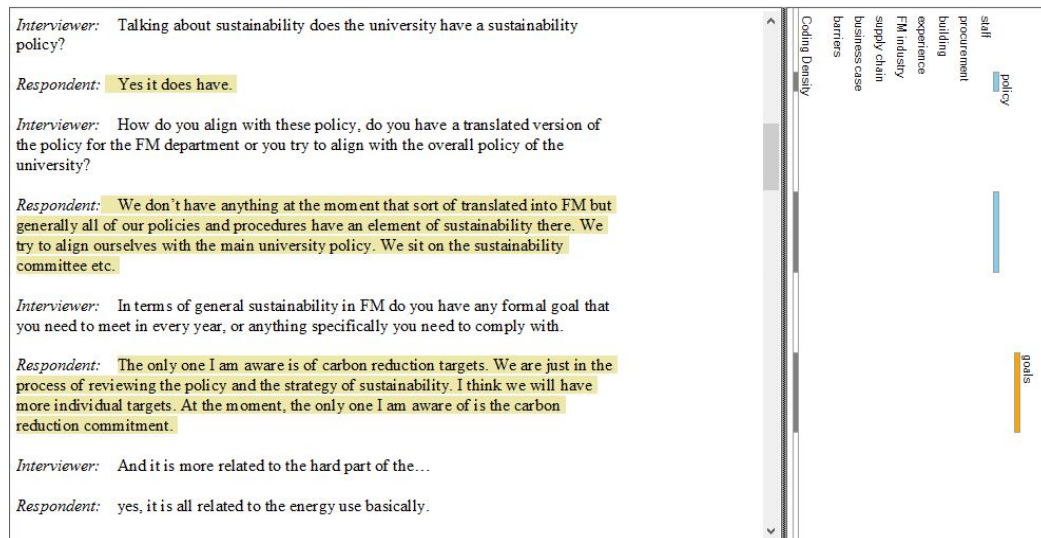


Figure 2-8: NVIVO example of coding

4. Continuing revision and refinement – the interviews were reviewed several times to ensure all the relevant parts were coded and included in the analysis. NVivo capability to show the different part of the texts labelled with the same code (or node in NVivo) was then used to understand the respondent’s approach to the single themes and analyse the responses. Figure 2-9 shows the example of part of text linked with the node ‘barriers to sustainability’.

Reference 2 - 4.08% Coverage

I think in terms of things like the recycling and anything in our residences, getting students on board is very difficult. Our recycling rate particularly in our residencies is terrible, students don't seem to buy into it. I would have imagined there would be younger generation buying into sustainability. That has always proves to be quite a challenge, getting students to buy into what you want to do.

<Internals\13> - § 2 references coded [6.23% Coverage]

Reference 1 - 5.26% Coverage

I think it is easy to get these incentives, especially if you report it to finance which most FM people tend to, is to get the buy in for cost saving exercises. If you going to say, I am going to recycle these stuff, and our branches in business improvement district, one of the things we pay for free recycling, and get about my waste and out it there and reduce my waste or if you looking at, and time switches turning, heaters online, just in terms of electricity.

Reference 2 - 0.97% Coverage

So it is easy to get the cost reduction stuff in, but not so easy for the other stuff.

<Internals\14> - § 2 references coded [4.70% Coverage]

Reference 1 - 2.64% Coverage

I think it has been able to prove that if you are going to get the savings that you say are going to get and in our business, because we are very reactive and our work fluctuates up and down through the year.

Figure 2-9: NVivo nodes analysis

The results of the interviews are presented in Chapter 3 Sustainability and Facilities Management.

2.4.2 Research objective 2 and research aim 1– Establish the aspects that define sustainability in the facilities management industry and develop a tool to enable facilities managers to evaluate sustainable performances in their practices

The second objective of the research was to establish the aspects that define sustainability in FM, which were used to develop a tool to enable facilities managers to evaluate sustainability performance (research aim 1). The two objectives were achieved through three different steps:

- analysis of sustainability policies;
- workshop; and
- questionnaire survey.

The results of the three steps are presented, together with the tool for sustainability in FM, in Chapter 4



Figure 2-10: Objective 2 and Aim 1 research methodology

2.4.2.1 Research objective 2 and research aim 1 – Analysis of sustainability policies

The first step used to establish the aspects that define sustainability in the facilities management industry (objective 2) was the analysis of sustainable policies of FM companies, with the aim of understanding how the concept of sustainability is envisioned at a corporate level for FM organisations. The analysis of secondary data is mainly used for explanatory research (Saunders et al. 2012) and was selected as an appropriate method to meet the aim, as it provides an unbiased view on the topic. Such a view is necessary as empirical studies have criticised the use of questionnaires and interviews for collecting data on sensitive issues, as they might be biased and the interviewee might be reluctant to talk about certain topics (Harris, 2001). The aim of documents analysis as research method is to attain a description of a phenomenon through the identification of concepts and categories describing the phenomenon (Elo & Kyngäs 2008). Moreover, the use of primary source of information (Cooper & Schindler, 2013) such as sustainability policy allowed a prompt access to the information – publicly available on internet – compared to other research methodology (Blumberg, Cooper & Schindler, 2011) and higher quality of the findings compared to self-collected primary data (Saunders et al. 2012). The companies included in the analysis were selected through a non-probability, purposive sampling method, which allowed for an in-depth understanding of the key themes analysed and ensured that relevant companies were included in the sample (Saunders et al., 2012). The selected companies for the analysis are FM providers who are

involved in sustainability initiatives, such as the Sustainable FM Index, the UK's only benchmark of sustainability in FM (Acclaro Advisory, n.d.) and provides their policies online. These policies were coded through NVivo using an open coding technique where codes are derived from the text, allowing "the researcher to find the answers within" (Blair, 2015). The coding technique allowed for the identification of a list of themes and objectives that define sustainability in FM.

As the knowledge on the different aspects which define sustainability in facilities management were limited, the analysis followed an inductive content approach where the particular instances observed in the policies were combined to generate the definition (Elo & Kyngäs 2008).

2.4.2.2 Research objective 2 and research aim 1 – Workshop

Based on the results of interviews with facilities managers and the analysis of the sustainability policies, the researcher developed a tool to support the enhancement and development of sustainability in FM (research objective 3). Following the initial development of the tool, the researcher organised a workshop with the aim of reviewing the tool and ensuring that all key aspects were included. The focus group interview method was selected for this part of the research, as the workshop's participants are encouraged to discuss the topic and share ideas (Krueger & Casey, 2009). Moreover, a focus group allows for the collection of a large amount of information from several people simultaneously (Berg, 2009), which was required to complete the development of the tool. To facilitate the moderation of the focus group, avoid the fragmentation into sub-groups and allow all the participants to contribute to the conversation, 10 participants were selected through snowball sampling, based on their knowledge of sustainability and FM and number of years they have worked in the facilities and construction industry (Table 4-5). After an introduction to the tool, the participants reviewed all objectives, performance indicators and measurement tools, discussing how the objectives should be improved.

2.4.2.3 Research objective 2 and research aim 1 – Questionnaire survey

The final step was the validation process of the tool for sustainability in FM. Owing to the complexity of the tool, validation relied on the participants of the focus group,

who had a full understanding of the tool and were able to provide meaningful feedback. The validation occurred after the workshop through an online questionnaire. Although alternative methods were considered for the validation process, the online questionnaire was selected for two main reasons: firstly, an online questionnaire reduces the level of commitment required by the participants as they can respond at the time that best suits them, and, secondly, owing to time limitations, other methods such as one-to-one interviews were not viable.

2.4.3 Research objective 3 – Investigate the FM relationship with BIM, exploring the benefits and barriers of integrating BIM into FM

Following the development of the evaluation tool for sustainable performances, the focus of the research moved to BIM and FM,. The research objective was to investigate the FM relationship with BIM and it was met through two different steps: a focus group interview and a questionnaire survey. The results are presented in Chapter 6 Building Information Modelling and Facilities Management



Figure 2-11: Objective 3 research methodology

2.4.3.1 Research objective 3 – Focus group interview

As BIM is a fairly new topic, in particular its relation to FM, the investigation began with a focus group aimed at understanding the benefits and barriers associated with integrating BIM into FM. According to Kvale and Brinkmann (2009), focus group interviews are well suited for exploratory studies in a new domain as the interaction during the interview may produce spontaneous responses and cognitive views. Vaughn, Schumm and Sinagub (1996) confirm that focus groups are particularly useful for exploratory research where little is known about the topic.

The focus group was developed following the four stages presented by (Morgan & Scannell, 1998):



Figure 2-12: Focus Group Stages (Morgan & Scannell, 1998)

Planning stage

The planning stage is key during the development of a workshop in order to obtain valuable results (Krueger & Casey, 2009). Four questions were developed to facilitate the conversation among the participants during the workshop. The questions used during the focus group are presented in Table 2-7. Before the workshop commenced, the questions were reviewed by a group of academics who verified the clarity of the questions and that there was no bias in the way they were phrased.

Table 2-7: BIM and FM Focus Group Questions

Question	Purpose
1. How can BIM help Facility Managers to manage their facilities?	Establish how BIM would impact FM practices and what benefits can be achieved with the implementation.
2. Intelligent BIM: How can BIM help facility managers to manage buildings in a more sustainable way?	Establish what aspects or functionality BIM can provide to support FM operational needs.
3. What kind of data does FM need in order to use BIM?	Establish what type of operational information should be included in a BIM model for FM purposes and how should be organised.
4. Research, education and policy: What are the key areas of research that would benefit from the integration of FM and BIM and the value it can bring?	Establish which aspects are currently preventing the implementation of BIM for FM.

During the workshop, participants were divided into three pre-arranged groups. The groups were organised to have a balance between the different professional groups represented and knowledge on the workshop’s topics. Groups remained unchanged during the first part of the workshop (which covered questions 1 and 2) and were subsequently modified for the third and fourth questions following the same logic.

The workshop was designed so that each group firstly discussed the different questions within the group, with the support of a moderator, and then presented their findings to the other participants.

Recruitment stage

One of the key aspects of achieving the required result and gathering data that contributes to meeting a research objective is the selection of the participants (Pope & Mays, 2006). The sampling strategy used for the workshop was a non-probability snowball sampling, which is appropriate for exploratory data collection (Saunders et al., 2012). The participants were required to have experience and knowledge in FM and an understanding of BIM in order to be able to contribute to the discussion.

Moderating stage

Each group worked on each question with a separate moderator that encouraged the discussion within the group using flip charts to review the different areas discussed. The results of the discussion were then presented to all the participants in a five-minute summary session that enabled further discussion within the different groups. The summaries of each of the group, together with the spontaneous discussions, were recorded using an electronic recorder so the data collected could later be analysed.

Analysis stage

The analysis of the data collected during the workshop was based on a qualitative analysis approach comprising four stages (Lacey & Luff, 2007):

- transcribing all presentations and comments recorded;
- organising the data;
- preliminary coding of interesting concepts; and
- identifying themes.

The coding process followed the same process used to code the interviews (paragraph 2.4.1.1) with the support of NVivo: as the objective of the focus group interview was to explore the benefits and barriers associated with integrating BIM and FM, the

themes identified during stage four of the analysis were then classified as benefits or barriers.

2.4.3.2 Research objective 3 – Questionnaire survey

Following the focus group interview a questionnaire survey was used to understand the gathered data on the relationship between FM and BIM. The questionnaire survey was selected for data collection as it allows to identify and describe the variability of a phenomenon (Saunders et al., 2012).

The questionnaires can be classified as descriptive (census-type questionnaires) or analytic (relationship-type questionnaires). A descriptive approach considers the number of occurrences in a population to determine the frequency of a specific answer and identify opinions or specific characteristics, whilst the analytic approach is used to understand the links between groups of data (Oppenheim, 2000). As the research objective was to understand the relationship between FM and BIM, the questionnaire was developed using a descriptive approach, and used to investigate the use of BIM. The questionnaire was divided into three sections, each dealing with a specific topic and including both open, closed and ordinal-scale questions.

Table 2-8: BIM and FM Questionnaire Survey Sections and Type of Questions

Questionnaire section	Purpose	Type of questions
1 – Profile of Respondents	Provide an overview of the respondents' profile	Open-ended questions Closed-ended questions
2 – Inefficiency in FM	Identify which, among a list of tasks provided, are the most inefficient in FM Validate the list and ensure it included all FM tasks	Ordinal-scale questions Open-ended questions
3 – BIM awareness, knowledge and use	Understand the relationship between FM and BIM, the knowledge on the topic and the current use of information models in the FM industry	Ordinal-scale questions Closed-ended questions

Before issuing the survey, a pilot questionnaire was distributed within a group of colleagues known to the researcher, who were asked (Saunders et al. 2012):

- how long the questionnaire takes to complete;

- how clear the instructions are;
- which, if any, questions were unclear or ambiguous;
- which, if any, questions the respondent felt uneasy about answering;
- whether in their opinion there were any major topic omissions;
- whether the layout was clear and attractive; and
- if they had any other comments.

Following the positive feedback from the pilot, the web-based survey was sent via email to all members of the BIFM across the United Kingdom as the targeted population. The BIFM online database of members was considered as to be the sample population, as BIFM represents the largest group of FM personnel across the whole of the UK, including members from various business sectors.

It should be noted that it was not necessary to collect a specific number of responses from participants representing different job roles or industries, because the purpose of the data analysis was not to perform cross tabulation or comparison between responses from specific professions, but rather to provide a general overview of the FM industry and BIM.

2.4.4 Research aim 2 – Develop a framework for the implementation of building information models for existing buildings

The results of the focus group and the questionnaire survey were used to establish a framework that would support the development of information models during building operations.



Figure 2-13: Aim 2 research methodology

Following the development, the framework was validated using an online questionnaire. Similar to the validation of the sustainability tool, the online questionnaire was selected to minimise the commitment required from the

respondents and reduce the time taken for data collection. As the framework focuses on two specific topics (BIM and FM), the participants (Table 7-3) in the validation process were selected through snowball sampling because experts in the two areas. The results of the validation process are presented, together with the BIM framework, in Chapter 7 RetroBIM Framework for Existing Buildings.

2.4.5 Research objective 4 – Verify the applicability of the sustainability tool and BIM framework

In the final part of the research, the sustainability tool and BIM framework were partially implemented in three case studies. The objective was to verify the applicability of the two tools to different scenarios and organisations. Case studies were selected for this objective as they provide an understanding of the context of the research (Eisenhardt & Graebner, 2007), and increasing conviction about a subject (Gray, 2016).

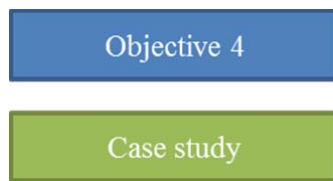


Figure 2-14: Objective 4 research methodology

The three case studies were selected to represent the different phases of a building life-cycle (new construction, mid-life, end of life) based on convenience and access (Yin, 2013). Although there is no ideal number of cases (Gray, 2016), especially since the purpose of the case study was not to generate theory, this number was deemed sufficient to establish whether the tool can accommodate different needs and requirements based on different buildings and companies. The data collection for the case studies was conducted through face-to-face interviews. The participants in the three case studies were asked the same questions (Yin, 2013), so that differences in responses and approaches could be easily identified.

Regarding the sustainability tool, the interviewees were requested to answer a series of closed-ended questions and evaluate the list of sustainable objectives included in the tool in order to identify sustainable priorities relevant to their business and building. Following the interview, the sustainability policy of each case study was

mapped against the priorities to verify the alignment between FM and the direction of corporate sustainability.

For the BIM framework, the interviewees were asked to identify information that would be useful for the management of their buildings and should be implemented in the information models. At the end of the interview, each interviewee was asked to provide a feedback on the two tools through a series of pre-defined questions.

Table 2-9: Case studies feedback questions

Sustainability tool	<ul style="list-style-type: none"> • Do you think the tool would be useful and facilitate the implementation of sustainable initiatives? • Would you implement the tool? • Do you think the tool can be practically implemented in the industry? • Do you think there are benefits to implementing the tool? • Do you think there are barriers to implementing the tool?
BIM framework	<ul style="list-style-type: none"> • Do you think the tool is useful and facilitates the implementation of information models for existing buildings? • Would you implement the tool? • Do you think there are benefits to implementing the tool? • Do you think there are barriers to implementing the tool?

The case studies are presented in Chapter 8 Case studies.

Chapter 3 Sustainability and Facilities Management

It is estimated that in the UK the built environment alone is responsible for almost half of the CO₂ emissions and water consumption and one-third of waste to landfill (Price, Pitt, & Tucker, 2011). Compared to other phases of the building life-cycle, operations has the biggest environmental impact (Elmualim, Shockley, Valle, Ludlow, & Shah, 2010), hence facilities managers have a better opportunity to deliver effective sustainable initiatives than other professionals within the built environment.

Within an organisation, the role of FM is to provide an environment that supports the primary objectives of the organisation itself (Alexander, 2004), whilst aligning with the business and organisational vision (Baaki, Baharum, & Ali, 2016). In relation to sustainability, the role of FM is to be “able to manage, implement and deliver an organisation’s non-core business services that contribute to the improvement of the economic, social and physical environment” (Cotgrave & Riley, 2012). Moreover, the role of FM has the potential to promote sustainably sound behaviours (Ramskov & Balslev, 2016), enhance quality of life and create effective relations with communities (Brad & Fred, 2016), as FM can have a direct impact on healthy living and social cohesion (Ikediashi, Ogunlana, & Ujene, 2014).

Among the professionals involved in the building lifecycle, facilities managers have the potential to deliver sustainable management in practice (Elmualim et al., 2010) owing to their role in the operation and management of properties. The realisation of sustainability goals requires an on-going commitment from FM throughout a building’s life (Min, Morgenstern, & Marjanovic-Halburd, 2016) beyond the environmental aspect: “it is becoming acceptable that sustainable FM will need to take into account social, economic and environmental aspects of sustainability to deliver a rounded service, which is demanded in modern times” (Elmualim et al., 2010).

However, there is not a full appreciation of how the FM industry can support sustainable developments (Price et al., 2011), and although companies understand the role of sustainability in their core business, they are still operating on the edge of compliance (Moriarty, 2014). As indicated by Pitt and Hinks (2001) and Jensen, van der Voordt, Coenen and Sarasoja (2014), FM is perceived and applied as a cost

management role rather than a strategic one. Although business-driven workspaces have been proven to be more productive than cost-driven ones (Price, Beard, Ellison, & Matzdorf, 2011) there is still no objective way to identify the value that FM brings to business (Hinks, Wright, & Halford-Maw, 2012). Thus although research and practitioners have argued for years about the importance of FM as an added value to the organisations (Jensen et al., 2014), and despite the evidence of economic return of sustainable investments, such as the £13M savings and 13,8% CO₂ achieved across 3000 public estates by the UK Government between 2010 and 2011 (CIBSE, 2011), facilities managers struggle to make a case for sustainability and shift the approach to sustainability from a “box-ticking” task to a long-term commitment (Moriarty, 2014).

3.1 Sustainability vision, mission and policy

Within an organisation, aspirations and objectives for the company’s social, environment and economic impact are defined based on the vision and mission, and translated into the sustainability policy (Shah, 2007) (Figure 3-1).

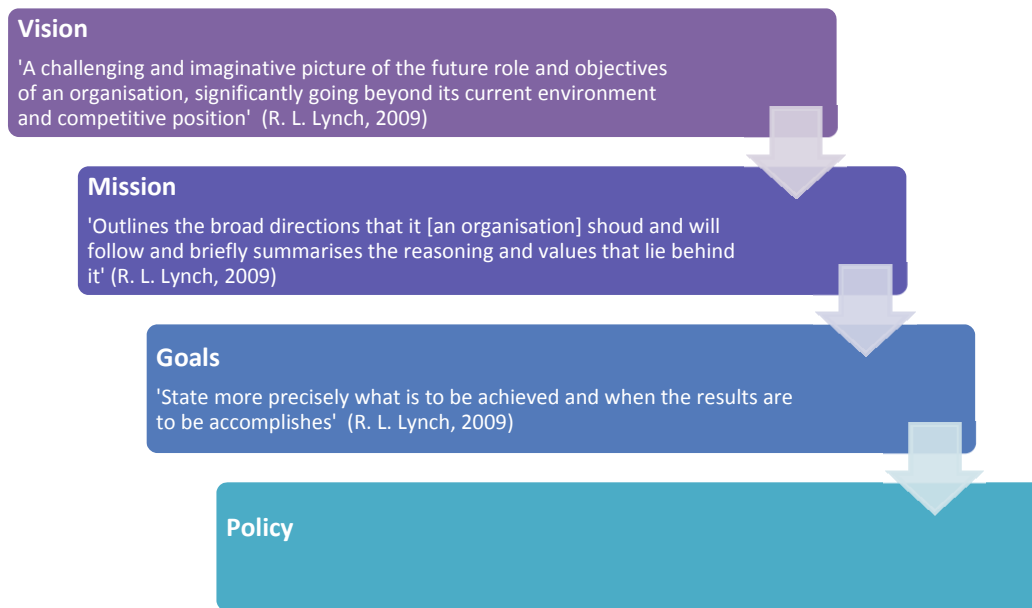


Figure 3-1: Hierarchy of Strategic Intent (adapted from: Miller, 1998)

The direction set by the organisation through the sustainability policy is conveyed to the different business units, including FM, where it is used to define each business unit’s strategy towards sustainability, together with the objectives of and contribution towards supporting the organisation’s goals (Figure 3-2). However, RICS (2012)

reported that facilities managers spend on average over 50% of their time dealing with day-to-day operations, leaving little time for strategic sustainable FM.



Figure 3-2: Sustainable FM Strategy Alignment with the Business

3.1.1 Sustainability policy and facilities management

Since 2007, the BIFM has interrogated the FM professionals on sustainability topics through the annual Sustainability Survey. Over the years, the results of the survey have confirmed that the importance of sustainability in FM has constantly risen (BIFM, 2014), and that the concept of sustainability has evolved and the focus is no longer only on energy and waste (Shah, Davies, & Brogan, 2016). Although the participants indicated legislation/regulation and corporate image as the main drivers behind the successful implementation of sustainability practices, emphasising how the Government, stakeholders and clients are playing a key role in sustainable FM (Elmualim et al., 2012), a number of other factors have been evaluated as being of significance, including organisational ethos, life-cycle cost reduction and the need to optimise resource use and improve profitability (Shah et al., 2016) (Figure 3-3).

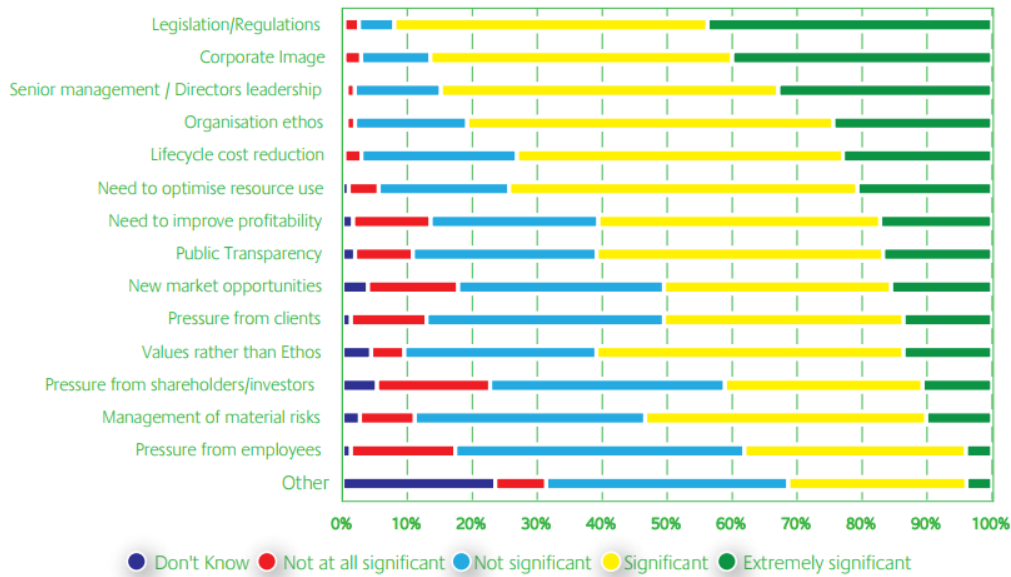


Figure 3-3: Influences in Driving Sustainability (Shah, Davies, & Brogan, 2016)

Nevertheless, health and safety, waste management and energy management remain the most important and mostly commonly covered areas of FM sustainability policies (BIFM, 2015).

As part of the conclusion to its survey, BIFM recognises a series of emerging themes that are affecting FM and have an impact on sustainable facilities management. These themes are:

- the use of BIM and the increased provision of data that will support the focus on people, carbon and life-cycle;
- the inclusion of social factors within the definition of sustainability, such as pay, diversity, human slavery and social value, which will require reporting, metrics and monitoring; and
- the inclusion within the FM role of wellbeing, productivity and life-cycle.

The results of the BIFM survey confirm that the concept of sustainability in FM has broadened from focussing merely on environmental issues, which has also been confirmed by other researchers (Ramskov & Balslev, 2016), and that the use of technology and information can support the delivery of sustainable FM.

Looking more specifically at sustainable policies, as part of a study on sustainability and FM, Elmualim et al. (2010) used a survey within the FM industry and reported that 31% of the respondents did not have a sustainability policy at company level and, out of the 251 replies, 41% indicated an inconsistent (25%) or poor (16%) organisational effectiveness in management of sustainability responsibilities. Researchers agree that companies with environmental policies do not always act upon the principle of these policies by implementing environmental and sustainable initiatives (Elmualim et al., 2010); (Carpenter & Meehan, 2002) and that sustainability policies are implemented at different levels by organisations (Price et al., 2011). To fully understand sustainable FM and how it can be improved, it is important to verify what sustainability means at an operational level and if there are any gaps between the directions set out in the policy and the day-to-day operation that prevents the development of sustainability in FM.

3.2 Sustainability in facilities management at an operational level

The goals and objectives included in the sustainability policies need to be translated into operational outcomes that provide direction and support to facilities managers to effectively embed the principles of sustainability into building operations. If the policies are not conveyed throughout the organisation, facilities managers are unable to implement sustainable initiatives and support the organisation's goals.

In order to better understand how sustainability in FM works at the operational level and how much of what is set out in the policies is implemented in practice, twenty facilities managers with different responsibilities and managing different types of buildings were interviewed. The data collection and analysis process were presented in section 2.4.1.1. All interviewees have multiple number of years they have worked in the facilities and construction industry and were selected both from in-house teams and outsourced FM teams delivering multiple services to clients

Table 3-1).

Table 3-1: Sustainability in FM Interviewees

ID	Experience	Type of building managed	In house/Contractor
1	5 years	Educational	Contractor
2	29 years	Educational	Contractor
3	15 years	Offices	Contractor
4	20 years	Educational	In-house
5	6 years	Offices	In-house
6	Over 20 years	Offices	In-house
7	Over 10 years	Educational	Contractor
8	23 years	Offices and industrial	In-house
9	6 years	Offices	In-house
10	Over 10 years	Military	In-house
11	12 years	Offices	Contractor
12	15 years	Educational	In-house
13	12 years	Offices	In-house
14	13 years	Offices and warehouses	In-house
15	28 years	Offices, warehouses and data centres	In-house
16	4 years	Educational	In-house
17	6 years	Offices and commercial	Contractor
18	17 years	Offices	Contractor
19	5 years	Commercial	Contractor
20	8 years	Offices	Contractor

3.2.1 Interview findings

The interviews were initially coded following the key themes of the questions (section 2.4): sustainability policy, sustainability goals, sustainability in the FM industry and barriers to sustainability. After the initial coding, a series of recurrent themes emerged, which were included in the analysis in order to provide a complete overview of sustainable FM at an operational level.

Sustainability policy

With only two exceptions (respondents 5 and 7), all interviewees work for companies or clients that have a sustainability policy. Participant 7 works for a company that has a sustainability policy, although the interviewee is not aware of it.

Sustainable goals

None of the interviewees has formal sustainable goals they are required to meet besides reducing waste to landfill (respondents 10 and 11) and achieving carbon reduction (respondents 4 and 12).

Management

A few participants (1, 3, 4, 7, 9, 15, 16, 19) indicated that everyone in an organisation, from the top management to the operational team, should be involved and champion sustainability. Clear communication of the direction and targets of sustainability needs to be in place, otherwise the corporate requirements become lost within the organisation and cannot be translated into operating targets. Another risk, in particular in large organisations, is that the direction set by the policy is not understood, such as in the case of participant 7, who commented, “[...] when you talk about sustainability in all honesty I am not really sure what the company wants. I think they need to raise awareness of it [...].”

Sustainability initiatives

Although most of the participants do not have formal sustainability goals that they need to meet, they all provided examples of sustainable initiatives developed in recent years. These initiatives can be categorised into initiatives that have a direct impact on the building and company performance, such as the use of renewable energy (respondent 3) or equipment replacement (respondent 2), and initiatives that focus on education and awareness of sustainability themes, such as campaigns to encourage turning off the lights (respondent 13) or putting waste into the correct bins (respondents 16 and 19). Overall, the initiatives discussed by the interviewees focussed mainly on recycling and waste management (respondents 2, 5, 7, 16, 17, 18, 19, 20), energy usage (respondents 3, 5, 7, 9, 13, 17, 18) and carbon reduction (respondents 4, 5, 18).

Business case

Some of the initiatives discussed during the interviews require capital investment to be implemented, especially in terms of building improvements or refurbishments. The interviewees, both in-house and out-sourced, reported the need to build a business case including all the costs and, in most cases, demonstrating a return on investment, before being able to implement any sustainable initiative. The business case to justify the project is created using different approaches: some of the interviewees do their own research trying to identify the best possible solution available on the market (respondents 14, 18 and 19), whilst others rely on knowledge and expertise within the organisation (respondents 15 and 20) or external consultants (respondent 3).

Procurement

In larger organisations, the tender process is managed through a dedicated procurement department with little or no input from the facilities managers on site (respondents 10, 14, 16 and 17). During the tender process, the suppliers' sustainable credentials, such as ISO 14001 accreditation, and sustainable capabilities are reviewed as part of the assessment, although the impact on the overall tender score is not excessive (respondent 12). Moreover, the interviewees reported that, following the procurement stage, the sustainable requirements for the suppliers are not included in the contract or formalised in sustainable targets during the contract period.

Supply chain

Although companies do not impose sustainability targets and goals on their supply chain, general sustainability requirements are conveyed to the contractors and suppliers. The interviewees reported initiatives delivered in partnership with the supply chain in two different ways: some facilities managers, such as respondent 11, challenge their supply chain to deliver new sustainability solutions, whilst others have a more prescriptive approach and prefer to provide a list of sustainable supplies and materials that the supplier should use to deliver the services (respondents 2 and 7). As part of their commitment towards sustainability, some companies award service contracts to small- and medium-sized local companies (respondents 1 and 4) instead of national enterprises.

Clients

Both in-house and outsourced teams have to respond to the client's requirements, whether the client is an internal stakeholder or an external, as in the case of outsourced FM contracts. If the client has an interest in sustainability, the facilities managers have more opportunities to develop initiatives and improve the sustainable performances. However, if the client is not concerned about sustainability, the facilities managers struggle to obtain support and funds. Some of the respondents (3, 7, 11, 18, 19) highlighted how initiatives are more likely to be approved and developed if the client is provided with clear financial benefits derived from implementing the initiative in a short period.

Staff

Although staff are required to comply with procedures and company guidance, which generally includes elements of sustainability, the individuals' sustainability performance is not reviewed or included in appraisals. As reported by respondent 3, for some contractors, the commitment to sustainability is limited to toolbox talks.

Sustainability in the facilities management industry

All interviewees agreed that sustainability is important for the FM industry and that the industry could have a positive impact on the environment and on society if included in day-to-day practices. Nevertheless, due to the nature of the role and the limitations within organisations, many sustainability initiatives are not implemented and the real impact of the FM industry on sustainability is still quite limited.

Barriers to sustainability

All interviews clearly identified funds availability and the request for a return of investment in a short period of time as two of the biggest barriers to developing sustainability initiatives in FM. Another challenge is ensuring sufficient levels of support from all organisational level: without the support from clients (internal and external) and the management team, many initiatives cannot be implemented, and without the support from staff and operatives, initiatives that are implemented will

likely be ineffective. Some of the contractors interviewed (respondents 1 and 17) also identified the lack of resources, not only financial but also in terms of time and people, as one of the barriers to sustainability.

3.2.2 Discussion of the interview findings

The interviews have shown that, although all three aspects of the triple bottom line are considered in sustainable FM, the financial aspect is more important than the others. All the respondents reported the need to make a business case, and indicated that initiatives with a short-term return on investment are more likely to be approved. As in FM cost is a key aspect, the initial driver for sustainability is likely to be the potential financial benefit.

Another aspect that emerged from the interviews is the importance of implementing sustainability at all levels and stakeholder inclusion, as without a buy-in from all parties, there are limits to what can be achieved: “[...] the top is not buying in and the bottom is not buying in and we have got just a couple of individuals within the business who have taken [sustainability] quite seriously; we are fighting a losing battle [...]” (respondent 1). Moreover, larger companies encounter other problems owing to the separation between the operational staff and the other levels: “[...] they are based at one location, which is the head office and I have never met them ... they have never come to the site to see what’s going on operationally [...]” (respondent 1).

As part of their role, facilities managers are not only responsible for implementing new initiatives, but also for communicating changes and explaining the rationale of what has been implemented. Without clear communication, resistance could influence the outcome of the initiative “[...] I think that the biggest challenge for our office is to be able to sell the benefits [...] to people that hate the change the most [...]” (respondent 14); “[...] there are some difficulties [...] trying to get people to break the norm [...]” (respondent 5).

In the journey towards sustainability, goals need to be aligned with the business. As policies are strategic documents that set out a company’s approach to sustainability, these should be translated into formal targets and used to evaluate the FM sustainable performances. Targets should be achievable and meaningful, in that the nature of the

core business needs to be taken into consideration when setting these targets. When selecting sustainability targets aiming for a constant reduction year on year can lead companies to stagnation points where further improvements are unlikely to be achieved. Without a full understanding of how the business is developing and an analysis of what has been achieved in the past, these types of targets can be counterproductive and reduce the effort towards sustainability. The same approach should also be applied to the supply chain: sustainability should not only be assessed during the procurement stage but pursued during the duration of the contract via the implementation of targets or key performance indicators (KPIs) measurements in collaboration with the client.

Although the concept of sustainability in FM can be extended to all aspects of the triple bottom line, the focus of the interviewees remained on specific aspects such as the reduction of CO₂, carbon emissions and waste. It can be argued that one of the reasons why these aspects are still the focus of facilities managers is the opportunity to easily collect data on performances and compare the results. Other aspects linked to sustainable FM are less tangible and more difficult to measure, making the creation of a business case for developing new initiatives a complicated task, as the performance and improvements thereof cannot be monitored. This observation is confirmed by the current deficit of sustainability measurement systems for the built environment (Lynch & Mosbah, 2017). As such, to support the enhancement and development of sustainability in FM, there is a need for a measurement tool that covers all aspects of sustainable FM and provides an insight into the performances and improvement achieved by FM over time, to support the development of business cases for the implementation of new initiatives and evaluate the effectiveness of what is already being implemented.

Chapter 4 Sustainability Performance and Reporting Tool

When evaluating how the vision is translated into outcomes, organisations utilise performance management systems (Oakland, 2004), which support the assessment of business performance and the identification of opportunities for improvements. In the same way, FM sustainability performance needs to be assessed and measured (National Research Council, 2005) to understand how FM aligns to an organisation's sustainable vision and objectives, and help recognise the support provided by FM in meeting the organisation's goals. By adapting Oakland (2004), the measurement of sustainable FM would enable facilities managers to:

- ensure requirements have been met;
- set objectives and comply with them;
- provide standards for establishing comparisons;
- provide visibility and “scoreboards” to monitor performance levels;
- highlight problems and determine which areas require priority attention; and
- provide feedback for driving the improvement effort.

As the focus on sustainable FM is growing, there are different sustainable accreditations available on the market for the companies that wish to go beyond compliance in sustainability, such as BREEAM. The purpose of the accreditation is to provide guidelines (Ramskov & Balslev, 2016) on how to deliver and improve sustainability during building operations and verify sustainability performance over time. However, the number of companies and buildings with such accreditations is low.

BREEAM was the first commercially available environmental assessment tool for buildings (Haapio & Viitaniemi, 2008), and according to the BREEAM website (BREEAM, n.d.), they are the world's leading sustainability assessment method, with 80% of the European market share. BREEAM provides specific accreditation for buildings in use, and in 2015, just over 10 million m² was certified (BREEAM, 2017), which approximately represents the office floor space in the City of London (City of London, 2016). Since BREEAM was established in 1990 in the UK, many other environmental assessment tools have been launched around the world (Haapio &

Viitaniemi, 2008), such as the Leadership in Energy and Environmental design (LEED) in the US, Ecoprofile in Norway (Todd, Crawley, Geissler, & Lindsey, 2001) and the Hong Kong Building Environmental Assessment Method (HK-BEAM) (Lee & Burnett, 2008), which also provide environmental assessment methods for existing buildings. Table 4-1 summarises the different topics covered by these environmental assessment methods.

Table 4-1: Comparison of Topics Covered in Environmental Assessment Methods for Existing Buildings
(BREEAM, 2016; U.S. Green Building Council, 2009; Pettersen, 2000; BEAM Society, 2016)

BREEAM	LEED	Ecoprofile	HK-BEAM
<ul style="list-style-type: none"> • Management • Health and Wellbeing • Energy • Transport • Water • Materials • Waste • Land Use and Ecology • Pollution • 	<ul style="list-style-type: none"> • Sustainable Sites • Water Efficiency • Energy and Atmosphere • Materials and Resources • Indoor Environmental Quality • Innovation in Operations • Regional Priority 	<ul style="list-style-type: none"> • External Environment • Resources • Indoor Climate 	<ul style="list-style-type: none"> • Management • Site Aspects • Materials and Waste Aspects • Energy Use • Water Use • Indoor Environmental Quality

As shown in Table 4-1, the majority of these certifications focus only on the building hardware (Graubner, Pelzeter, & Pohl, 2016), with limited analysis of aspects not linked to energy, materials, waste and water usage, and excluding key aspects of sustainable FM linked with building and company operations. Moreover, the generally limited funds available in FM (Cotts, Roper, & Payant, 2010) does not make accreditations a viable solution for numerous companies.

Facilities managers can nevertheless use performance measurements to positively change culture, systems and processes (Baaki et al., 2016) whilst working towards the company's sustainability objectives and testing the FM strategy and its effectiveness (Amaratunga & Baldry, 2002). Yet because the measurement of FM sustainable performance is not supported by any defined comprehensive process, there is a need for practical tools for supporting sustainable FM (Elmualim et al., 2010). The tool would help FM in improving sustainable performance and achieving goals and objectives in line with the organisation's strategy.

4.1 Performance improvement

Performance measurement is the “process of assessing progress towards achieving pre-determined goals, including information on the efficiency by which resources are transformed into goods and services, the quality of these outputs and outcomes, and the effectiveness of organisational objectives” (Amaratunga & Baldry, 2002) and traditionally has three different purposes (Baaki et al., 2016):

- to ensure the achievement of goals and objectives;
- to evaluate, control and improve procedures and processes; and
- to compare and assess the performance of different organisations, teams and individuals.

By incorporating the strategic direction set in the policies, performance management provides support for the identification of goals, the allocation of appropriate resources, sharing performance results and providing feedback on the viability of the policy (Baaki et al., 2016). Among the performance measurement systems available, the Balanced Scorecard is the more comprehensive framework for business processes improvements, with worldwide adoption (Wongrassamee, Simmons, & Gardiner, 2003).

4.1.1 Balanced Scorecard

The Balanced Scorecard is an internal strategic management tool “used to set priorities, focus energy and resources, strengthen operations, ensure that employees and other stakeholders are working towards common goals, establish agreement around intended outcomes/results, and assess and adjust the organisation’s direction in response to a changing environment. [...] Effective strategic planning articulates not only where an organisation is going and the actions needed to make progress, but also how it will know if it is successful” (Wilsey, Rohm, Perry, & Montgomery, 2013). According to Kaplan and Norton, creators of the Balanced Scorecard in the early 1990s “there is a huge gap between the vision and strategy developed at the top and the things people down in the organisation, at the frontline, are doing” (de Waal, 2007). An evaluation of an organisation is generally based on profit, which alone does not provide a comprehensive understanding of an organisation’s performance. The Balanced Scorecard, however, expands its performance evaluation by including three

additional operational measures: customer satisfaction, internal business processes and innovation and improvement (Berry, Broadbent, & Otley, 2005).

The financial perspective allows one to assess business performance through financial data and indicates whether the strategy implemented has led to economic success. Customer satisfaction covers both customer demographics data and how products and services have been disseminated across different customer groups (Wilsey et al., 2013), whilst the internal business processes focus on aspects such as efficiency, speed, quality, delivery and development of the services. Lastly, the innovation and improvement perspective examines how capable a business is of maintaining a competitive edge. Through the Balanced Scorecard (Figure 4-1), an organisation should aim to analyse each of these four perspectives in an equal manner and set targets that will support the organisation's goals (Dziak, 2015).

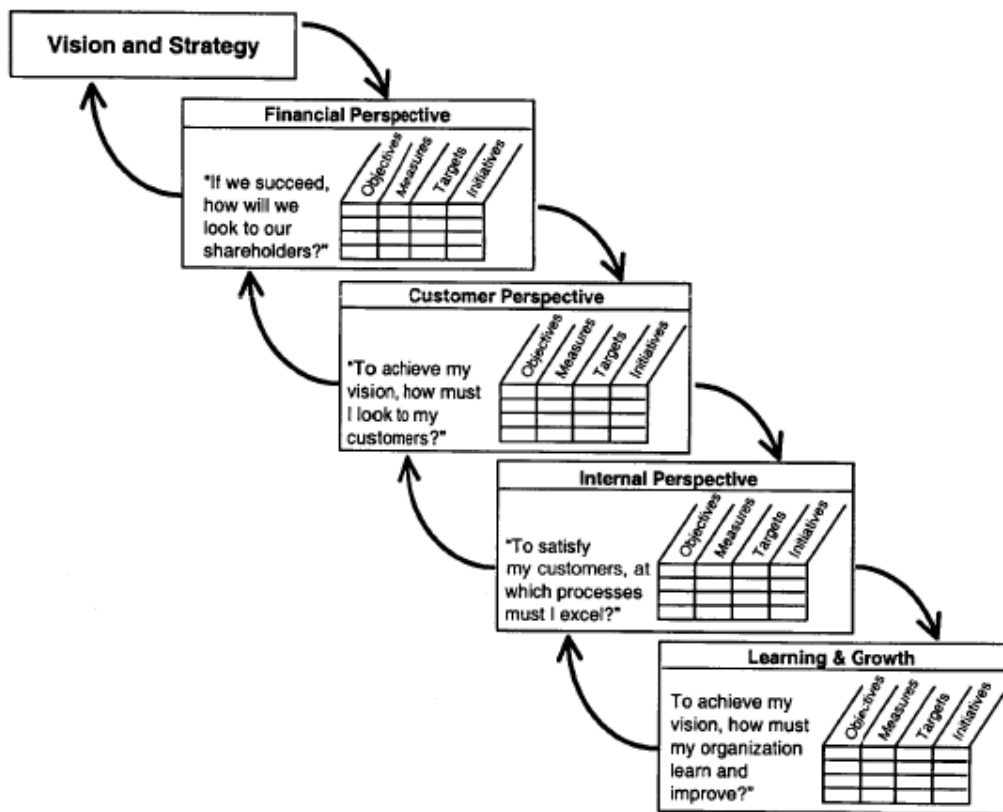


Figure 4-1: Balanced Scorecard (Kaplan & Norton, 2001)

Over the years, the system has been developed and reviewed, and in the mid-1990s, Kaplan and Norton included the Strategy Map, a tool which assists organisations in

choosing performance measures and justifying their choices by linking the organisation's objectives to the four perspectives through a cause-and-effect relationship (Kaplan & Norton, 2004).

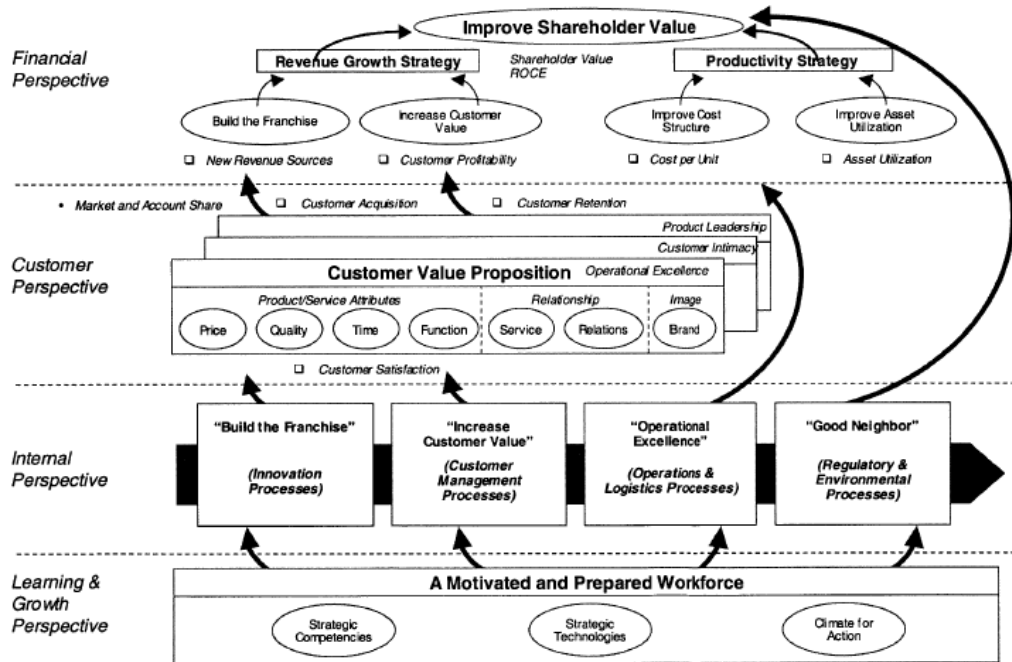


Figure 4-2: Strategy Map (Kaplan & Norton, 2001)

Kaplan and Norton designed the Balanced Scorecard not as a template ready to be applied but as a tool that should be customised to fit a company's mission, strategy, technology and culture (Neef, Siesfeld, & Cefola, 1998). Therefore, although the Balanced Scorecard was developed for divisional performance evaluation, the basic principles underpinning the performance evaluation tool can be adapted and extended to sustainability in FM, answering the need for a practical tool that can support the development and evaluation of sustainable FM.

4.2 Sustainability performance and reporting tool

Traditionally, performance measures tend to focus solely on the financial aspects and ignore other organisational priorities that might not easily be measured (Berry et al., 2005). In 1979, Lee D. Parker argued that "Given the existing range of changing corporate and divisional goals, the divisional profit test taken by itself is inadequate as a measure of any division's progress towards the attainment of the corporate goal set" (Parker, 1979). As shown in the previous chapter, the same principle also to

sustainability in FM: one of the key factors in the implementation of sustainability initiatives is the initial cost and the return on investment, which most of the time determines whether or not an initiative will be implemented. There is therefore a need to evaluate sustainability performance in FM beyond the financial aspects and verify that not only the policies set at the corporate level are implemented, but also that the related objectives set for FM are met, which is currently an issue (Shah, 2007). By adapting the principle of the Balanced Scorecard to sustainability in FM, a performance evaluation tool specific for sustainability in FM was developed, which supports the view that FM plays a large role in the organisation’s sustainability goals and identifies where further improvements can be made. To maximise the opportunities for implementing the tool in the FM industry, the tool is based on self-assessment, which has been recognised as a useful technique for monitoring and improving performances by regular reviews of results (Oakland, 2004), and identifies strengths and possible improvements without incurring the cost of third-party assessment or accreditation.

The sustainable performance and reporting tool (Figure 4-3) provides support to facilities managers in identifying opportunities in line with their business’s sustainability agenda and guidance on how to verify progress whilst ensuring alignment with the organisation’s goals.

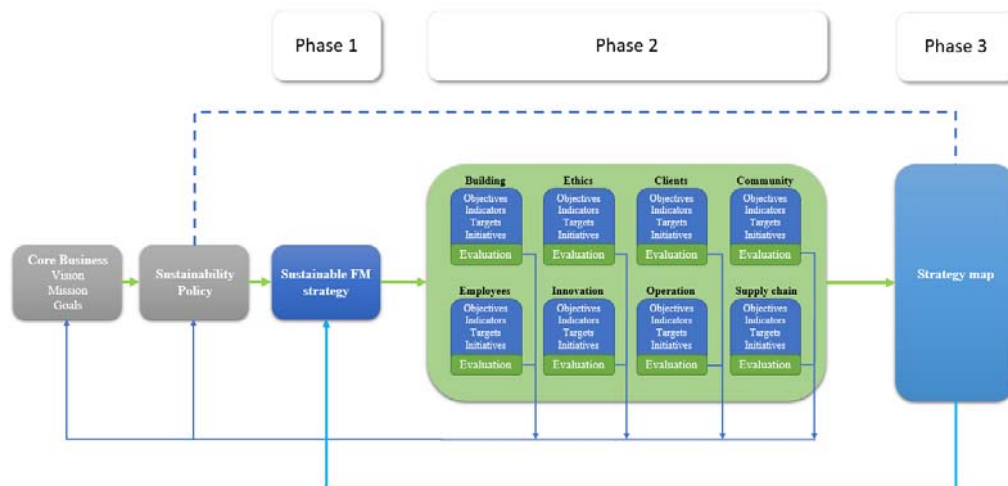


Figure 4-3: Sustainability Performance and Reporting Tool

The tool comprises three different phases, which are defined by the business sustainability vision, mission, goals and the sustainability policy.

4.2.1 Phase 1 – Strategy review

The first phase of the sustainability performance and reporting tool comprises the review of the FM sustainability strategy through a list of questions. The aim of the first phase is to verify whether the key elements for the success of sustainable FM – compliance, targets, communication, roles and responsibilities, plans – are in place before moving to a more detailed analysis and evaluation of the objectives (phase 2).

Table 4-2: Sustainability Performance and Reporting Tool – Strategic Review Questions

Questions
Does FM comply with all applicable legal requirements on sustainability?
Does FM have a defined FM strategy in terms of sustainability?
Is this translated into achievable objectives and targets?
Is there an action plan developed to achieve the objectives and targets?
Are long- and short-term priorities for this strategy defined?
Does FM create corrective action plans when sustainability performance is below expectations or does not achieve targets?
Are strategy and linked objectives and targets communicated within the organisation?
Are there resources available for implementing these initiatives?
Does FM comply with relevant standards and code of practices for sustainability?
Are stakeholders aware of the strategy?
Are stakeholders involved in the development and implementation of the strategy?
Do stakeholders receive reports on the performance and progression of these strategies?

By going through these closed-ended questions, the facilities manager can immediately identify any shortfall that needs to be addressed before reviewing the specific objectives.

4.2.2 Phase 2 – Objectives evaluation and reporting

After the strategy review the sustainability performance and reporting tool focuses on the evaluation of single objectives, which are divided into eight categories (Figure 4-4). Because one criticism against the Balanced Scorecard is that the metrics can be difficult to quantify (Dziak, 2015), the sustainability performance and reporting tool

provides for each of the objectives included a list of indicators and recommended tools that facilities managers should use to measure the performance and evaluate the improvements.

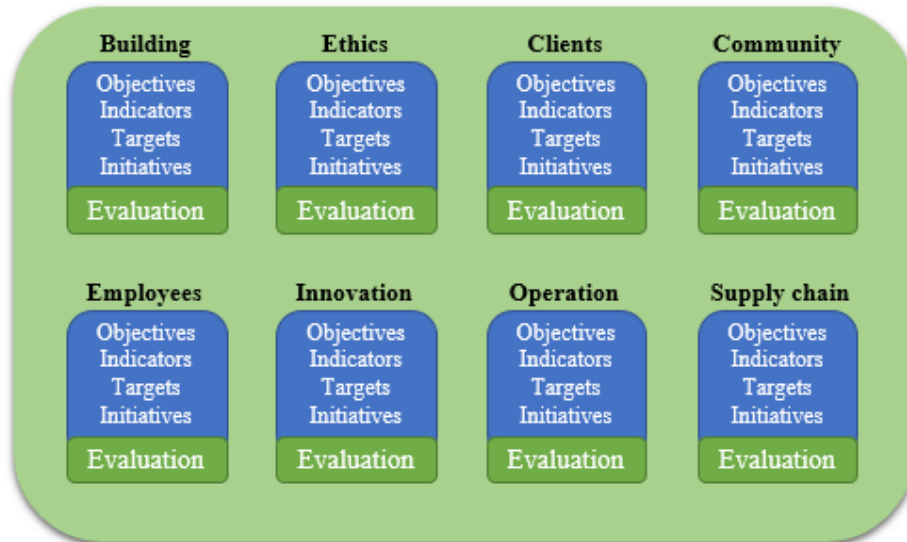


Figure 4-4: Sustainability Performance and Reporting Tool – Objectives Evaluation

As part of the review, facilities managers should define the specific targets for each of the objectives selected and list all the initiatives that will be implemented to achieve the targets.

4.2.2.1 Objectives development

Phase 2 of the sustainability performance and reporting tool includes a list of sustainable FM objectives that was developed through a two-stage process: the list was initially created through the analysis of the sustainability policies of FM companies and then finalised through a workshop with FM and sustainability experts.

4.2.2.1.1 Sustainability in facilities management at policy level – analysis

The analysis of sustainability policies provides an insight into the sustainability goals FM companies have and aids understanding of what aspects are considered to be pivotal in the development of more sustainable practices in FM. As discussed in section 2.4.2.1, the analysis of secondary data was used to start establishing the

aspects that define sustainability in the facilities management industry and include them in the tool development.

As the definition of sustainability varies from company to company, to achieve a more comprehensive understanding of all the aspects of sustainability in FM within the triple bottom line, the analysis was not limited to sustainability policies but included environmental, energy, corporate and social responsibility policies, where available, as detailed in Table 4-3.

Table 4-3: Policies Analysed per Company

Company	Policies analysed
Amey	Energy and Environmental
BAM	Environmental and Sustainability
Bilfinger	CSR and Sustainability
Boygues	CSR
Carillion	Sustainability
CBRE	Environmental
Cofely	Energy and Environmental
Compass	Environmental
G4S	Environmental
Galliford Try	Environmental and Sustainability
Integral	Environmental
Interserve	Environmental and Sustainability
ISS	CSR and Environmental
Johnson Control	Sustainability
Kier	Environmental
Mace Macro	Sustainability
Mitie	Sustainability
OCS	Sustainability
Sodexo	Environmental
Telereal	Environmental
Vinci	Sustainability

4.2.2.1.2 Sustainability in facilities management at policy level – results

The policies were coded and the analysis showed thirteen recurrent themes: biodiversity, business ethics, clients, community, employees, energy, environmental impact, health and safety, innovations, resources, supply chain, transport, and waste and recycling. Figure 4-5 shows the distribution of the themes across the policies.

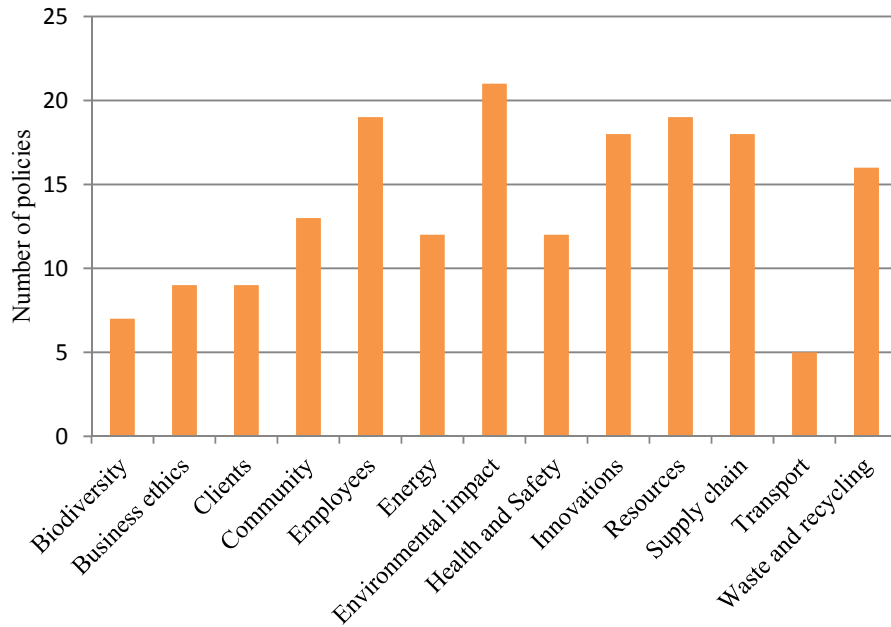


Figure 4-5: Distribution of Sustainability Themes across Company Policies

Biodiversity – the companies analysed have a proactive approach towards the protection and enhancement of biodiversity.

Business ethics – as part of their policies, nine of the companies reviewed focus on business ethics to guarantee that their businesses are run with integrity and observe all the statutory regulations.

Clients – companies are committed to supporting their clients towards shared sustainability goals, working together to develop strong relationships and promote the adoption of best practices.

Community – the impact on communities is included in thirteen of the policies, with a commitment to respect and making a positive contribution to local communities.

Employees – there is a dual focus on employees, in that together with raising awareness on sustainability issues and providing training on sustainability to employees, companies are also committed to developing an inclusive and supportive work environment, with a focus on staff wellbeing.

Energy – as part of the initiatives linked with the environment impact, there is a general emphasis on efficient use of energy and on creating initiatives to reduce energy consumption.

Environmental impact – all the policies analysed include a commitment to reduce the company’s environmental impact with a focus on carbon footprints and pollution.

Health and Safety – more than half of the companies analysed include health and safety in their policies, confirming their commitment towards a safe working environment with no injuries and incidents.

Innovations – together with continuous improvement, innovation is included in almost all policies (18 out of the 21 analysed), showing a general interest in developing new initiatives aimed at supporting the sustainability agenda.

Resources – almost all companies promote an efficient use of resources as well as responsible sourcing to reduce their environmental impact.

Supply chain – companies seek the support of the supply chain to achieve their sustainable goals, creating strategic partnerships with their suppliers. When possible, the companies aim at working with small- and medium-sized local businesses.

Transport – policies confirm that companies are committed to minimising the environmental impact of travel by providing alternatives, such as teleconferencing, and by encouraging environmentally friendly means of travel.

Waste and recycling – almost all companies (16) seek the reduction of waste generation and waste to landfill by focusing on material reuse and recycling.

Table 4-4 shows which policies include the thirteen identified themes.

Table 4-4: Policies Mentioning Each Sustainable Theme

Biodiversity	Business ethics	Clients	Community	Employees
<ul style="list-style-type: none"> • Amey • BAM • Bouygues • Carillion • Galliford Try • Kier • OCS 	<ul style="list-style-type: none"> • BAM • Bilfinger • Bouygues • Carillion • CBRE • Interserve • Johnson Control • OCS • Vinci 	<ul style="list-style-type: none"> • BAM • Carillion • Galliford Try • ISS • Kier • Mace Macro • Mitie • OCS • Sodexo 	<ul style="list-style-type: none"> • BAM • Bilfinger • Bouygues • Carillion • Galliford Try • Interserve • ISS • Johnson Control • Kier • Mace Macro • Mitie • OCS • Vinci 	<ul style="list-style-type: none"> • Amey • BAM • Bilfinger • Bouygues • Carillion • CBRE • Cofely • Compass • G4S • Galliford Try • Integral • Interserve • ISS • Johnson Control • Mace • Mitie • OCS • Sodexo • Vinci

Energy	Environmental Impact	Health and Safety	Innovation	Resources
<ul style="list-style-type: none"> • Amey • BAM • CBRE • Compass • G4S • Galliford Try • Integral • ISS • Johnson Control • Kier • Sodexo • Telereal 	<ul style="list-style-type: none"> • Amey • BAM • Bilfinger • Bouygues • Carillion • CBRE • Cofely • Compass • G4S • Galliford Try • Integral • Interserve • ISS • Johnson Control • Kier • Mace Macro • Mitie • OCS • Sodexo • Telereal • Vinci 	<ul style="list-style-type: none"> • BAM • Bilfinger • Bouygues • Carillion • CBRE • Compass • Galliford Try • ISS • Johnson Control • Mitie • OCS • Vinci 	<ul style="list-style-type: none"> • Amey • BAM • Bouygues • Carillion • CBRE • Cofely • Compass • G4S • Galliford Try • Integral • Interserve • Johnson Control • Kier • Mace Macro • Mitie • Sodexo • Telereal • Vinci 	<ul style="list-style-type: none"> • Amey • BAM • Bilfinger • Bouygues • Carillion • CBRE • Compass • G4S • Galliford Try • Integral • Interserve • ISS • Johnson Control • Kier • Mace • Mitie • OCS • Sodexo • Vinci
	Supply Chain	Transport	Waste and Recycle	
	<ul style="list-style-type: none"> • Amey • BAM • Bilfinger • Bouygues • Carillion • CBRE • Cofely • Compass • G4S • Galliford Try • ISS • Kier • Mace Macro • Mitie • OCS • Sodexo • Telereal • Vinci 	<ul style="list-style-type: none"> • Compass • G4S • ISS • Kier • Mitie 	<ul style="list-style-type: none"> • Amey • BAM • Bilfinger • Bouygues • Carillion • CBRE • Compass • G4S • Galliford Try • Integral • Interserve • ISS • Johnson Control • Kier • OCS • Sodexo 	

Following the review of the policies, 122 sustainable FM objectives were identified, which were grouped in terms of similarities and common themes. For each of the

identified objectives, a list of performance indicators and measurement tools were established through a literature review.

4.2.2.1.3 Objectives review workshop

To validate the list of objectives, the performance indicators and the measurement tools identified through the policy analysis and the literature review, a workshop was held with ten professionals (Table 4-5) from the built environment who have comprehensive knowledge of sustainability and FM. The data collection process was presented in section 2.4.2.2.

Table 4-5: Sustainability Performance and Reporting Tool – Participants

ID	Job	Number of years worked in the industry
1	Sustainability Advisor	5
2	Director of FM	30
3	Senior manager	25
4	Sustainability Director	15
5	Senior manager	5
6	Sustainability Consultant	7
7	Senior Lecturer	25
8	Sustainability Consultant	5
9	Lecturer	4
10	Director of FM	25

During the workshop, the participants reviewed all the objectives, the performance indicators and measurement tools, and the list of 92 objectives presented in the following section is the result of the review process.

4.2.2.2 Objectives and measures

The final list of objectives identified through the workshop has been sub-divided into eight categories. Each objective includes specific performance indicators and measurement tools that should be utilised to assess the sustainable performance of FM and the effectiveness of the initiatives developed.

Building

Table 4-6: Sustainability performances and reporting tool Building group

Objective	Performance indicators	Measurement tool
Emissions to air	<ul style="list-style-type: none"> • Air emissions • Number and place meters and sub meters • How often emissions are monitored and follow up action plan developed • % reduction air emissions achieved • Effectiveness initiatives implemented • Number of initiatives to reduce emissions to air implemented 	External audit BIM Internal review
Impact on biodiversity	<ul style="list-style-type: none"> • Impact on biodiversity • How often the impact on biodiversity in monitored and follow up action plan developed • % reduction impact on biodiversity achieved • Effectiveness initiatives implemented • Number of initiatives to reduce impact on biodiversity implemented 	External audit Internal review
CO ₂ Emissions	<ul style="list-style-type: none"> • CO₂ emissions • Number and place meters and sub meters • How often emissions are monitored and follow up action plan developed • % reduction CO₂ achieved • Effectiveness initiatives implemented • Number of initiatives to reduce CO₂ emissions implemented 	External audit BIM Internal review

Electricity usage	<ul style="list-style-type: none"> • Electricity usage • Number and place meters and sub meters • How often usage is monitored and follow up action plan developed • % reduction electricity usage achieved • Effectiveness initiatives implemented • Number of initiatives to reduce electricity usage implemented 	External audit BIM Internal review
Embodied energy <i>Use embodied energy as factor to evaluate materials</i>	<ul style="list-style-type: none"> • Number of materials evaluated • Number of materials selected using embodied energy 	BIM Internal review
Energy usage	<ul style="list-style-type: none"> • Energy usage • Number and place meters and sub meters • How often energy usage is monitored and follow up action plan developed • % reduction energy usage achieved • Effectiveness initiatives implemented • Number of initiatives to reduce energy usage implemented 	External audit BIM Internal review
Impact on land	<ul style="list-style-type: none"> • Impact on land • How often impact on land is monitored and follow up action plan developed • % reduction impact on land achieved • Effectiveness initiatives implemented • Number of initiatives to reduce impact on land implemented 	External audit Internal review

<p>Life cycle analysis <i>Use life cycle analysis as factor to evaluate materials and systems</i></p>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using life cycle analysis • Life span of materials/systems against predicted life span 	<p>BIM Internal review</p>
<p>Building modifications impact <i>Evaluate the impact of possible building modifications</i></p>	<ul style="list-style-type: none"> • Number of alternatives evaluated • Criteria for selecting preferred option • Evaluation of effectiveness and profitability • Evaluation return of investment 	<p>BIM Internal review</p>
<p>Sustainable accreditation</p>	<ul style="list-style-type: none"> • Number of accreditation achieved • Number of accreditation maintained 	<p>External audit Internal review</p>
<p>Building systems durability <i>Evaluate the durability of building system to create ad hoc plans for extending durability</i></p>	<ul style="list-style-type: none"> • Building systems durability • How often building systems are assessed and follow up action plan to extend durability developed • % extension building systems durability achieved • Effectiveness initiatives implemented • Number of review of Planned Preventive Maintenance plans based on system durability 	<p>BIM Internal review</p>

Water usage	<ul style="list-style-type: none"> • Water usage • Number and place meters and sub meters • How often water usage is monitored and follow up action plan developed • % reduction water usage achieved • Effectiveness initiatives implemented • Number of initiatives to reduce water usage implemented 	External audit BIM Internal review
Emissions to water	<ul style="list-style-type: none"> • Emissions to water • How often emissions to water are monitored and follow up action plan developed • % reduction emissions to water achieved • Effectiveness initiatives implemented • Number of initiatives to reduce emissions to water implemented 	External audit BIM Internal review
Building end of life <i>Evaluation of different possible alternatives for the end of life of the building in use</i>	<ul style="list-style-type: none"> • Number possible alternatives identified 	BIM Internal review
Building performance	<ul style="list-style-type: none"> • Building performance • Number of processes evaluated • Number of components evaluated • Number of processes identified for poor performances • Number of actions implemented to improve performance • Effectiveness initiatives implemented • Users' satisfaction • Number of benchmark performed in a year • Number of initiatives implemented to improve benchmark 	External audit BIM Internal review Employees survey

Life cycle cost <i>Use of life cycle cost as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using life cycle cost 	BIM Internal review
--	---	------------------------

Business Ethics

Table 4-7: Sustainability performances and reporting tool Business Ethics group

Objective	Performance indicators	Measurement tool
Comply with Modern Slavery Act	<ul style="list-style-type: none"> • Modern Slavery Act policy created, updated and followed • Number of external audits to verify compliance • Number of staff aware of the policy • Number of hours of training provided to staff • Number of suppliers aware and aligned with the policy 	External audit Internal review Employees survey
Code of conduct and staff compliance (fiscal duties, ethical behaviours, etc.)	<ul style="list-style-type: none"> • Number of external audits to verify compliance • Number of staff aware of code of conduct and compliance • Number of hours of training provided to staff 	External audit Internal review Employees survey
Treat supply chain with respect without abuse of position	<ul style="list-style-type: none"> • Supply chain employees' wage • Number of complaints received • Payment terms • Number of contractors 	Internal review Suppliers survey
Company transparency	<ul style="list-style-type: none"> • Number of documents publicly available • Number of report produced 	Internal review

Clients

Table 4-8: Sustainability performances and reporting tool Client group

Objective	Performance indicators	Measurement tool
Review clients' perceptions, expectations and suggestions	<ul style="list-style-type: none"> • Number of reviews undertaken • Number of initiatives to address concerns and suggestions implemented • Effectiveness initiatives developed 	Internal review Clients survey
Alignment with client's sustainability requirements	<ul style="list-style-type: none"> • Number of reviews undertaken to verify alignment 	Internal review
Support client toward sustainability	<ul style="list-style-type: none"> • Number of initiatives developed in partnership with clients • Effectiveness initiatives developed 	Internal review Clients survey

Community

Table 4-9: Sustainability performances and reporting tool Community group

Objective	Performance indicators	Measurement tool
Develop initiatives to combat employment issues (long-term unemployment, apprenticeships, etc.)	<ul style="list-style-type: none"> • Number of initiatives created • Impact of initiatives created • Number of participants • Number of hours of training provided • Feedback from the community 	Internal review Community survey
Employ local labour	<ul style="list-style-type: none"> • % of local labour employed 	Internal review
Establish communication channels with local authorities for sustainability matter	<ul style="list-style-type: none"> • Number of meetings/communication with the local authorities • Feedback from the community 	Internal review Community survey
Respect community traditions	<ul style="list-style-type: none"> • Feedback from the community 	Community survey

Support local communities (financially or otherwise)	<ul style="list-style-type: none"> • £ and number of hours donated to the community each year • Feedback from the community 	<p>Internal review</p> <p>Community survey</p>
--	---	--

Employees

Table 4-10: Sustainability performances and reporting tool Employees group

Objective	Performance indicators	Measurement tool
Increase employees' participation during decision-making processes	<ul style="list-style-type: none"> • Number of initiatives to include employees in decision-making processes • Type of decision-making processes • Feedback from the employees 	Internal review Employees survey
Increase employees' participation in the company ownership	<ul style="list-style-type: none"> • Number of shares owned by employees • Feedback from the employees 	Internal review Employees survey
Ensure employees receive fair remuneration	<ul style="list-style-type: none"> • Employees wage • Initiative to achieve living wage • Gap between highest and lowest earners • Feedback from employees 	Internal review Employees survey
Provide employees with work benefits	<ul style="list-style-type: none"> • Number and type of benefits available for employees • Employees' satisfaction survey 	Internal review Employees survey
Ensure equality of opportunities for employees	<ul style="list-style-type: none"> • % employees for each category against total number employees • Feedback from employees 	Internal review Employees survey
Develop an inclusive work environment	<ul style="list-style-type: none"> • % employees from disadvantaged groups against total number employees • Feedback from employees 	Internal review Employees survey
Respect employees'	<ul style="list-style-type: none"> • Feedback from 	Employees

traditions	employees	survey
Commitment to Human Rights	<ul style="list-style-type: none"> • Human Rights policy created, updated and followed • Number of external audits to verify compliance • Number of staff aware of the policy • Number of hours of training provided to staff • Number of suppliers aware of the policy • Number of suppliers aware and aligned with the policy 	External audit Internal review Employees survey Suppliers survey
Create initiatives to enhance sustainability among employees	<ul style="list-style-type: none"> • Number of initiatives created in a year • Effectiveness initiatives implemented • Employees participation • Employees awareness • Feedback from employees 	Internal review Employees survey
Create initiatives to motivate and facilitate employees' commitment to sustainability	<ul style="list-style-type: none"> • Number of initiatives created in a year • Effectiveness initiatives implemented • Employees participation • Employees awareness • Feedback from employees 	Internal review Employees survey
Evaluate and review employees' wellbeing and working conditions	<ul style="list-style-type: none"> • Air quality • Space temperature • Acoustic conditions, • Employees' satisfaction survey • Number sick days • Staff turnover • Staff productivity • Feedback from employees 	External audit BIM Internal review Employees survey
Evaluate employees' awareness of sustainability aspects linked with their activities	<ul style="list-style-type: none"> • % staff awareness of sustainability aspects linked with their activities • Number of initiatives implemented to increase awareness • Effectiveness initiatives 	Internal review Employees survey

	implemented	
Implement employees' complaints procedure and ensure employees are aware of it	<ul style="list-style-type: none"> • Employees awareness of the procedure 	Employees survey
Implement measures to reduce employees' vehicle dependency	<ul style="list-style-type: none"> • CO2 emissions from vehicles • Number of initiatives implemented to reduce vehicle dependency • Effectiveness initiatives implemented • % reduction achieved 	Internal review Employees survey
Review employees' perceptions, expectations and suggestions	<ul style="list-style-type: none"> • Number of suggestions received • Number of initiatives in place to assess employees' perceptions and expectations • Number of suggestions implemented following employees' feedback 	Internal review Employees survey
Support workforce training and career development	<ul style="list-style-type: none"> • Number of initiatives created to support career development • £ per employees spent on training • Feedback from employees 	Internal review Employees survey
On-going sustainability training for workforce	<ul style="list-style-type: none"> • Number of hours of training provided to staff • Effectiveness of the training • Feedback from employees 	Internal review Employees survey
Employees receive training on how to operate the building efficiently	<ul style="list-style-type: none"> • Number of hours of training provided to staff • Effectiveness of the training • Feedback from employees 	Internal review Employees survey

Innovation

Table 4-11: Sustainability performances and reporting tool Innovation group

Objective	Performance indicators	Measurement tool
Commitment to continual improvement and enhanced sustainable performances	<ul style="list-style-type: none"> • Number of initiatives implemented • Effectiveness initiatives implemented • Number of previous innovations still in use 	Internal review
Supply chain collaboration to achieve innovation	<ul style="list-style-type: none"> • Number of initiatives implemented in collaboration with the supply chain • Effectiveness initiatives implemented • Number of previous innovations still in use 	Internal review Suppliers survey

Operation

Table 4-12: Sustainability performances and reporting tool Operation group

Objective	Performance indicators	Measurement tool
Perform life cycle management	<ul style="list-style-type: none"> • Number of performance evaluated • Effectiveness management over life cycle 	Internal review
Supply relevant training on health and safety to employees	<ul style="list-style-type: none"> • Number of hours of training provided to staff • Number of employees with H&S certifications 	Internal review
Use sustainability as a key driver in the procurement process	<ul style="list-style-type: none"> • Number of sustainability questions asked during procurement process • Weight of the questions compared to overall score 	Internal review

GHGs emissions from employees' transportation	<ul style="list-style-type: none"> • GHGs emissions per employee • Number of initiatives to support flexible working • Number of initiatives to support home working • Number of IT support system (teleconference, etc.) available • Number of staff utilising the initiatives • % reduction GHGs emissions from employee transportation achieved 	External audit Internal review
Consider consumables impact on the environment before purchasing	<ul style="list-style-type: none"> • Number product evaluated • Number of product selected using environmental impact • % spend on green product 	Internal review
Develop and maintain an environmental management system	<ul style="list-style-type: none"> • Environmental Management System developed and maintained • Accreditations achieved 	External audit Internal review
Develop defined processes to respond to environmental emergencies	<ul style="list-style-type: none"> • Number of processes implemented • Number of incidents • Effectiveness processes implemented • Employees' awareness 	Internal review Employees survey
Monitor health and safety performance data	<ul style="list-style-type: none"> • Number of processes implemented • Number of incidents • Effectiveness processes implemented • Employees' awareness 	External audit Internal review Employees survey
Define and meet health and safety targets	<ul style="list-style-type: none"> • Number targets achieved • Employees' awareness 	Internal review Employees survey
Establish internal reviews to achieve sustainability improvements	<ul style="list-style-type: none"> • Number of internal reviews performed • Number of improvements identified • Number improvements developed • Effectiveness improvements implemented 	Internal review

Implement initiatives to improve employees' sustainable impact (habits, processes, behaviours, etc.)	<ul style="list-style-type: none"> • Number initiatives implemented • Effectiveness initiatives implemented 	Internal review Employees survey
Implement measures to avoid landfill	<ul style="list-style-type: none"> • Volume waste to landfill • Number initiatives implemented • Effectiveness initiatives implemented • % recycling against landfill 	External audit Internal review
Implement measures to increase recycling	<ul style="list-style-type: none"> • Volume recycling • Number initiatives implemented • Effectiveness initiatives implemented • % recycling against landfill 	External audit Internal review
Implement measures to reduce waste quantities	<ul style="list-style-type: none"> • Volume waste • Number initiatives implemented • Effectiveness initiatives implemented • % reduction achieved 	External audit Internal review
Select environmental-friendly alternatives (vehicles, materials, resources, etc.)	<ul style="list-style-type: none"> • Number of alternatives evaluated • Criteria for selecting preferred option 	Internal review
Utilise locally sourced materials	<ul style="list-style-type: none"> • Number of local suppliers utilised • Transport impact 	Internal review
Utilise locally sourced services	<ul style="list-style-type: none"> • Number of local suppliers utilised • Transport impact 	Internal review
Reduce the likelihood of environmental incidents	<ul style="list-style-type: none"> • Number of processes implemented • Number of incidents • Effectiveness processes implemented • Employees' awareness 	External audit BIM Internal review Employees survey
Reduce the likelihood of health and safety incidents	<ul style="list-style-type: none"> • Number of processes implemented • Number of incidents • Effectiveness processes implemented • Employees' awareness 	External audit BIM Internal review Employees survey

Reduce the likelihood of 'near miss' incidents	<ul style="list-style-type: none"> • Number of processes implemented • Number of 'near miss' • Effectiveness processes implemented • Employees' awareness 	External audit Internal review Employees survey
Undertake environment risk assessment to minimise environmental impact	<ul style="list-style-type: none"> • Number of processes implemented • Number of risks identified • Number of initiatives to mitigate risks identified • Effectiveness initiatives identified 	External audit Internal review
Undertake health and safety audits	<ul style="list-style-type: none"> • Number of external audits • How often external health and safety audits are performed and follow up action plan developed • Number of internal audits • How often internal health and safety audits are performed and follow up action plan developed 	External audit Internal review
Climate change impact <i>Use climate change impact as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using climate change impact 	Internal review
End of life possible re-use <i>Use end of life possible re-use as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using end of life possible re-use 	BIM Internal review
Environmental impact <i>Use environmental impact as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using end of life possible re-use 	BIM Internal review

Use KPIs to measure internal sustainable performances	<ul style="list-style-type: none"> • Number of KPIs • Frequency measurement • Performance overtime • Number of initiatives implemented to improve performances • Effectiveness initiatives implemented 	Internal review
Life expectancy <i>Use life expectancy as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using life expectancy 	BIM Internal review
Material efficiency <i>Use material efficiency as factor to evaluate materials and systems</i>	<ul style="list-style-type: none"> • Number of materials/systems evaluated • Number of materials/systems selected using material efficiency 	BIM Internal review
Use new and renewable energy sources	<ul style="list-style-type: none"> • % new and renewable energy used 	Internal review
Prefer sustainable products	<ul style="list-style-type: none"> • % sustainable products used 	Internal review
Use renewable and ecological resources	<ul style="list-style-type: none"> • % renewable and ecological resources used 	Internal review
Develop a responsible sourcing policy	<ul style="list-style-type: none"> • Responsible sourcing policy created, updated and followed • Number of external audits to verify compliance • Number of staff aware of the policy • Number of hours of training provided to staff • Number of suppliers aware and aligned with the policy 	External audit Internal review Employees survey Suppliers survey
Use sustainability criteria when sourcing resources	<ul style="list-style-type: none"> • Number of sustainable criteria used • Weight of sustainable criteria 	Internal review

Supply chain

Table 4-13: Sustainability performances and reporting tool Supply chain group

Objective	Performance indicators	Measurement tool
Work with businesses of different size (small, SMEs, etc.)	<ul style="list-style-type: none"> • % different size companies used 	Internal review
Ensure supply chain alignment with strategy and values	<ul style="list-style-type: none"> • Strategy and values awareness in the supply chain • Initiatives implemented to verify alignment 	Internal review Suppliers survey
Assess sustainability performance of supply chain	<ul style="list-style-type: none"> • Number of processes to assess • Supply chain performance • Sustainable KPIs utilised 	Internal review Suppliers survey
Assess sustainable capability of supply chain during procurement	<ul style="list-style-type: none"> • Number of suppliers that have an environmental management system • Number of sustainable criteria used to assess supply chain • Weight of sustainable criteria 	Internal review
Develop strategic partnerships with supply chain	<ul style="list-style-type: none"> • Number of long term suppliers • Number of initiatives developed together 	Internal review
Encourage supply chain to use sustainable products	<ul style="list-style-type: none"> • % sustainable products used 	Suppliers survey
Ensure supply chain complies with the Modern Slavery Act	<ul style="list-style-type: none"> • Number of audits performed to ensure compliance 	Suppliers survey
Ensure supply chain is committed to Human Rights	<ul style="list-style-type: none"> • Number of audits performed to ensure compliance 	Suppliers survey
Ensure supply chain maintain ethical behaviours	<ul style="list-style-type: none"> • Number of audits performed to ensure compliance 	Suppliers survey
Organise strategic review meetings with the supply chain to identify sustainability improvements	<ul style="list-style-type: none"> • Number of review meetings • Number of objectives and actions identified • Number of objectives achieved 	Internal review Suppliers survey

Promote employment of local labour	• % local labour employed by the supply chain	Suppliers survey
------------------------------------	---	------------------

Whilst the performance indicators are specific and relevant to each objective, the tool suggests the use of four possible measurement tools that should be adapted for each objective:

- External audit – some of the objectives should be verified through third party auditors, which can ensure compliance with rules and regulations.
- BIM – most of the objectives linked to the building can be measured through BIM, as it includes information about the building and provides support for the evaluation of different scenarios
- Internal review – most of the information necessary for the evaluation will be available within the organisation through the company’s systems and historical data.
- Survey – surveys should be utilised to gain feedback and information from employees, suppliers, clients and community, asking specific questions about the relevant objectives.

4.2.3 Phase 3 – Strategy map

As the sustainability policy is conveyed from corporate level to FM, it is important to ensure a full alignment of the FM objectives with the direction set at corporate level. Phase 3 is developed to verify the alignment through a strategy map.

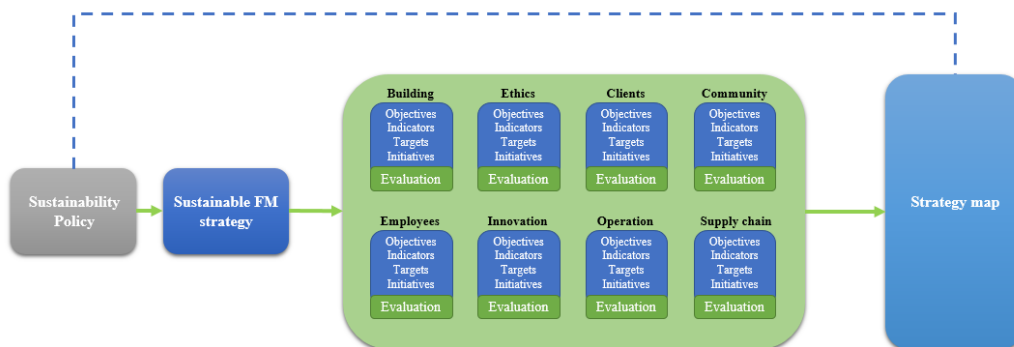


Figure 4-6: Sustainability Performance and Reporting Tool – Strategy Map

The Strategy map is a visual tool which support facilities managers in understanding whether the FM objectives are actually aligned with the direction set in the company's sustainability policy or not. Researchers agree that information can be interpreted rapidly if it is presented well and in a visual manner (Ware, 2012) by using the human visual system in order to provide insight about abstract information (Patterson, Blaha, Grinstein, Liggett, Kaveney, Sheldon, Havig & Moore, 2014). When data are simply presented without a visual representation the task of identify, remember and draw inferences about the information resides with the user whilst the visualisation of data facilitates the human cognitive process and support high-level cognitive functioning such as reasoning and thinking (Patterson et al. 2012). According to Card et al. and the reference model (Mei, Ma, Wei & Chen, 2018) there are different steps that need to be followed whilst creating and manipulating information visualisations:

1. Data transformation - enables to move from raw data into data tables
2. Visual mapping – data are encoded and mapped to visual structures
3. View Transformation – the visual structures are rendered and displayed to users

As measures are effective only if aligned with the core business strategy, each of the objectives included as part of phase 2 of the Sustainability Performance and Reporting Tool are evaluated by the facilities managers in terms of priority and, as part of a strategy map, the objectives are mapped against the goals set in the sustainability policy, following the steps of the reference model. The visual tool that combines the visual mapping was developed to facilitate the analysis of the links between the priorities and the sustainability goals (Figure 4-7).

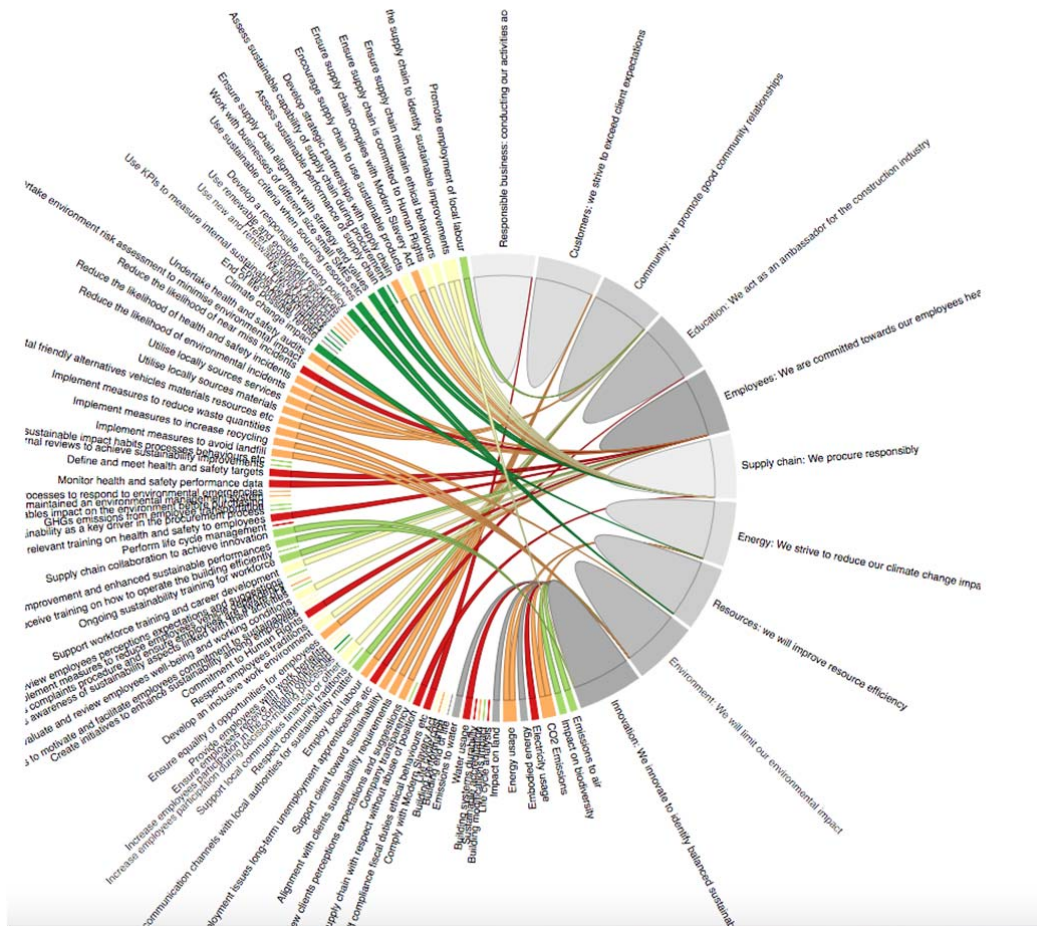


Figure 4-7: Sustainability Performance and Reporting Tool – Strategy Map Graphical Representation

As shown in Figure 4-7, on the top part of the Strategy Map are presented all the goals included in the sustainability policy whilst the FM objectives included in Phase 2 are represented in the remaining part of the wheel. Each of the objective is coloured based on the evaluation completed by the facilities manager: the high priorities are in red, the low priorities in green and in yellow are all the objectives that were indicated as not a priority.

The visualisation of the Strategy Map has a dual purpose as part of the performance evaluation tool: by selecting a single goal (Figure 4-8), it is possible to identify which FM objectives are linked with it as well as their priority and highlight whether facilities managers are following the direction set in the sustainability policy by giving high priority to the right objectives.

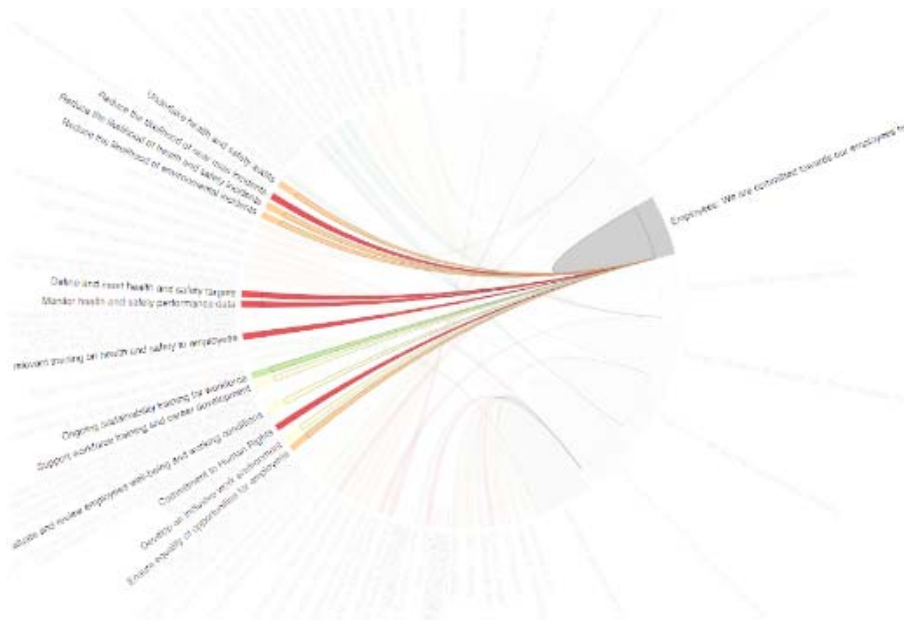


Figure 4-8: Sustainability Performance and Reporting Tool –Strategy Objectives/Goals Correlation

Furthermore, by selecting a single FM objective (Figure 4-9), it is possible to verify whether is linked to any of the corporate goals, and identify objectives that might be considered as high priorities by the facility manager but not linked to any corporate goals or objectives that are considered by FM as not a priority but with direct implications to a corporate goal.

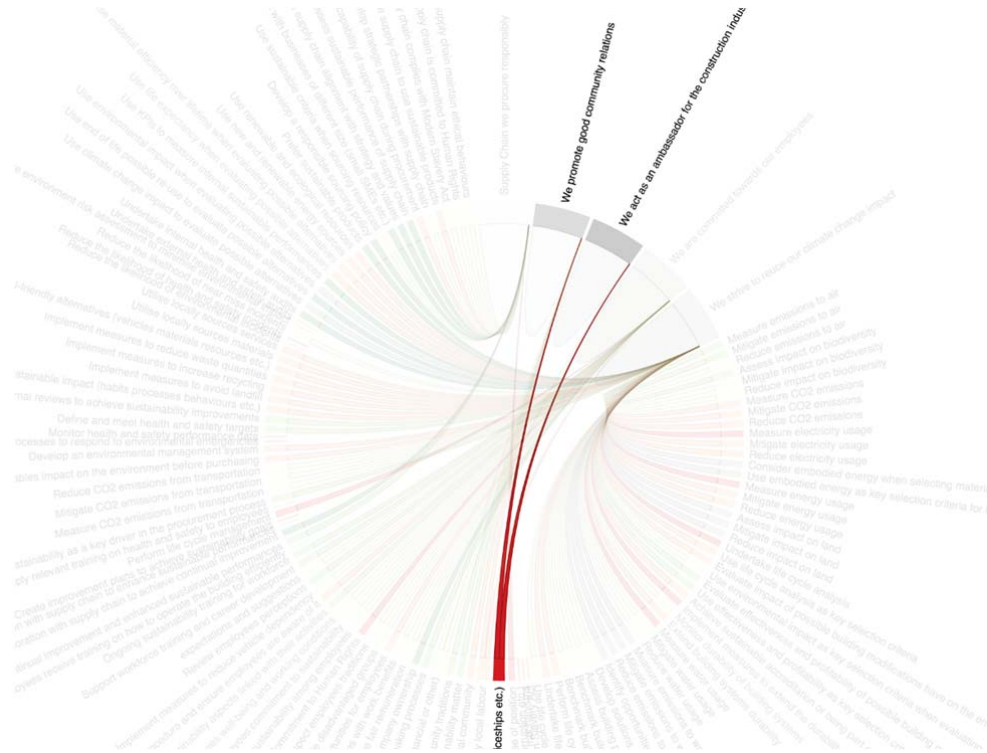


Figure 4-9: Sustainability Performances and Reporting Tool – Strategy Map Goals/Objectives Correlation

The purpose of the graphical representation of the strategy map is to enable the facilities managers to review if the FM objectives identified as high priority are contributing to the company’s goals and whether there is potential to modify the current objectives to better meet the organisation’s guidelines.

4.2.4 Report feedback

The purpose of the tool is not only to support the evaluation of FM sustainability performance but also report whether the results achieved are in line with expectations, and if the FM sustainability strategy can be achieved. Within the tool there are two different report feedback mechanisms. The first one begins at the end of phase 2, after the evaluation of the objectives (Figure 4-10).

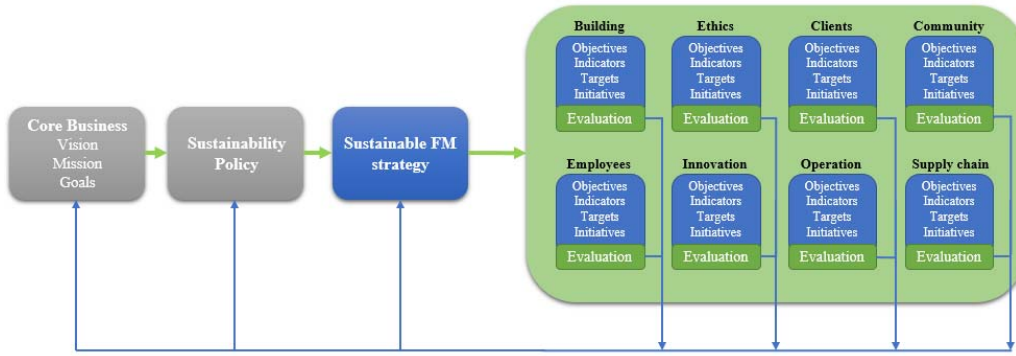


Figure 4-10: Sustainability Performances and Reporting Tool – Phase 2 Feedback

Once the evaluation of the single objectives is concluded, the results should be shared not only within the FM team to review the effectiveness of the FM sustainability strategy, but also at corporate level, to share the performance report and feedback regarding the vision and mission, if goals set have been achieved, or if there is any barrier that prevents their achievement.

The second feedback mechanism is at the end of phase 3 (Figure 4-11) and is used to evaluate the FM sustainability strategy.

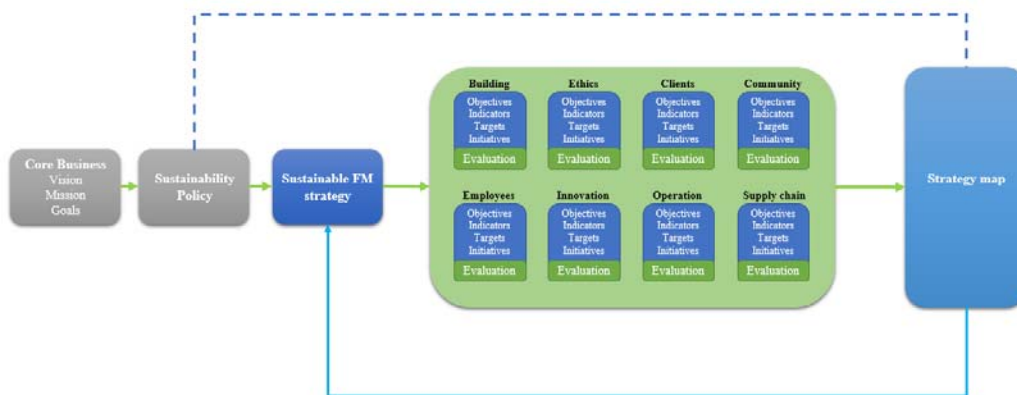


Figure 4-11: Sustainability Performances and Reporting Tool – Phase 3 Feedback

The strategy map provides the opportunity to verify whether the objectives identified by FM support the corporate direction as set in the sustainability policy. If there is a misalignment, the FM sustainability strategy should be reviewed and modified.

4.3 Sustainability performance and reporting tool validation

The validity and usability of the sustainability performance and reporting tool were tested through a questionnaire to understand how professionals would perceive the tool (section 2.4.2.3). At the end of the objective development workshop, the participants (Table 4-5) were asked to rate, using a 5-point agreement Likert scale, the following statements:

- The tool facilitates the implementation of sustainability initiatives.
- The tool is potentially useful.
- The tool is comprehensive and covers all the key areas linked with sustainability in FM.
- The tool is practical to be implemented in the industry.

The reviewers were also asked if they could identify any benefit for using the tool and possible barriers.

All reviewers agreed that the tool facilitates the implementation of sustainability initiatives, and commented as follows:

- “[The tool] seeks to identify initiatives and their importance to an organisation” (reviewer 2).
- “Leadership will be required within the organisation and supply chain to ensure the tool is used effectively” (reviewer 4).
- “[This is a] whole new approach to sustainability of buildings during user occupation” (reviewer 5).

All reviewers also defined the tool as potentially useful:

- “It gives direction and breaks down the stages in order to achieve major sustainability milestones” (reviewer 1).
- “The tool could be used to both facilitate sustainable initiatives and to measure the on-going progress of said initiatives” (reviewer 7).
- “[It is useful] especially to small and medium enterprises” (reviewer 10).

Based on a theoretical evaluation of the tool, 90% of the reviewers agreed that the tool is practical and can be implemented and that there are benefits linked to the implementation of the tool:

- “It gives direction and steps to take in a field which can be quickly overwhelming. As it is a tool that can help to measure non-financial capitals, it could also help companies by providing a pathway towards certain aspects of integrated reporting” (reviewer 1).
- “I do [think there are benefits for implementing the tool] as it encourages organisations to take a systematic view of this subject, looking in detail at a significant number of areas” (reviewer 2).
- “[The tool] clearly shows what is required, where the gaps are and how a company can improve” (reviewer 3).
- “I think there are benefits to the performance of the building ... The reporting and performance of the organisation to show compliance and achievements against corporate responsibility targets” (reviewer 4).
- “This tool provides a more complete approach for providing sustainable buildings” (reviewer 5).
- “It is beneficial for companies to evaluate and channel their policy” (reviewer 9).
- “[This tool] should act as a good checklist and provide direction for the implementation of sustainable initiatives” (reviewer 10).

The reviewers also identified a series of potential barriers to the implementation of the tool:

- “As with all tools, embedding a new one takes time and resources” (reviewer 1).
- “I think there are barriers linked with the organisation’s own maturity and familiarity in these areas” (reviewer 2).
- “Time and knowledge [are barriers]” (reviewer 3).
- “It is very detailed and I feel the limitations on skill sets within the industry and supply chain might limit implementation. A change manage programme,

comprising training for end users, would be required to support implementation” (reviewer 4).

- “[There is] concern regarding the amount of time required to implement the tool” (reviewer 5).
- “Budget and resource allocation [are barriers]” (reviewer 6).
- “I perceive the tool is overly comprehensive and I would feel the need to prioritise and ‘close down’ certain parts” (reviewer 7).
- “Over complication of the tool would put people off” (reviewer 8).
- “It is time-consuming. A person who wants to use the tool has to be an expert in many areas” (reviewer 9).

4.4 Conclusion

The sustainability performance and reporting tool was developed to provide facilities managers with a comprehensive and easy-to-use self-assessment tool that would support the evaluation of sustainability performance and provide metrics to measure improvements. The tool covers a wide range of aspects, which were identified through the interviews (Chapter 3), the analysis of sustainability policies and the workshop (Chapter 4). The output of the validation process confirmed that the tool is useful, practical to be implemented and has the potential to support the development of sustainability initiatives in FM. The tool was designed to allow for the flexibility required to accommodate the needs of different FM teams and building types. The ability to meet different requirements and the applicability of the tool were partially tested through three case studies presented in Chapter 8.

One of the measurement tools included to verify sustainability performance is BIM, which was identified by BIFM (Chapter 3) as an emerging theme affecting sustainable FM. The many benefits of BIM during the different phases of the building life-cycle have been studied by both practitioners and academics, but for building operations and facilities managers, BIM is still a relatively new topic. Its potential is still not fully understood and there is little interest regarding what happens once the building model is completed and handed over, and how BIM will be used to manage the facility, aside from the possible use for enhanced building maintenance. The next

chapter provides an overview on BIM, and Chapter 6 focuses specifically on BIM and FM.

Chapter 5 Building Information Modelling

Technology has played a large role in the construction industry, especially in the last decades, with an ever increasing adoption of IT (Laakso & Kiviniemi, 2012). and different manual processes and industry's practices have already been recognised as being replace by IT since early 2000 (Mitropoulos & Tatum, 2000). In 1973, the first 3D design tools were produced that allowed designers to create, manipulate and edit solid 3D models of building entities (Eastman, Sacks, Sacks, & Liston, 2011). In the early 1980s, 3D modelling morphed into the first computer aided design (CAD) systems that linked digital designs to construction documents and facilitated the first real-time electronic communication between the different stakeholders involved in a construction project (Eastman et al., 2011). In the early 1990s, object-oriented CAD (OOCAD) was developed, which linked building graphics with non-graphical data about common building elements (e.g. doors, walls, windows), thus simplifying building section drawings (Autodesk, n.d.). Since the early 2000s CAD developed into BIM, which includes different dimensions to the model (time, cost, energy, etc.) by utilising parametric sub-models (Barnes, 2013).

The BIM acronym is attributed to Jerry Lassarini (Turk, 2016), and there are a multitude of different definitions of BIM:

- “Building information modelling is a digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it and forming a reliable basis for decisions during its life cycle, from earliest conception to demolition” (RICS, 2015).
- “A ‘building information model’ is a digital representation of the building, from which views and data appropriate to various users’ needs can be extracted and analysed to generate information that can be used to make decisions and improve both the process of delivering the building and the entire life-cycle use of the building” (Barnes, 2013).
- “BIM: building construction information model is a shared digital representation of physical and functional characteristics of a built object (including buildings, bridges, roads, etc.) which forms a reliable basis for decisions” (International Organization for Standardization, 2010).

- “[BIM is a] digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward. A basic premise of BIM is collaboration by different stakeholders at different phases of the lifecycle of a facility to insert, extract, update, or modify information in the BIM to support and reflect the roles of that stakeholder. The BIM is a shared digital representation founded on open standards for interoperability” (BuildingSMARTalliance, 2007)

Although an official BIM definition does not exist, as shown in the examples provided, all definitions encompass three key elements (RICS, 2015): the BIM model, the process of developing the model and the different uses of the model.

5.1 The BIM model

BIM is an information and communication technology (ICT) based on CAD principles. Yet whilst CAD supports the development of a coordination-based geometric model, BIM can be used to create “intelligent” models, which include an object-oriented representation of the project (Barnes, 2013). Each object in a model can be described by two different sets of information:

- attributes and properties about the objects such as materials, specification, thermal performances, acoustic performance, fire rating, U-value, etc.; and
- the relationship between the objects in the model.

The ability to include attributes and properties into the model allows for series of analysis and evaluation that are not possible through CAD only, enabling a more efficient and effective management of building information (Succar, 2009).

Moreover, whilst CAD uses geometric entities (points, lines, planes, etc.) to represents data and does not capture information about the single objects, BIM has the ability to include not only the object representation and the information linked with it, but also the relationships between the different objects within the model. Thus BIM is considered to be a technical advance on traditional CAD (Miettinen & Paavola, 2014). Within a BIM model, each element adjusts automatically if a related element is

modified (Figure 5-1), and the element's associativity is a defining feature of a BIM model (Barnes, 2013). The object representation in a BIM model can be used to extract information based on the items' relationship – for example, it is possible to extract the information related to a specific room, identified by walls, ceilings and floors, and use the information about the space to run analysis such as energy performance.

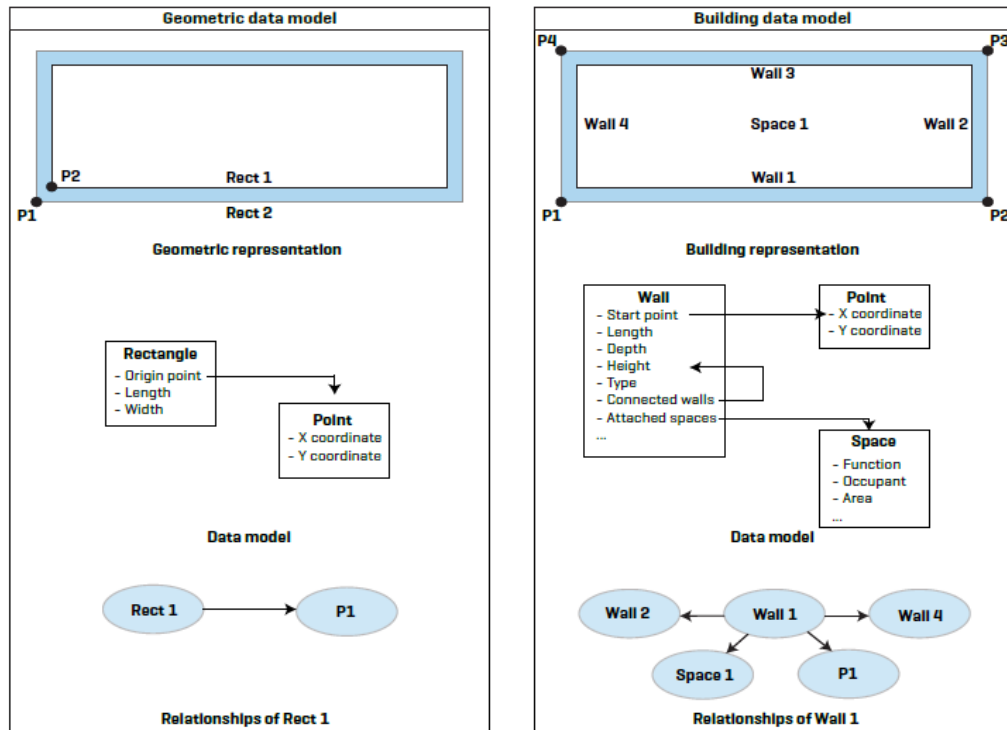


Figure 5-1: Representation of Objects in BIM (RICS, 2015)

Ideally, each project should utilise a single model that develops together with the building stages and supports collaboration and coordination between the different parties involved, providing information and knowledge to support decision-making during design, engineering, construction and operations (Chen, Lu, Peng, Rowlinson, & Huang, 2015). Consequently, another key element that defines BIM is the process that underpins how the information is collected, managed and used, and defines how the models should be developed.

5.2 Developing a building information model

Although the technology behind BIM has been available for over a decade (RICS, 2015) the “BIM age” only started between 2005 and 2008 when BIM started to become a popular topic in the industry and among researchers (Sacks & Barak, 2010). In the UK, BIM awareness and adoption has been significantly influenced by the UK Government Construction Strategy (SmartMarket Report, 2014) published in May 2011. Created in collaboration with construction industry stakeholders, the strategy aimed at improving the growth of British businesses and at putting “Britain at the forefront of global construction over the coming years” (HM Government, 2013). As part of the strategy, the Government envisioned the use BIM as a mean to achieve “significant improvements in cost, value and carbon performance through the use of open sharable asset information” (HM Government, 2013), and as part of the strategy mandated the delivery of BIM Level 2 for all centrally procured Government projects from April 2016.

The level definitions were developed in 2008 by Mervyn Richards and Mark Bew as part of the BIM Maturity Diagram, as shown in Figure 5-2.

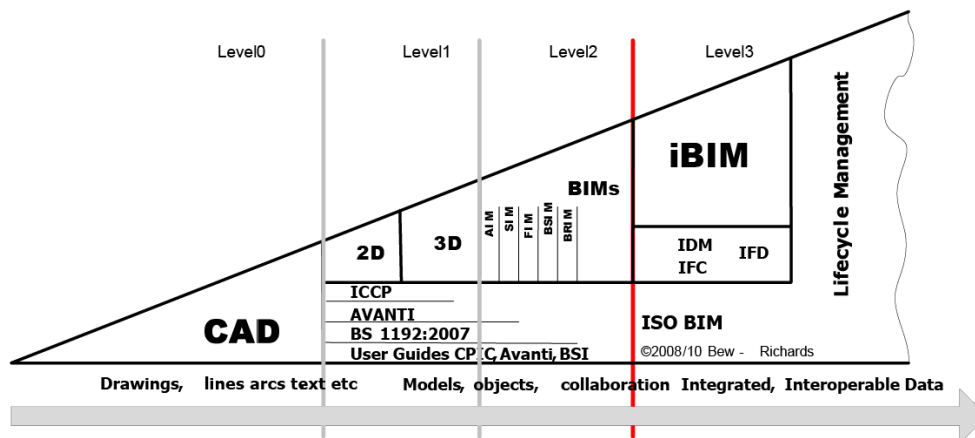


Figure 5-2: BIM Maturity Diagram (BSI, 2013)

The BIM Maturity Diagram (BSI, 2013) explains the level of collaboration achieved and the tools and techniques utilised at the different levels of maturity. Level 0 BIM is effectively unmanaged CAD with minimal automated data exchange, where paper or electronic prints are used as an exchange mechanism. Level 1 BIM envisages a

managed environment where 2D or 3D CAD drawings provide a common data environment that has possibly some standard data structures and formats but which supports little integration outside the dedicated application. Many organisations are currently operating at this level (NBS, 2017a). Level 2 BIM seeks to integrate the 3D environment with external tools and data. The relationship between data is generally managed through an enterprise resource planning system but not necessarily through a single shared model. Essentially, this level is a practical realisation of the OOCAD models developed in the 1990s. Level 3 will fully support data integration through web services, achieving the creation of a single full collaborative model.

To achieve BIM Level 2, the UK Government and different UK construction professional bodies have created standards and guides to support the creation and use of information models.

5.2.1 The eight pillars of BIM

To realise the potential of BIM, it is important that the use of technology to create the model is supported by a systematic approach and a clear definition of goals, roles, responsibilities, process and outcomes. In the recent years, a series of documents has been published by different bodies to provide guidance to and support for the BIM process during the different stages of the building life-cycle. Among them, the following are considered the eight pillars of BIM, and provide definitions of the context, processes, conventions, contractual arrangements and roles required to achieve Level 2 (Eynon, 2016):

- PAS 1192-2:2013
- PAS 1192-3:2014
- BS 1192-4:2014
- PAS 1192-5:2015
- BIM Protocol
- Soft landings
- Classification
- Digital plan of works

PAS 1192

PAS 1192 comprises seven different parts, five published and two due to be published in 2018, which originated from the British Standard (BS) 1192 “Collaborative production of architectural, engineering and construction information. Code of practice.” When first created, the BS was not envisioned to support the creation of information models, but to provide a framework for managing information. Originally dated 1998, and then updated in 2007, the standard has as main focus construction information and presents a methodology to manage the production, distribution and quality of the information. After the advent of BIM and Government mandate, the PAS was divided in different sections, covering the key aspects of the creation and maintenance of the model.

In order to create a data-rich model, the British Standards Institution (BSI) published in 2013 the Publicly Available Specification (PAS) 1192 Part 2 “Specification for information for the capital/delivery phase of construction projects using building information modelling” (BSI, 2013). PAS 1192-2 determines a set of standards needed to meet the BIM Level 2 requirements for new constructions or refurbishments and ensure a collaborative digital environment. Through the various stages of the information delivery cycle (Figure 5-3), the PAS 1192-2 provides a framework for the creation and development of an information model that results, after the project handover, in the delivery of the as-constructed asset information model (AIM).

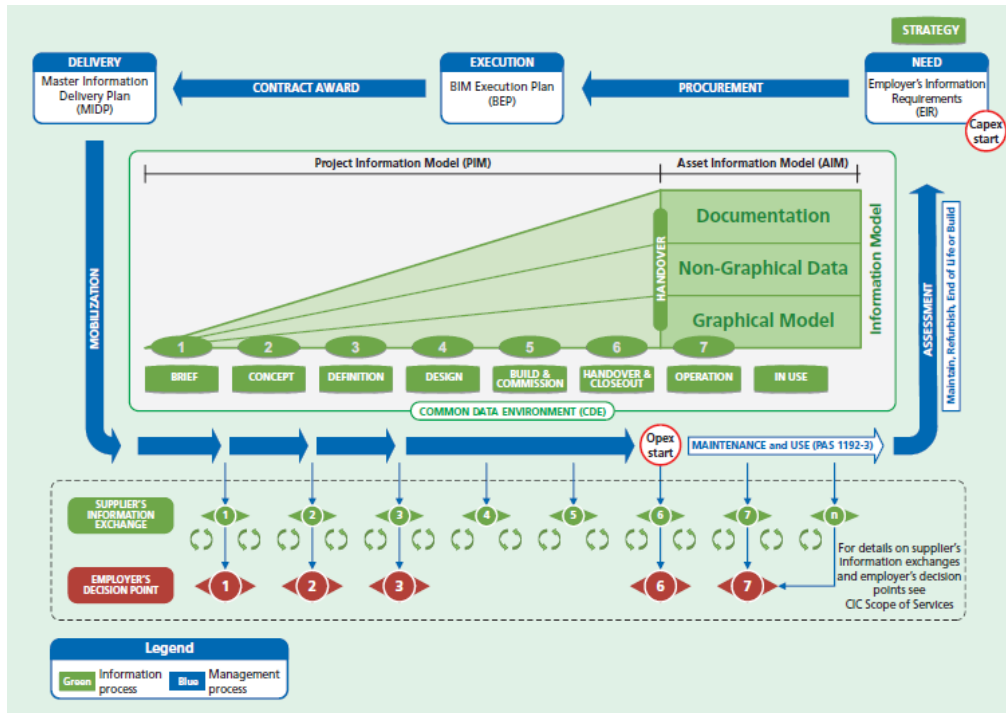


Figure 5-3: The Information Delivery Cycle (BSI, 2013)

Information within the model grows as the project moves from stage 1 (brief) to stage 6 (handover and closeout), and is based on the Employer’s Information Requirements (EIR) identified at the beginning of the process. PAS 1192-2 was used as basis for the international BIM standard ISO 19650 “Organisation of information about construction works – Information management using building information modelling,” due to be published in 2018.

During the operational phase, analysed in the PAS 1192 Part 3 “Specification for information management for the operational phase of construction projects using building information modelling” (BSI, 2014b), the AIM evolves according to the events (e.g. major and minor works, breakdowns, transfer ownership) that occur while the building is in use (Figure 5-4), enabling access to structured and consistent information during the operational phase. The standard also identifies the relationship between the key elements of information management: organisational information requirements, asset information requirements, AIM, employer’s information requirements and project information model.

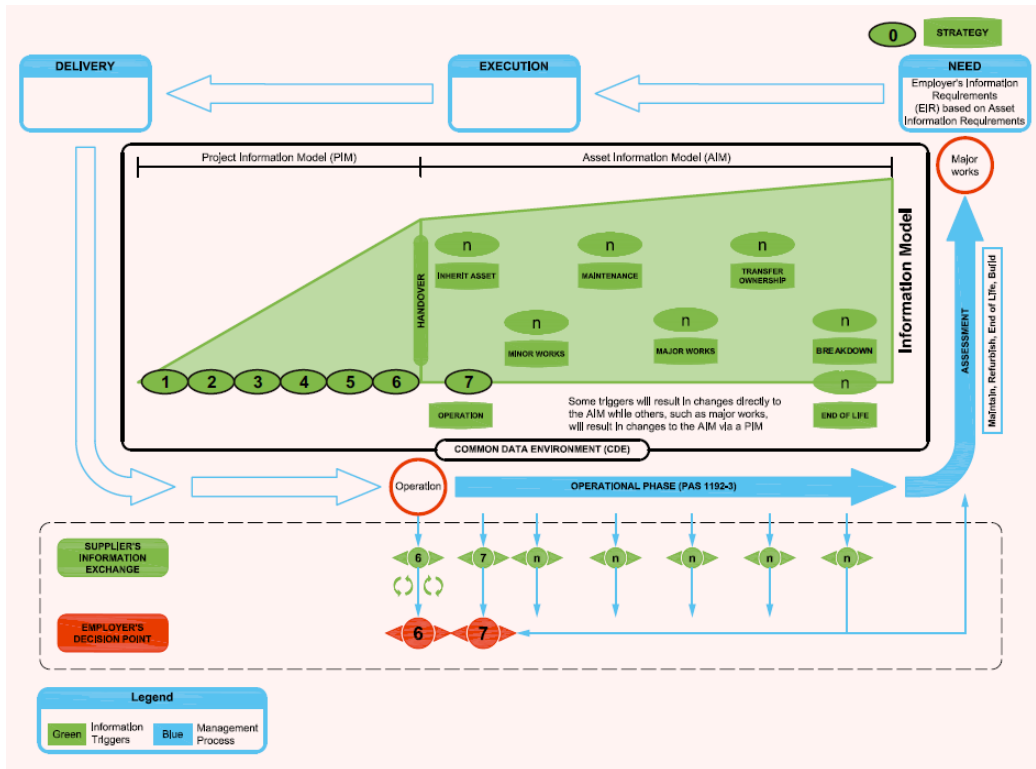


Figure 5-4: Information Delivery Cycle for Asset Management (BSI, 2014)

BSI192 Part 4 is “Collaborative production of information. Fulfilling employer’s information exchange requirements using COBie.” The code of practice presents the methodology for information exchange through the life-cycle of a facility (BSI, 2014a) through COBie, an information exchange schema that contains structured content related to the model.

The final published document of the PAS 1192 suite is Part 5 “Specification for security-minded building information modelling, digital built environments and smart asset management” (BSI, 2015). As BIM supports the collaboration between parties and information sharing, the document specifies the processes that companies should follow to implement measures to reduce the risk linked with loss, disclosure of information and cybersecurity.

In 2018, the BSI will publish PAS 1192-6 “Specification for collaborative sharing and use of structured hazard and risk information for Health and Safety” and PAS 1192-7

“Specification for defining and sharing structured digital construction produce information.”

BIM Protocol

The BIM Protocol is a supplementary contract agreement created by the Construction Industry Council (CIC), which identifies obligations and rights of all parties involved in a BIM project and can be integrated with all forms of contracts currently used in the construction industry. The Protocol should be incorporated into the professional services appointments and identifies “the Building Information Models that are required to be produced by members of the Project Team and puts into place specific obligations, liabilities and associated limitations on the use of the models” (Construction Industry Council, 2013).

Soft landings

A soft landing is a process that ensures a complete alignment between design and construction expectation and the performance of the asset during operation. Soft landings aim at achieving alignment between procurers, constructors and designers with users and operators, as defined on the BIM Task Group website (BIM task Group, n.d.) by:

1. Engaging with end users throughout design and delivery process.
2. Setting clear targets and measures:
 - for functionality and effectiveness, so that the working environment is conducive to productivity and social wellbeing;
 - for operational and capital costs, to reduce costs in construction and operation;
 - for environmental performance, to meet carbon and other sustainability targets;
 - to commission the facility with the inclusion of training in partnership with end users;
 - to assess performance for at least three years post completion to establish outcomes and lessons learnt; and

- o to involve the design team in the early operating phase to tune performance and ensure target outcomes.

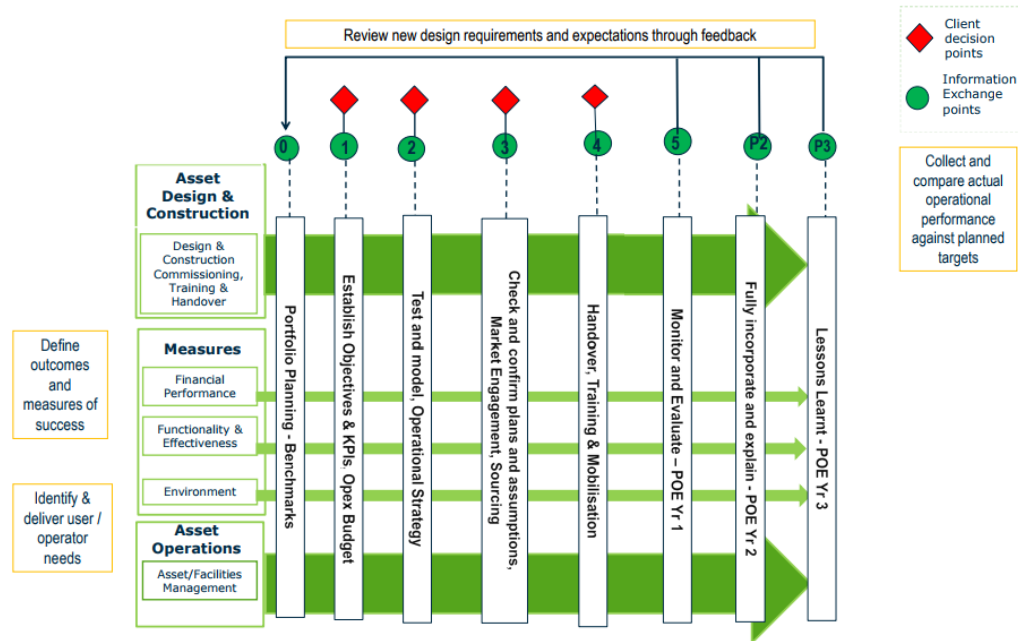


Figure 5-5: Soft Landing Process Map (NBS, 2013)

Once the building is complete, soft landings ensure that designers and contractors remain involved in the construction project beyond construction completion to ensure a smooth handover and verify, through feedback and post occupancy evaluation, that the building operates as designed and all the parties involved during operations (client, users, FMs, etc.) know how to use it to achieve optimum performances (Figure 5-5).

Classification

Owing to the quantity of data included in a model, classification is a key element that needs to be defined at the beginning of each project in order to achieve structured and effective information management. In the UK, Uniclass2015 is the classification utilised by the construction industry, which covers buildings, landscape and infrastructure through a hierarchical suite of tables.

Digital plan of work

The digital plan of work identifies the different stages of a construction project, providing details of the tasks and the outputs of the different stages. As shown in the information delivery cycle (Figure 5-3), supplier's information is exchanged at the end of each construction stage and the digital plan of work identifies the plan of work stages, the level of details of the information required and the uses.

5.3 BIM uses

The third and final element of the BIM definition are the possible uses of information models. A BIM use defines how BIM can be used to achieve specific objectives. Although BIM can be used for single, different activities during a building life-cycle, the BIM uses are not linked with a single phase (Kreider & Messner, 2013). The classification of BIM uses, according to Kreider and Messner (2013), can be divided in five categories and 18 subcategories:

- **Gather** – Collect or organise facility information.
- **Capture** – Represent or preserve the current status of the facility and facility elements.
- **Quantify** – Express or measure the amount of a facility element.
- **Monitor** – Collect information regarding the performance of facility elements and systems.
- **Qualify** – Characterise or identify the status of facility elements.
- **Generate** – Create or author information about the facility.
- **Prescribe** – Determine the need for and select specific facility elements.
- **Arrange** – Determine location and placement of facility elements.
- **Size** – Determine the magnitude and scale of facility elements.
- **Analyse** – Examine elements of the facility to gain a better understanding of them.
- **Coordinate** – Ensure the efficiency and harmony of the relationship of facility elements.
- **Forecast** – Predict the future performance of the facility and facility elements.

- **Validate** – Check or prove accuracy of facility information and ensure that is logical and reasonable.
- **Communicate** – Present information about the facility in a method in which it can be shared or exchanged.
- **Visualise** – Form a realistic representation of a facility or facility elements.
- **Transform** – Modify information and translate it to be received by another process.
- **Draw** – Make a symbolic representation of the facility and facility elements.
- **Document** – Create a record of facility information including the information necessary to precisely specify facility elements.
- **Realise** – Make or control a physical element using facility information.
- **Fabricate** – Use facility information to manufacture the elements of a facility.
- **Assemble** – Use facility information to bring together the separate elements of a facility.
- **Control** – Use facility information to physically manipulate the operation of executing equipment.
- **Regulate** – Use facility information to inform the operation of a facility element.

BIM different uses can easily accommodate the different users' needs and support several activities through the different stages of a building life-cycle, as shown in Table 5-1.

Table 5-1: BIM Activities at Different Life-Cycle Stages (RICS, 2015)

Strategic definition Preparation and brief Concept design Developed design Technical design	3D sketching and form generation Massing Spatial programming Sustainability studies Project budget Identify key modelling elements Existing conditions e.g. as-built models Disciplinary models Federated models Time and cost dimensions Sustainability information Model extraction for design and analysis Preliminary design coordination Detailed modelling, integration and analysis Project procurement documentation Detailed design coordination
Construction	Phasing and prototyping Quantity extraction Specifications Fabrication models Contract administration Collect as-built information
Handover and close out	As-built models Validation and testing Integration with facilities management systems
In use	Integration BMS Integration with monitoring systems

5.3.1 BIM applications during design

The ability to digital represent objects and transfer data between multidisciplinary teams have made BIM a preferred choice for many design practices (Ghaffarianhoseini, Tookey, Ghaffarianhoseini, Naismith, Azhar, Efimova & Raahemifar, 2017). During the design stage, BIM can be used for three main activities: assist in the development of the design, conduct design analysis and develop construction-level information (Eastman et al., 2011). Most of the BIM software currently available on the market supports the creation of the model from the sketching phase, where ideas are quickly generated and assessed against each other. As the model develops over time (Figure 5-6), moving from the schematic design stage to the design development stage, BIM can be used to do some key assessments such as circulation and security, energy analysis and preliminary cost estimate. Once details about the building's systems are included, the model can then be used to verify compliance with structural, environmental, water and power distribution and fire

requirements, both in terms of legislative requirements and client’s requirements for the building through the model visualisation and the analysis of the functional spaces.


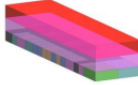

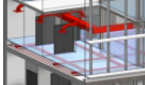

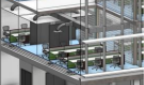
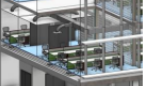
RIBA Work Stages						
1	2	3	4	5	6	7
Preparation	Concept Design	Developed Design	Technical Design	Specialist Design	Construction	Use & Aftercare
The Initial Project Brief	The Concept Design including Outline Structural and Mechanical Services Design, associated Design Strategies, Preliminary Cost Information and Final Project Brief.	The Developed Design including the Co-ordinated Architectural, Structural and Mechanical Services Design and Developed Cost Information.	The Technical Design of consultants agrees in sufficient detail to enable construction or Performance Specified Work to commence.	The Specialist Design including the integration of Performance Specified Work.	"As Constructed" Information.	"As constructed" Information updated in response to on-going client feedback, Asset Management updates and Facilities Management Information.
						

Figure 5-6: BIM Development through RIBA Stages (RIBA, 2013)

As the design reaches more advance stages and different consultants are involved in the project, the model can be used to extract the relevant information to be shared with the stakeholders. As each involved in the project would develop their own model, BIM is used to transfer data and specifications between multidisciplinary software (Ghaffarianhoseini et al., 2017) and to identify any possible clashes between the different models by creating a federated model that highlights any design issue, possible errors and omissions together with possible conflicts and constructability problems.

BIM is also a powerful tool used to support the decision-making process and the evaluation of possible alternatives that have, in particular during the early stages of the project, a greater impact on the effectiveness and lower costs, as shown in the MacLeamy curve (Figure 5-7) (Eastman et al., 2011).

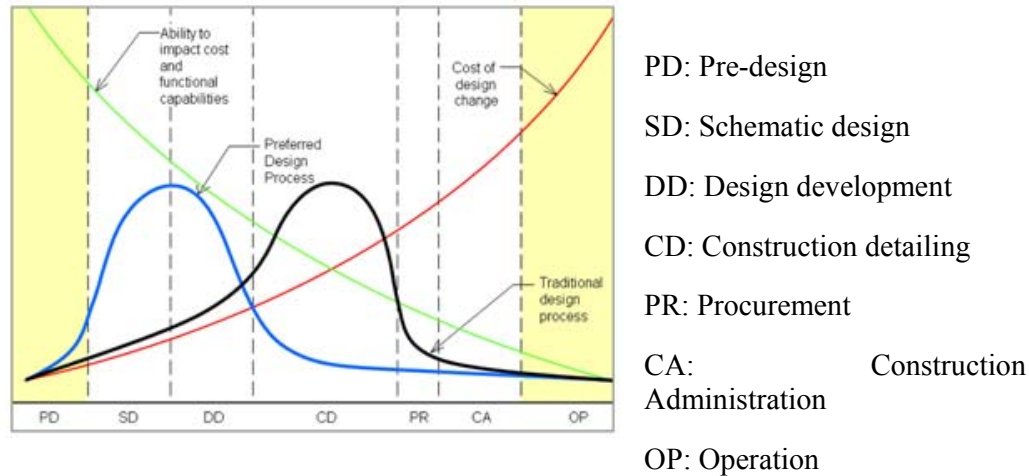


Figure 5-7: MacLeamy Curve (Eastman et al., 2011)

The curve shows how decisions made during the early design stages have a direct impact on the functionality and costs of a building project compared to a traditional design stage (Eastman et al., 2011). The red curve represents how the cost of changes increases by moving from the earlier stages towards construction and operation whilst the effectiveness of those changes (green line) decreases as the project develops. In the traditional design process (black curve), changes are made when the effectiveness is lower and the cost of changes higher, while in a preferred design process (blue curve), the decision process is complete before the construction documentation phase, when the effectiveness of the decisions is higher and the cost is lower. To achieve the blue curve, a “shift of effort” (Light, 2011) is needed and information needs to be available during the first stages of the project, then BIM can support the shift. The collaboration between designers, constructors, installers, fabricators, suppliers and facilities managers (The American Institute of Architects, 2007) and the ability of BIM to model and simulate a project right from the earlier stages of the design enables the identification of the optimum project solutions at a stage at which the effectiveness of the changes is still high and the cost for design changes is low.

5.3.2 BIM applications during construction

Before starting working on site, BIM can be used for phasing and communication (Kymmell, 2008), providing details on a day-to-day basis on how the site will work and identifying any potential problems or risks, such as health and safety hazards, equipment on site, etc. The model also provides a detailed schedule of activities and

can be used to support lean construction techniques and identify possible uses for prefabricated components.

Once the design stage is complete, the model includes accurate quantities and specifications of the project and can be used for procuring contractors, subcontractors and suppliers (Irizarry, Karan, & Jalaei, 2013). Lastly, the model can be used to analyse the impact that design changes that occur during construction would have on the overall project and on the different disciplines designs.

5.3.3 BIM applications during operations

A fully populated model handed over at the beginning of the operational phase would act as a unique source of data during operations. Becerik-Gerber, Jazizadeh, Li and Calis (2012) identify several possible application areas of BIM for FM:

- locating building components;
- facilitating real-time data access;
- visualisation and marketing;
- checking maintainability;
- creating and updating digital assets;
- space management;
- planning and feasibility studies for noncapital construction;
- emergency management;
- controlling and monitoring energy; and
- personnel training and development.

According to IFMA (2013), the main benefits of an integration of BIM and FM are:

- reduced costs: accurate and complete data ready for use when the building is completed, and lowers data capture and operations and maintenance costs;
- improved performance: more complete and accessible FM data allows faster analysis and correction of problems and fewer breakdowns, supporting happier and more productive users; and

- integrated systems: data from BIM integrates with Computerised Maintenance Management System (CCMS), Computer-aided facility management (CAFM), Building Automation System (BAS), updated over the life of a building.

As the focus for BIM remains on design and construction, the issue with FM is that the research focuses on managing newly built buildings with available information models rather than creating information models for existing buildings, which limits the applicability of BIM for FM (Volk et al., 2014).

5.4 Benefits of implementing BIM

Since 2016, the UK Government has mandated BIM for publicly procured projects in order to achieve the vision set for the construction industry for 2025 (HM Government, 2013). The UK Government identified in BIM a tool that would support the delivery of more sustainable buildings, more quickly and more efficiently. Based on the latest NBS BIM Report (2017b), the industry agrees that BIM is helping in achieving the targets, in particular regarding cost and time reduction (Figure 5-8)

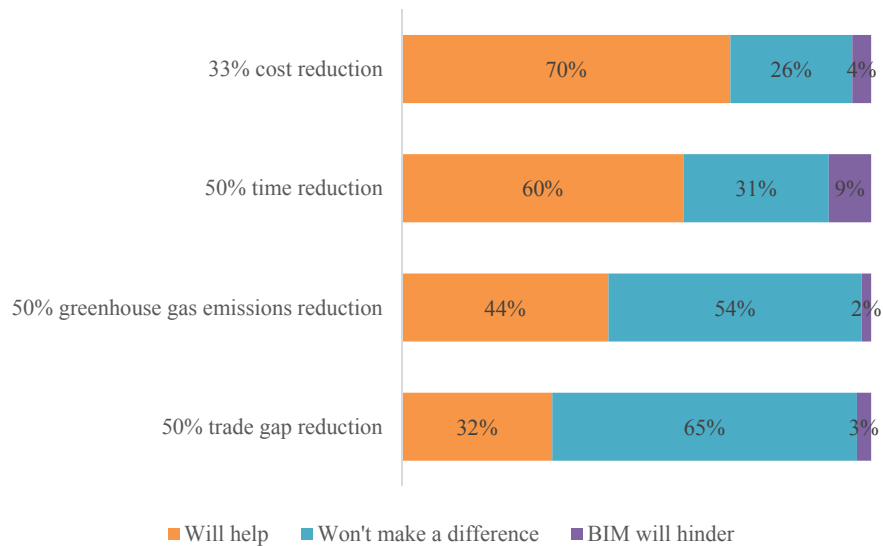


Figure 5-8: Construction Industry View on Support Provided by BIM towards Industry Targets (NBS, 2017b)

The time and economic benefits of implementing BIM have also been confirmed by different researchers (Lee, Park, & Won, 2012).

The three key elements of the BIM definition – the model, the developing process and the uses – ensure the availability of information at different stages of the building life-cycle, which is used for key decisions and allow for the development of a project in time, on cost and in line with the client’s expectations. The different parties work collaboratively using a common data environment, following the process described in PAS 1192-2, which directly minimises the amount of miscommunication and misalignment between the different disciplines, reducing the amount of rework generally needed during projects. Moreover, BIM is encouraging the industry to think beyond the practical completion of buildings and embrace a more life-cycle approach by including FM needs and requirements into the design and in the output.

5.5 BIM adoption in the UK

Although utilising BIM for a construction project has several potential benefits, BIM is still fairly new in the construction industry. Moreover, although the implementation rate is constantly increasing, currently BIM is not part of the construction practice (Jung & Joo, 2011).

The National Building Specification (NBS) every year releases a BIM report, which provides an insight into the current use and awareness on BIM in the UK. The latest edition of the BIM Report (NBS, 2017b) shows how the awareness and usage of BIM have increased over the past seven years (Figure 5-9).

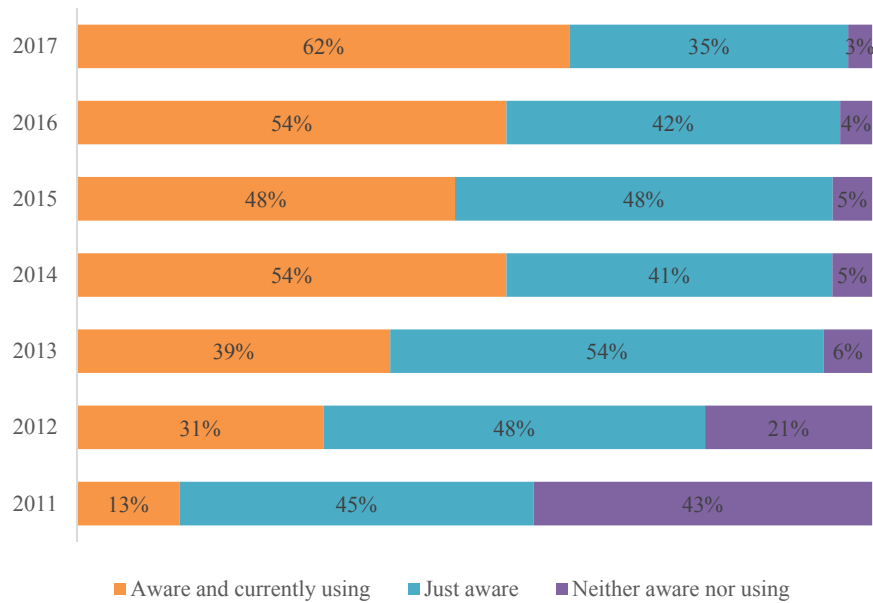


Figure 5-9: Construction Industry: BIM Awareness and Use (NBS, 2017b)

In 2011, only 13% of the participants were using BIM, compared to the 62% in 2017, whilst the percentage of respondents that were not aware of nor using BIM reduced from 43% to 3%. The report also shows that 96% of the respondents are expecting to use BIM for their projects within the next five years.

Although the industry awareness and use of BIM have grown in the last years, some of the responses highlight how the industry still does not fully understand BIM, its potential and its uses, as shown in Figure 5-10.

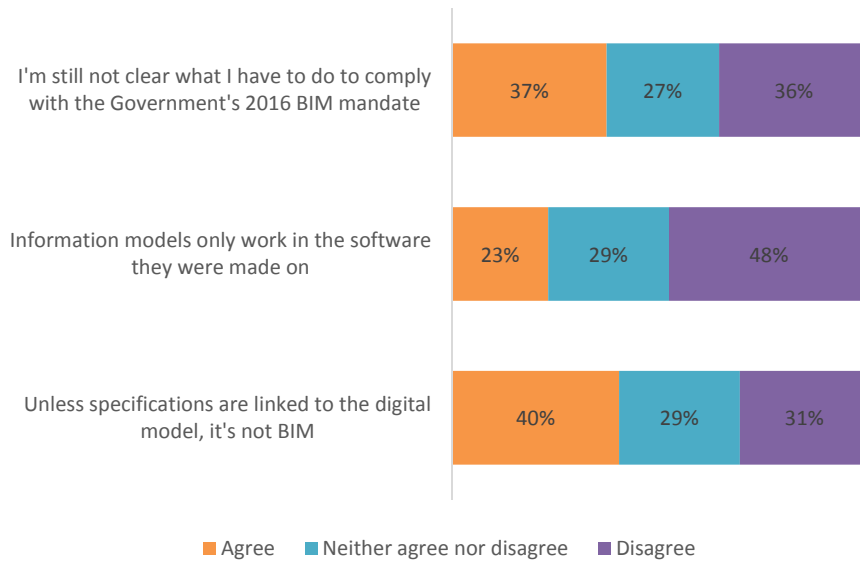


Figure 5-10: Construction Industry: Understanding of BIM (NBS, 2017b)

Over a third (37%) of the respondents are not clear on what to do to comply with the Government mandate, whilst 23% indicated that information models only work in the software in which they were made. Lastly, the final question confirms how the construction industry does not have a distinction between BIM and 3D models.

Moreover, 7% of the participants stated that their organisation achieved Level 3 BIM on projects: as BIM Level 3 has not been defined or standardised, it is possible that the respondents are either going beyond the requirements of Level 2 or have not clear conceptions of the different BIM maturity levels.

The report also shows that although the Government and industry bodies produced a series of formal standards, the industry perception is that BIM is not yet sufficiently standardised. At the same time, there is resistance towards the standards and publications available. BS 1192:2007 and PAS 1192-2:2013 are the most used among the standards or publications, but the percentage of use does not go beyond 40% with, only 11% of the respondents utilising soft landings (Figure 5-11).

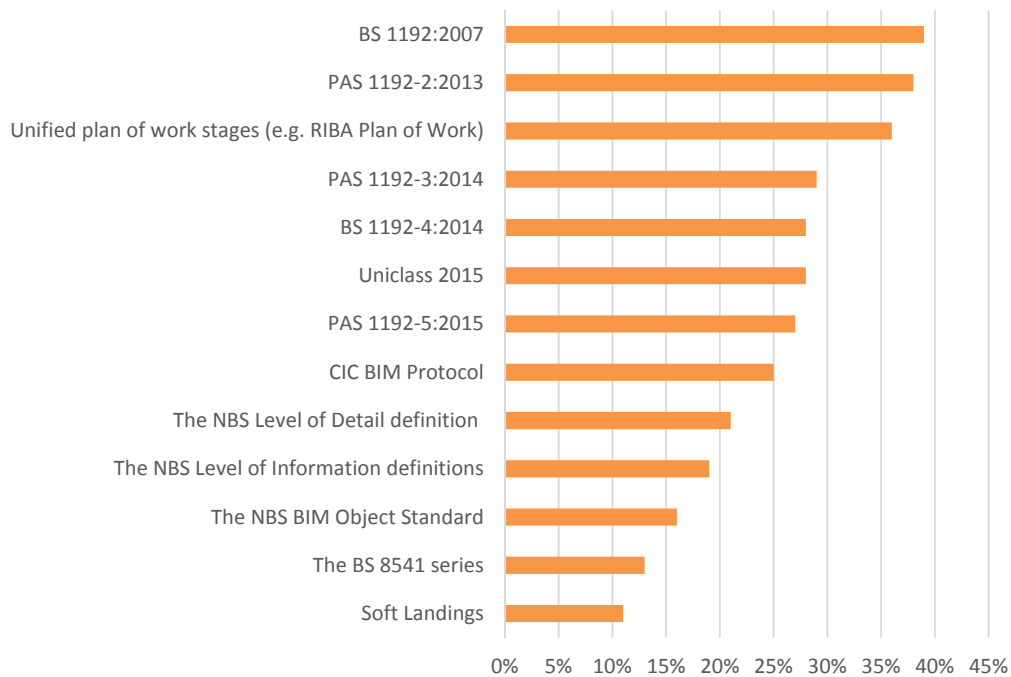


Figure 5-11: Overview of BIM Standards and Publications Utilised by the Construction Industry (NBS, 2017b)

The comparison between the use of standards and publications and the respondents' awareness and use of BIM (Figure 5-9) show that most of the respondents who are aware of and use BIM are not implementing the procedures created by the UK Government and industry bodies. As BIM is based on collaboration and information sharing between different parties, standards should always be agreed upon and used to define processes and structures, otherwise the industry will not move beyond BIM Level 0 or 1 and fully benefit from BIM.

5.6 Resistance to BIM adoption

As discussed, the potential uses of BIM for a construction project are numerous and the awareness and use of BIM have grown in the past years (Figure 5-9). However, there are a series of challenges and risks that are currently slowing BIM uptake.

5.6.1 Limited investment in technology

Despite the integral role played by technology in the construction industry for the past 40 years, compared to other industries, the investment in technology has been quite limited (Figure 5-12).

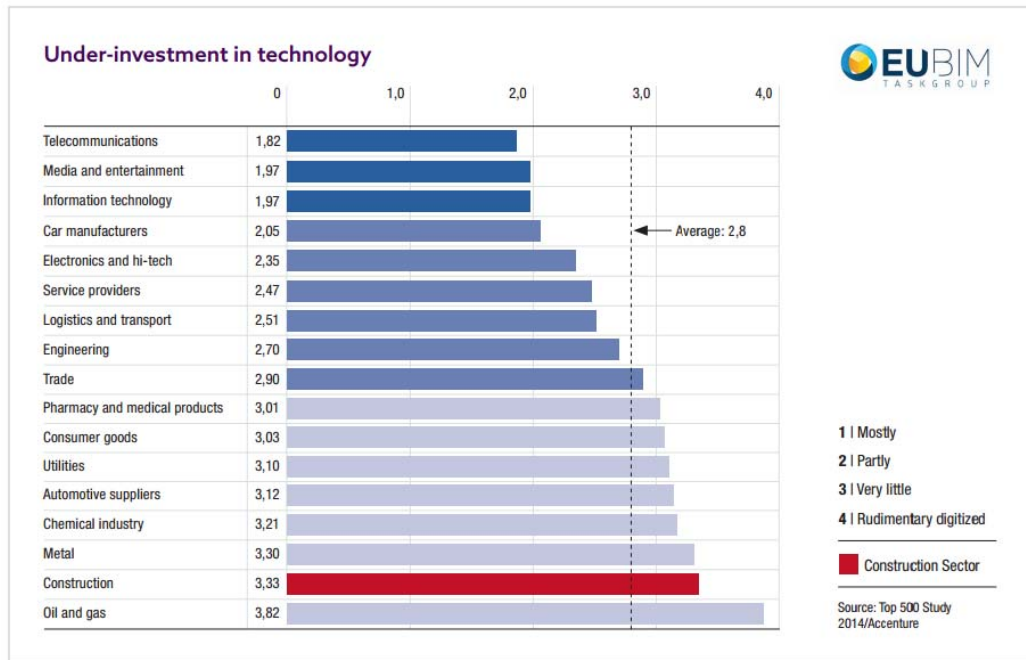


Figure 5-12: Construction Industry Investment in Technology Compared to Other Industries (NBS, 2016b)

BIM is a process underpinned by a technology, hence there is a necessary cost linked with acquiring software, hardware and provide staff training (Elmualim & Gilder, 2014). Owing to the complex project-based nature of the industry and the domination of small and medium enterprises (Elmualim & Gilder, 2014), many companies might not see the benefit in making the investment, causing a market inequality between small and large companies (Ghaffarianhoseini et al., 2017). Moreover, as the BIM initiative has as its main driver the Government mandate, there is a risk that the private sector uptake will be slower or reduced compared to the public sector.

5.6.2 BIM interoperability issue

The construction industry is characterised by a lack of unified standards and mechanisms that allow for the integration of information produced and utilised by different disciplines (Juan & Z heng, 2014). Furthermore, the fragmented nature of the industry has led the different professionals involved in a construction project to develop separate and independent tools (Walasek & Barszcz, 2017). As BIM is based on collaboration, information sharing and exchange are vital for the success of any BIM project. Yet although there is a growing interest in Open BIM standards, which were developed with the concept that models and information should be exchangeable independently from a specific software or format, for example Industry Foundation Classes (IFC), there are problems regarding accuracy and precision of models exchanged between the different disciplines (Yousefzadeh, Spillane, Lamont, McFadden, & Lim, 2015) but the industry is developing standards to assist the process (Lee et al., 2012).

As part of the BIM mandate, the UK Government decided to demand the use of COBie, avoiding prescribing any type of proprietary file format and therefore imposing the use of specific software. COBie is a subset of the IFC, a data standard developed by buildingSMART alliance, which is likely to be integrated into Digital Built Britain (NBS, 2012), the BIM Level 3 strategy.

5.6.3 BIM client's needs and user requirements

PAS 1192-2 specifies that the client's needs should be defined and included into the Employer's Information Requirements (EIR) at the beginning of any construction project. As described in PAS 1192-2, one of the "fundamental principle of level 2 information modelling is the provision of a clear EIR, [...] [which is a] pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process." The EIR should be included into the tender documentation to ensure all the appointed parties have a clear understanding of what the client is requesting and what they are expected to deliver and when. Without a structured and clear definition of the client's needs, the outputs of the BIM project are not clear to the different parties and there might be a misalignment with the client's requirements.

5.6.4 BIM training and new roles

Moreover, as the BIM process is different from the traditional workflow, there is also the need for a structured approach that provides a clear understanding of requirements, responsibilities and outcomes. The approach should be applied from inception to operations and, in order to achieve all the BIM benefits and full collaboration, all the parties involved in the construction project need to be engaged in the process.

5.6.5 BIM legal issues

As the model is shared among different teams/companies to include information and achieve collaboration, there are often concerns about the intellectual property of the model and the model items, together with the risk of unauthorised accesses to the information and copyright infringement (Chien, Wu, & Huang, 2014). Owing to the collaborative nature of BIM, there are also grey areas in term of level of responsibilities of the different members involved in each project (Azhar, Khalfan, & Maqsood, 2015). Accuracy is a key risk in the development of the model and responsibility and accuracy need to be clearly stated and agreed upon during the procurement phase of the project to avoid claims (Olatunji, 2011). New forms of contract that include BIM are needed to cover any legal aspect linked with the model.

Chapter 6 Building Information Modelling and Facilities Management

BIM is a technical evolution of CAD that supports not only the physical representation of any built object but also its functional characteristics. Following the BIM mandate in 2016 by the UK Government, the awareness and use of BIM have grown across the construction industry and, through collaboration and information sharing, BIM has made the design and construction phase more effective and efficient.

Across the different phases of a building life, BIM has gained popularity amongst designers and constructors by facilitating the increasing complexity of construction projects (Cooke & Williams, 2009) and supporting more advanced analysis. However, the FM uptake is still in its “normative stage” (Charlesraj, 2014). Moreover, although there are numerous uses and benefits for implementing BIM during building operations, researchers agree that facilities managers are currently falling behind and not involved as much as the other disciplines in the BIM process.

6.1 FM and technology

Since the 1980s, when facilities managers had their first encounter with IT, the impact of technology on the industry has been profound and caused many changes in the way the industry developed. From building control systems to videoconferencing facilities, CAFM and CMMS, IT has allowed facilities managers “to do more and accomplish many tasks faster” (May & Williams, 2012). Owing to the nature of their work, facilities managers deal with tremendous amounts of data in heterogeneous formats, such as texts, spreadsheets and databases. Most of the documents are still paper-based (Kassem, Kelly, Dawood, Serginson, & Lockley, 2015), and part of the facilities manager’s role is to recreate incomplete, inaccurate (Lucas, 2013) and obsolete information (Becerik-Gerber et al., 2012; Gursel, Sariyildiz, Akin, & Stouffs, 2009), hence, during operation, “an inordinate amount of time is spent locating and verifying specific facility and project information” (O’Connor, Dettbarn, & Gilday, 2004).

Although information is critical for the facilities manager’s duties, owing to the fragmentation and the specific nature of information required for operating buildings,

data management is a challenge for the FM industry (Pärn, Edwards, & Sing, 2017). Whilst in design and construction technological innovation is frequent and companies need to follow the new trends or risk losing value, most of the facilities manager's functions are still done manually (Motamed, Hammad, & Asen, 2014). A pool organised as part of the Facilities Show, the world's largest dedicated facilities management event (Facilities Show, n.d.), which included over 500 responses confirmed that technology is considered by the majority of the respondents (27%) the most important challenge facing facilities management professionals (Service Works Group, n.d.). In general terms, compared to other fields in the construction industry, facilities managers have always had a more hesitant approach regarding the implementation of new technologies to support business needs. In the technology adoption life-cycle, the FM industry cannot be considered as one of the early adopters, but rather a laggard industry, always monitoring new developments before implementing them.

The FM approach towards IT has been confirmed by the slow uptake of BIM. Using BIM would increase efficiency and accuracy (Becerik-Gerber et al., 2012) and the building model would be used as a single source for all the project information (GSA, 2011). Facilities managers could use BIM as a tool for knowledge creation, support the improvement of working tasks by developing strategic solutions, make tasks more efficient and enable the interpretation and analysis of the information. But although BIM would be a useful tool for FMs to improve and standardise all available information and support day-to-day operations together with life-cycle management, only 10% of BIM use occurs during operation (Eadie, Browne, Odeyinka, McKeown, & McNiff, 2013), and there is limited evidence of applications of BIM by facilities managers in the industry (Pärn et al., 2017).

6.2 FM and building information models

Facilities managers have specific requirements in terms on information needed to manage a facility and, over the building life-cycle, the number of graphics and amount of data required varies from state to stage (Figure 6-1). The volume of graphical information, fundamental during the design stage, decreases once the design is complete, while other data become more important during the construction and operation phases (IFMA, 2013) as facilities managers heavily rely on information on

asset inventory, condition and performance (The building information modelling trajectory in facilities management:A review paper).

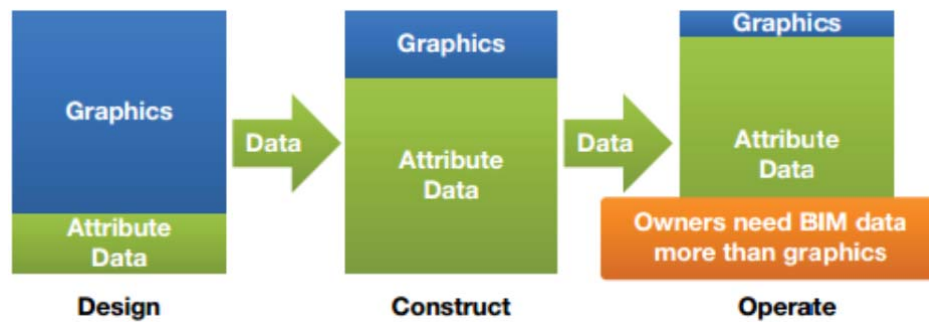


Figure 6-1: Graphics and Data Needs over Building Life-Cycle (IFMA, 2013)

During the design and construction of new building it is important that facilities managers are involved throughout the process so that their requirements can be articulated and then included in the final information model, as described in PAS 1192-2. The involvement of facilities managers can also support the early identification of potential issues related to operation and maintenance of the building (The building information modelling trajectory in facilities management:A review paper). However, the NBS BIM survey (2016a) shows that only 26% of the participants passed over the model to the FM team during the last year, confirming how the focus on BIM is still mainly on design and construction with little interest and impact on what happens after practical completion.

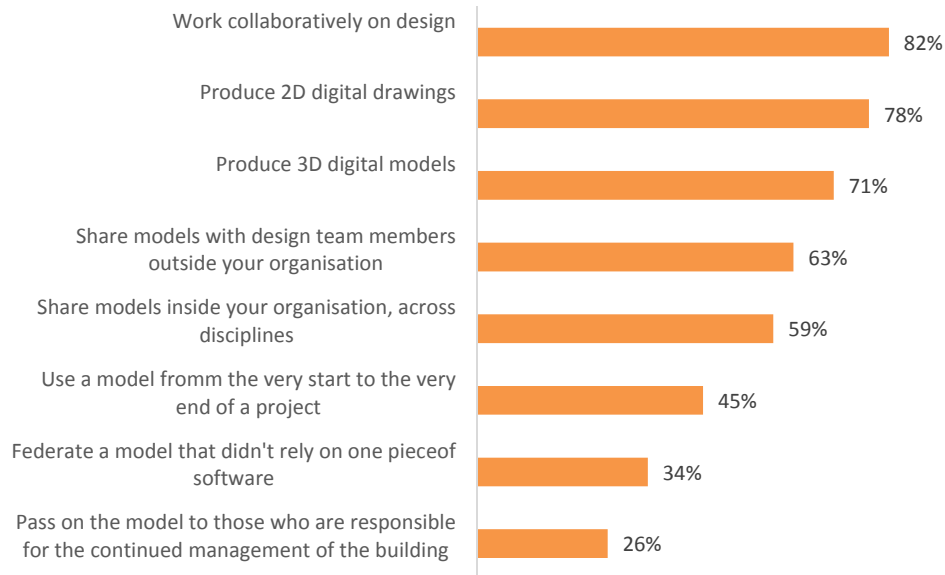


Figure 6-2: Uses of BIM Models in the Construction Industry in the Last 12 Months (NBS, 2016a)

The potential application of BIM for FM has not yet been fully exploited, however more research are now focussing on this area (Pishdad-Bozorgi, Gao, Eastman, & Self, 2018). 50-70% of the annual facility operating cost is on operations and maintenance, which require the analysis of a variety of information such as maintenance records, work orders, cause analysis, etc, generally produced by different stakeholders and hold in different systems. It was estimated that during operation, more than 80% of the time is used to retrieve information, due to poor data integration (Chen, Chen, Cheng, Wang, & Gan, 2018). By providing a single well-integrated data system, the decision making process can be improved and the risk of cost increase due to lack of information/knowledge can be reduced (Kwok Wai Wong, Ge & Xiangjian He, 2018). Moreover, during building operation, BIM offers facilities managers the opportunity to retrieve all relevant information from the building virtual model and potentially support tasks such as space management, capital planning, asset management, preventative maintenance, building system analysis, commissioning processes, development of emergency planning and decommissioning and re-purposing (Pishdad-Bozorgi & al. 2018) by supporting the integration with other information technologies (IFMA, 2013). However, analyses of the FM industry have shown that significant work still needs to be done within the FM industry to fully appreciate the benefits that BIM can provide to FM (Ashworth & Tucker, 2017).

There are limited number of case studies available looking at BIM and FM, however the initial results shown are promising (Wetzel & Thabet 2015): one case study presented by IFMA (2013) shows a return of investment of 64% with a payback period of 1.56 years through the intelligent use of information collected during design and construction that supported better and faster maintenance decisions whilst Ding et al. revealed a reduction of 98% of time required to update FM database through BIM (Ding, Drogemuller, Akhurst, Hough, Bull, & Linning, 2009)

Moreover, as every building requires a bespoke BIM model which should be constantly updated based on repairs and refurbishments (Pärn, Edwards, & Sing, 2017), facilities managers not only have to understand the benefits of BIM but also need to be able to manipulate the model and the lack of knowledge and technical expertise represent a major obstacle in the implementation (Pärn & al. 2017).

Another important issue that has a direct impact on FM uptake in terms of BIM is modelling existing buildings. While following the construction project that has been formulated in series of documents and procedures has several benefits throughout the different stages, creating a model during operation is a more complicated process, and cannot follow the same process stages of design and construction. Given that 70-75% of the buildings that will be in used in the UK by 2050 have already been built (Ravetz, 2008), and as the major opportunities for improvement comes from utilising information models during operations (Barnes, 2013), there is a need to address the problem of creating building information models for the existing estates to make BIM available for all buildings, new and existing.

To investigate the relationship between FM and BIM, in particular the benefits of and barriers to using information models for building operations, it was necessary to interrogate the FM industry. As discussed above, the use of BIM for FM is not limited, hence the analysis began with a focus group interview, which was used as an exploratory study, followed by a more detailed study through a questionnaire survey, which was used to verify some of the results that emerged from the focus group interview.

The results of the focus group interview were published in the paper 'How Facilities Management can use Building Information Modelling (BIM) to improve the decision

making process' in the Journal für Facility Management, Issue 10 (see Appendix 6 for full text).

6.3 BIM and FM focus group interview

With the objective of exploring the benefits and barriers associated with integrating BIM into FM, a one-day workshop was held in January 2014 in London at the University of Greenwich. Owing to the new domain of the study of BIM for FM, a focus group interview was deemed appropriate to collect data as it produces spontaneous responses (Kvale & Brinkmann, 2009) through the participants' interaction, and generates data through group discussions (Morgan & Scannell, 1998). The data collection and analysis process were presented in section 2.4.3.1.

Twenty-two participants representing different stakeholder groups from the building operational phase were pre-selected and invited. Having an adequate number of participants with relevant knowledge of the focus areas ensured the progression of the discussion during the day without biased views being presented. All participants (Table 6-1) were invited directly via email and received the agenda of the day, together with a short biography of the other participants, before the workshop.

Table 6-1: BIM and FM Focus Group Interview Participants

Job	Number of years worked in the industry	Group
Lecturer	22	Academia
Managing Director	20	Public sector
Estate Development Manager	10	Private sector
Project Manager	28	Private sector
Director	20	Private sector
Technical Director	30	Private sector
Lecturer	10	Academia
Lecturer	20	Academia
Responsible IT strategy and operational delivery	30	Public sector
Researcher	20	Academia
Consultant	20	Private sector
Lecturer	30	Academia
Head of BIM	15	Private sector
Head of Digital Construction	10	Public sector
Compliance and Risk Manager	17	Private sector
Consultant	40	Private sector
Head of Facilities Management	20	Public sector
Associate Director for the Built Environment	15	Professional Body
Consultant	15	Private sector
Chief Operating Officer	20	Professional Body
Principal BIM Integrator	15	Private sector
Group BIM Manager	12	Private sector

6.3.1 Focus group findings – Benefits of implementing BIM for FM

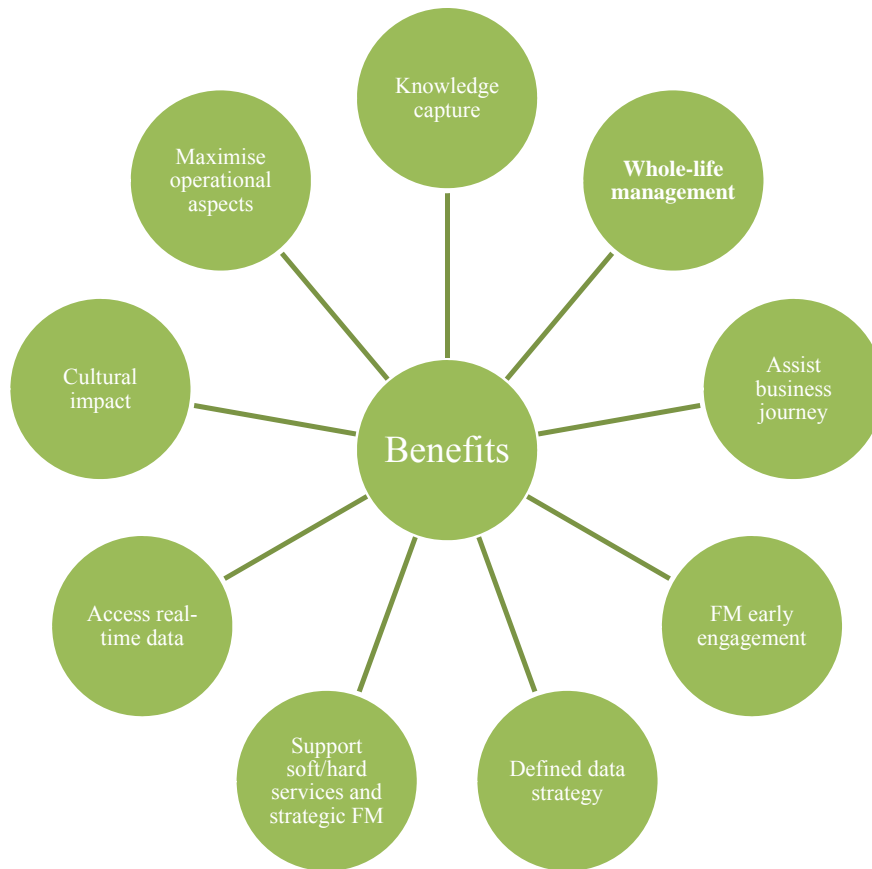


Figure 6-3: Workshop Findings – Benefits from Implementing BIM for FM

6.3.1.1 Knowledge capture

“BIM forms parts of a connection of a number of other systems that link together to provide all of the data that we need [to manage a building].”

“You can just attach your spacial data into that data set and it starts to grow over time.”

The participants believed that sharing a common model among all the stakeholders allows for the sharing of information in a more rapid and effective way, in that once a change is made, the model will automatically show if it could cause any issue or if other changes are needed, unlike what happens with 2D/3D stand-alone drawings.

If facilities managers are involved in the design process, providing feedback on the decisions made by designers and architects using the visualisation and walkthrough

opportunities provided by BIM, the asset will have an increased value and the management process will be easier during the building life. BIM will enable collaboration and information sharing among designers, engineers, builders, suppliers, clients and facilities managers, allowing the industry to break down the silos in which the different teams have worked in the past.

6.3.1.2 Whole-life management

During the discussion, it was argued that the inclusion of FM in the design stage and the consequent collaboration on a single model would facilitate capturing detailed information on the building before it is built. The information can then be used during the tender process and to model the building behaviour over time, identifying potential alternatives, and make informed decisions that will have a greater impact on the whole-life cost of the building.

6.3.1.3 Assist business journey

“It is about the adaptability, the flexibility of the building. The fact that [...] the business journey may change may influence the way the building is being used. Therefore [BIM] looks at how that building can accommodate the changing.”

“[We have to map] The business journey to understand the movement dynamics of what would happen in the property, to try to look at productivity because we're looking at large numbers of people, potentially operation people and salary cost of those.”

The participants agreed that a building has to accommodate the business' needs, and facilities managers can use BIM to review what has changed in the past in order to create hypotheses and scenarios of what might happen in the future. As such, during the life-cycle of the building, BIM can be used to accommodate the business changes, modelling different solutions and helping the decision-making process. Essentially, BIM can be used as a tool to increase flexibility and adaptability of a building, improving the quality of the work environment and therefore having positive effects on productivity.

6.3.1.4 FM early engagement

“If you don’t get the right people around the table upfront. It's difficult to control once the horse has bolted.”

“We could be looking at internal FM staff that were already parts of client organisations that initially broke into the project team to be advising and working with the design team, project manager and the quantity surveyors. If there isn't one present, perhaps we're building a new facility then we should be looking to bringing in an external consultant who advises on the FM, the implications of design how they manifest themselves going forwards or we could be looking to procure an FM consultant to engagement within that team.”

During the group discussion, it emerged that BIM allows facilities managers to be involved in the design stage, giving them the opportunity to visualise the building and influence the design process. This use of the BIM would create a feedback loop, resulting in a continuous improvement of buildings, and consequentially less need to rework during the construction phase. Facilities managers can also use the model to calculate, once the design is complete and before the construction begins, the operational expenditure (OPEX) that together with the capital expenditure (CAPEX) gives the total expenditure (TOTEX) of the building during its whole life.

6.3.1.5 Defined data strategy

“Essentially we have the one single source of truth which is the BIM data. And actually, what our facilities managers’ need is usable information. They don’t need reams and reams and reams of numbers and figures that actually may be quite meaningless to them. That is the information that is usable for them.”

“[...] understanding from the beginning what it is we need at the end, because there is no point getting to the end of a project and handing over tons of data because you know it's going to be the wrong data.”

According to the participants, identifying the data needed by facilities managers for managing the building during the pre-design stage helps in collecting this data into the BIM model before handover and in the right format, providing a single source of data

fit for purpose. Doing so will allow facilities managers and clients to set the targets at the beginning of the process and test the outcomes while the building is in use. BIM can also facilitate the building handover and provides easier access to data, as it contains all the information needed to operate the building in a single database.

6.3.1.6 Support soft/hard services and strategic FM

“[...] as we change things, perhaps we extend or upgrade or improve our facility, all these [sic] information [...] should be fed back into the one single source of truth.”

“Obviously spacial data and a lot of soft services information will sit within the BIM model and that information will then be taken forward to put it into [...] CAFM systems to map some of that activity.”

“It’s so easy in construction because [...] crash detection saves money, ‘design twice, build once’ is a no brainer. In the FM world, it might be about de-risking the FM. Traditionally they come in and validate all of the asset databases. If they’ve got the confidence that that information is good, then they may de-risk the whole service and obviously then with that the cost come down, they make more profit.”

During the workshop, it was agreed that the data within the model and collected during the life of the building can be used to make informed decisions, and provides the opportunity to improve the maintenance strategy. Data can be located in an easier and quicker way, for example by using mobile devices directly on site. The workshop participants agreed that the model should include cultural and behavioural aspects in order to enable more informed decision-making processes, tailored to the building and users. Unfortunately, presently available software on the market does not present these features as yet, to the authors’ knowledge.

6.3.1.7 Access real-time data

The participants recognised that BIM, as an intelligent model, automatically updates the model once a change is made, which can help facilities managers to make decisions based on real-time data about the building behaviour and use. The information stored within the model can create a learning cycle, enabling a deeper

understanding of the building dynamics and a constant improvement throughout the facility's life-cycle.

6.3.1.8 Cultural impact

“Actually involving the stakeholders, the operators, the potters, the cleaners, all those guys in the business delivery [...] you start to solve the problem. And then you have an impact on the social outcome which is actually the big deal.”

“What FM will probably get out of BIM straight away is getting a structure around how they can impact the culture within design and construction phases as well.”

BIM can also have a positive impact on the building's users. According to the participants, improved buildings can enhance the users' experience and a deeper understanding and analysis of the building can lead to a building tailored on the users' and company's needs. A deeper understanding of the building in use, from pre-design to the building end of life, leads to reduced costs and waste, especially in terms of energy use.

6.3.1.9 Maximise operational aspects

“That will feed in to the model, then that would speed up everything. So, we're onto a high level of actually getting things done quicker and better and we all learn as long as we can.”

Facilities managers can use BIM not only for location and visualisation purposes but also as a tool to maximise operations and maintenance. The data stored within the model can be used for analysis of the building during its life, revealing information useful for future strategies.

6.3.2 Focus group findings – Barriers to implementing BIM for FM

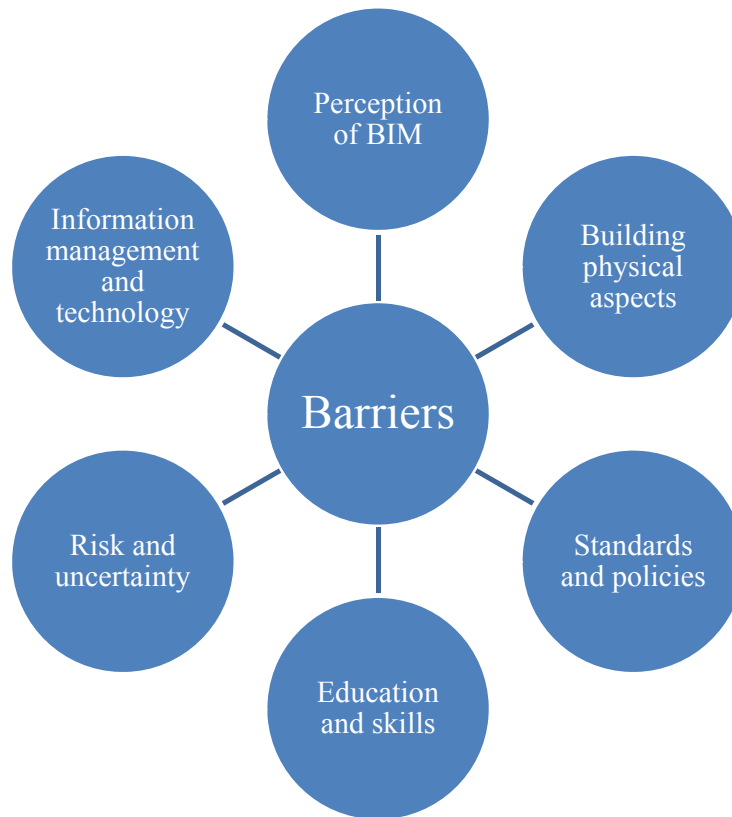


Figure 6-4: Workshop Findings – Barriers to Implementing BIM for FM

6.3.2.1 Perception of BIM

“FM contracts tend to be low margin so therefore, actually the people who run the FM companies are under accounted. So that’s nothing new. To translate them that it’s worth doing this [BIM] you need to have a huge body of evidence to say that it’s going to save them money, bottom line.”

During the discussion, it was clear that even though facilities managers consider BIM a facilitator rather than an inhibitor to their work, BIM is still a new topic and its potential is not fully understood. Although the industry is aware of the possible use of BIM for enhanced building maintenance, there is not enough evidence to convince facilities managers to fully embrace this new process. The current lack of interest is slowing the process of implementing BIM for FM, in contrast to its reception its reception in the rest of the construction industry.

6.3.2.2 Building physical aspects

“[The data needed] vary on an FM by FM basis.”

“The first thing we really need to understand is what’s the minimum information we can derive from an existing asset rather than a new asset that gets us to this point because we can’t start the game until we got some data.”

“So, I’ve got a crappy asset and I’ve got no money. I’ll now build some data, I now need to apply a strategy to it. How do I generate a strategy while someone is having that conversation about fixing the price rather than just giving me the asset and say you got no money to administrate and manage it? Those two pieces of, what’s the data and what’s the process? I guess the two really important pieces of data for an existing asset, including condition survey.”

Implementing BIM for existing buildings seems to be a great concern for both the construction industry and facilities managers, and the issue was raised by different participants. There is the need to understand to what extent the model has to be created, what data is necessary to make a BIM model helpful for facilities managers, and who will be in charge of implementing it and overseeing its on-going management.

Furthermore, companies can have different attitudes towards FM, which can change the potential use of BIM. Different management strategies imply different information that needs to be stored and recorded during the building’s life-cycle, and needs to be taken into consideration while implementing the model.

6.3.2.3 Standards and policies

“There’s talk about integrating all the tools sets [...] but it doesn’t work quite right yet and actually we need to get a proper set of tools to support this process.”

“Data standards are required, we know that.”

The participants agreed that in order to assist the industry adoption of BIM, there is a need to create a unique BIM standard, preferably at an international level. Such a standard would put pressure on software developers to create globally applicable tools

that will make information and data exchange between other tools a straightforward process. The UK Government is currently demanding COBie files as output from a BIM model for public projects, but as long as there is not a unique standard interoperability between software and integration, this will be hard to achieve.

6.3.2.4 Education and skills

“I think there is a real disparity between the educated and the non-educated [clients] at the moment.”

“We then discussed some of the issues in terms of the FM phase around equipment selection, reviewing access, and we were talking about sign offs on design and etc. Do they have the kind of actual capability to sign off on design?”

“Where they are actually as clear as it should be currently in terms of the guidance out there or in terms of contracts, and when we are as a contractor tendering for work, it's touched on and it's talked around with the government soft landings, but there is no a specific client requirement identified generally out there at the moment in and around that.”

“Going back to that sort of skills and knowledge gap really, I think we are in a bit of a lag at the moment. I think we are all working forward with that but we are not quite there yet across in the industry.”

“We talked about the need to educate clients and also our chain, cross pollination across professionals. Contractors might be unaware of what we do in FM and FM guys understanding what the contractor is doing, understanding how that comes about.”

The participants believed that as BIM is a fairly new topic about which the construction industry is still learning. If the stakeholders are not aware of the potential of BIM, there is the risk they will not be interested in investing money, time and effort to implement it, therefore losing future opportunities. Training will help stakeholders to understand what can be achieved using BIM and how it can be helpful to accomplish the company's goals.

6.3.2.5 Risk and uncertainty

“What about product developers who may be looking to build an asset and then sell it on very quickly?”

“If they’re just going to sell the building six months afterwards, [BIM] is a cost that they would like to remove quite possibly.”

“What we don't want is repetition of data that then becomes inconsistent and unmanageable, and that comes back to having some standards the industry needs.”

The workshop participants agreed that the new BIM market might create new BIM job roles and specific courses, which would lead to a fragmentation instead of the integration and shared information that ideally underpin a BIM model. All the stakeholders should understand how the model works, what its purpose is and how to use it as part of their work. Until the stakeholders’ minds change, investors will probably not be interested in including FM at the design stage or creating BIM for buildings that will be sold once they are complete.

6.3.2.6 Information management and technology

“You get different levels of accuracy. You have to understand or define validity and checking and certification of those data. You have data that is valid but incorrect, and that's the problem you get with these sorts of data.”

“Everybody suddenly says, “have you been collecting all data?” Then people think they’ve been collecting it but when you then try to benchmark it, it’s in a way that doesn’t quite work, doesn’t quite fit and you end up in a complete bloody mess because you haven’t clarified up front what you want.”

Once the BIM model is handed over to FM, not all the information within the model will be useful for managing the facility during its operational phase, thus the model may be overloaded with unnecessary information. The information will then be exchanged with various other software such as computerised maintenance management systems, building automation systems, energy management systems and

electronic document management systems, and the data might be duplicated or lost during the process.

During the life-cycle of the building, the information about changes needs to be recorded in a unique format, but the participants were not clear as to who would be in charge of this task. Also, it is necessary to decide whether specific types of information should be included in the BIM model or in different software.

6.3.3 Discussion focus group findings

The purpose of the workshop was to gain initial insight into the perceived benefits and barriers linked to the implementation of BIM and FM. During the group discussions and interactions, the attendees identified a series of possible benefits that facilities managers could achieve by implementing and using BIM, as well as industry gaps that need to be overcome before the implementation will be possible. Some of the key points were:

- having a single source of usable information for FM is essential, but a data strategy is essential to ensure that the right information is included in the model;
- information within the model can support decision-making and improve maintenance strategy, but the use of BIM should not be limited to hard services but also include soft services;
- implementing BIM for existing buildings and understanding what data should be included is a key issue for FM and the construction industry; and
- the participants' perception is that BIM is still new for facilities managers and, although they do understand the benefits, there is a general lack of interest.

Following the initial study on BIM and FM, a more detailed analysis of the industry was necessary to verify whether the perception and views that emerged during the workshop on the relation of FM with BIM truly represent the industry.

6.4 Building information modelling use in facilities management

The literature offers only limited in-depth studies that focus on the facilities managers' views and awareness of BIM, thus provides only partial insight into their relationship with BIM. The most recognised are the NBS annual BIM report and the BIM4FM survey presented in 2013 by the BIM4FM group. Although these studies are useful to gain some insight into the reality of BIM in the construction and FM industry in the UK, they both have limitations.

The NBS survey is realised yearly and presents an overview of how the construction industry has changed in terms of BIM over the past seven years. However, the participation from the FM industry is very limited – in the 2016 edition only 1% of the respondent were facilities managers (Figure 6-5).

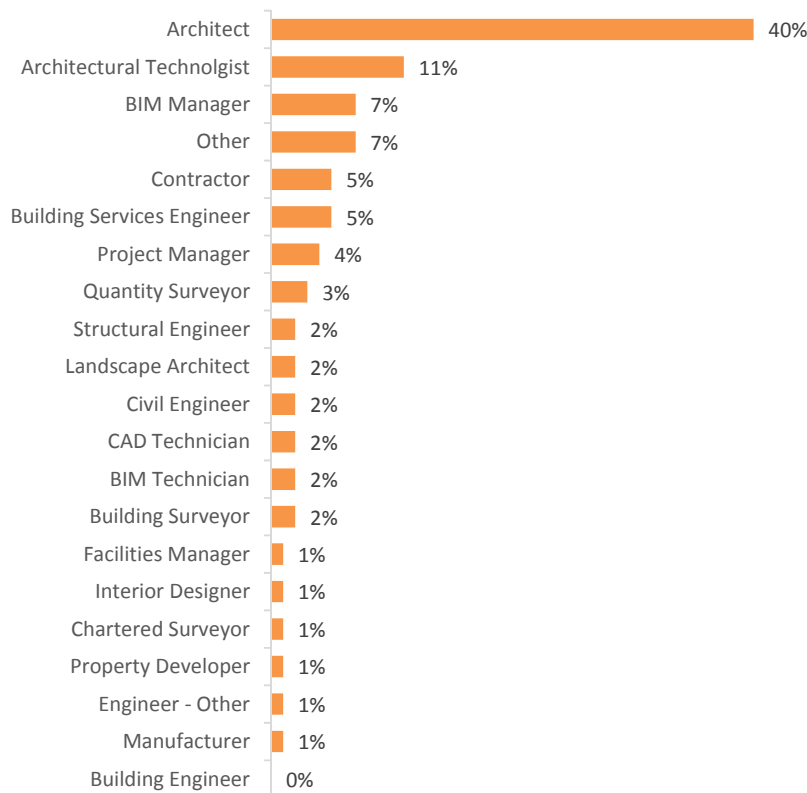


Figure 6-5: Respondents' Jobs in the NBS BIM Report (NBS, 2016a)

Conversely, the BIM4FM survey focuses on the FM view and perception about BIM, with questions such as “Do you believe that BIM will help support the delivery of

FM?” and “How do you think your company will use BIM?”. The survey highlights how the majority of facilities managers believe that BIM will support the delivery of FM (61.7% of the participants), and that the key opportunities for implementing BIM will be in life-cycle management, improving efficiencies, cost reductions and carbon reductions (Figure 6-6) .

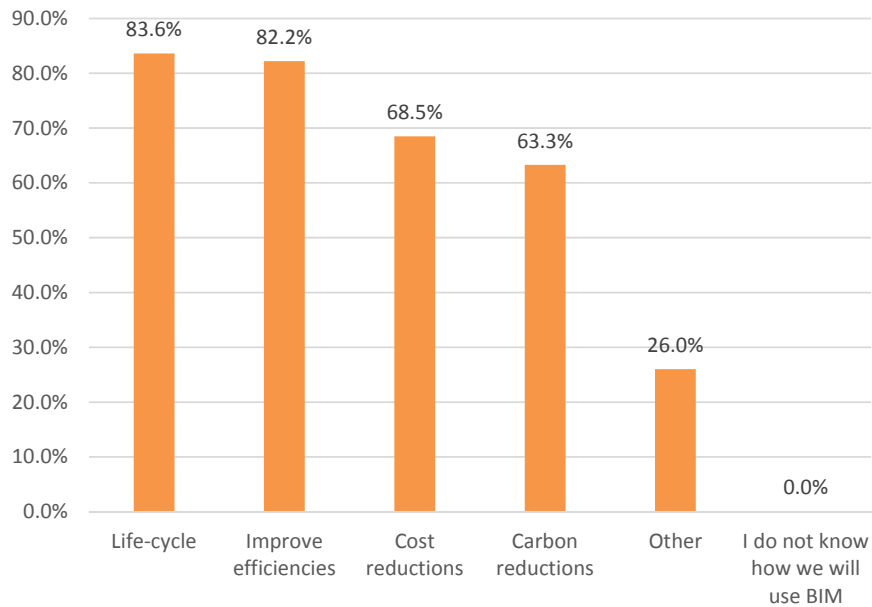


Figure 6-6: Uses of BIM from BIM4FM Survey (BIM4FM, 2013)

The results, although interesting, do not provide an insight into how much facilities managers know about BIM and how BIM is used in the FM industry. To answer these questions and verify the findings from the workshop, the FM industry was interrogated through a questionnaire survey.

6.5 Questionnaire survey

As discussed in section 2.4.3.2, the survey comprised three separate sections. The questions asked in section 1 – profile of respondents, were intended to gather general information about each respondent, including role, organisation and nationality, confirming that the correct audience has been targeted. Section 2 – inefficiencies in FM, aimed at understanding which, among the tasks generally performed by facilities managers, are perceived as the most inefficient. The results of section 2 of the questionnaire are presented in Chapter 7. Lastly, the questions in section 3 – BIM

awareness, knowledge and use offered some understanding of the relationship between BIM and the FM industry.

6.5.1 Response rate

A total of 7055 professionals, identified through the BIFM website, were directly contacted for the questionnaire survey through email by the researcher. The questionnaire was emailed and the link to the online survey was provided to ensure that the potential respondents could easily participate in the survey. When the designated period for responding to the online questionnaire expired (on 15th November 2015), 1000 responses had been received. From these, only those submitted from the UK and that had more than 30% of the questions completed were considered for the final analysis, resulting in 753 responses, with a final response rate of 14%. The participants had the opportunity to skip questions during the questionnaire, therefore despite receiving 753 responses, the number of responses to each question varies. The number of valid responses to each question is indicated in the analysis.

6.5.2 Questionnaire section 1 – Profile of respondents

The initial section of the questionnaire was intended to gather general information about each respondent and provide an overview of the respondents' profile.

Question 1: What is your job position?

The respondents were required to provide details about their job role and organisation in the first part of the questionnaire.

Table 6-2 provides a breakdown of the valid responses by job role.

Table 6-2: Questionnaire – Number of Valid Responses to Question 1

Valid responses	752	Missing responses	1	Total	753
-----------------	-----	-------------------	---	-------	-----

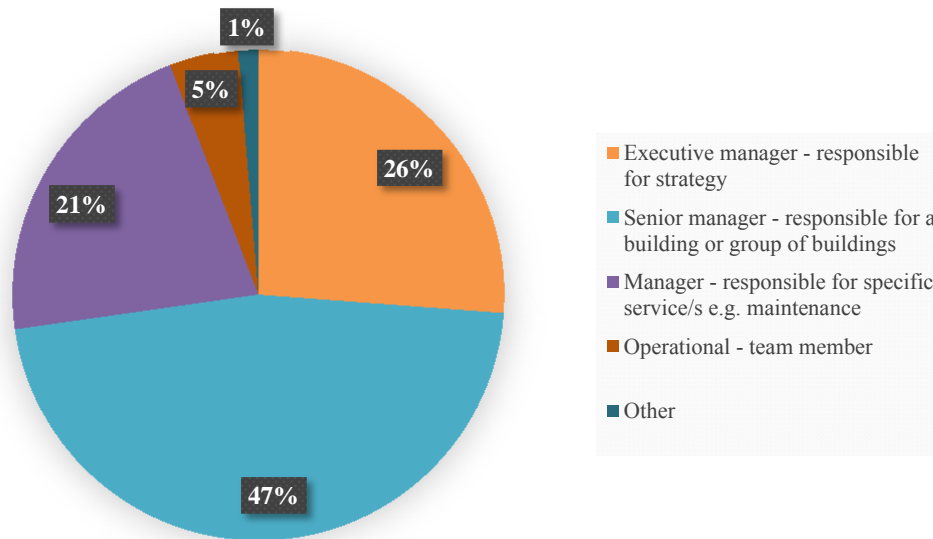


Figure 6-7: Questionnaire Results – Distribution of Respondents by Job Role

As shown in Figure 6-7, the highest number of respondents was from senior managers, representing almost 50% of the total number of responses. The second most represented group was executive managers (26%), followed by managers (21%), operational (5%) and other (1%).

Question 2: Which of the following market sectors best describes your organisation?

Table 6-3: Questionnaire – Number of Valid Responses to Question 2

Valid responses	752	Missing responses	1	Total	753
-----------------	-----	-------------------	---	-------	-----

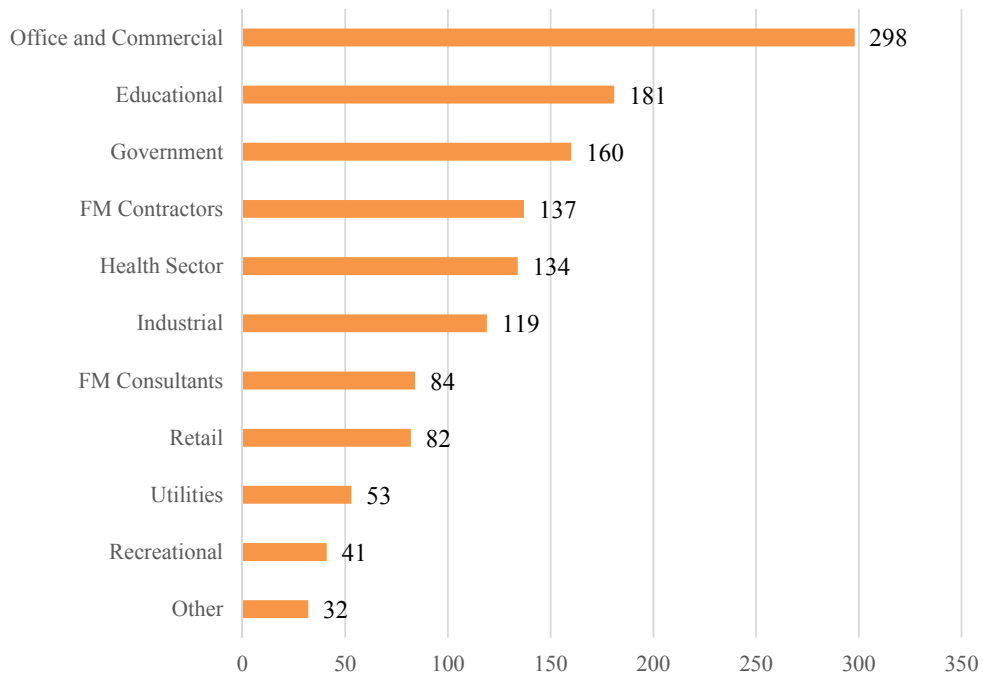


Figure 6-8: Questionnaire Results – Distribution of Respondents by Market

The participants could select multiple market sectors. Based on the survey results, more than 22.56% out of the 752 respondents work or manage offices and commercial buildings.

Question 3: How would you define your organisation?

Table 6-4: Questionnaire – Number of Valid Responses to Question 3

Valid responses	751	Missing responses	2	Total	753
-----------------	-----	-------------------	---	-------	-----

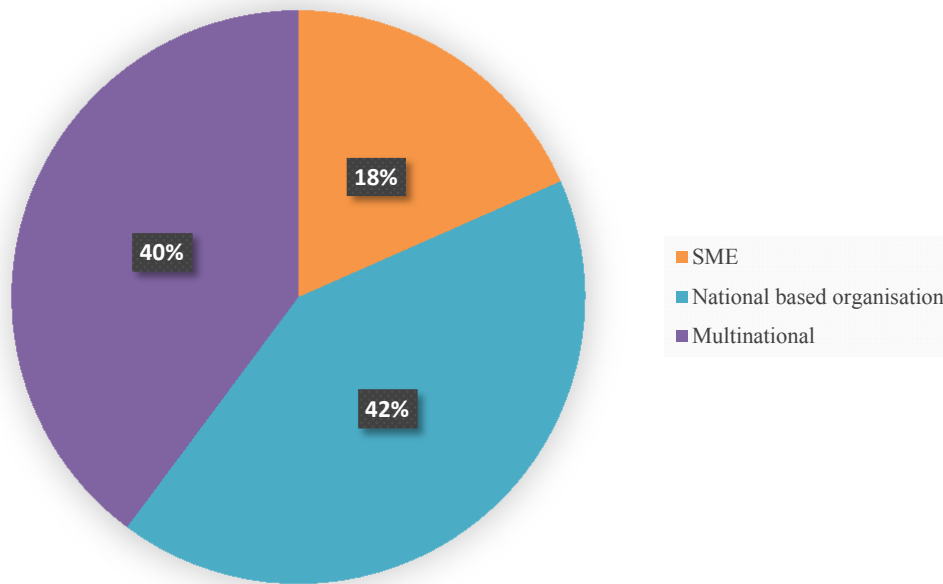


Figure 6-9: Questionnaire Results – Distribution of Respondents by Organisation Type

As can be observed in Figure 6-9, most of the respondents are part of a nationally based or multinational organisation, although small and medium enterprises represented almost 20% of the participants.

6.5.3 Questionnaire section 3 – BIM awareness, knowledge and use

Following the questions about their profiles, questions regarding inefficiencies in FM were asked. These results are presented in Chapter 7. Thereafter, respondents were asked questions on their awareness, knowledge and usage of BIM. Section 3 is divided in four parts: BIM awareness and knowledge (questions 17 to 24), BIM applications and use (questions 25 to 30), information models' creation and use (questions 31 to 35) and BIM protocols and norms (question 36)

6.5.3.1 Questionnaire section 3 part 1 – BIM awareness and knowledge

Respondents were asked to answer questions about their awareness and knowledge of BIM for design, construction and FM, both at personal and company level, using a 5-point Likert scale from 5 – very aware/knowledgeable to 1 – not at all aware/knowledgeable

Question 17: How would you rate your personal level of awareness of BIM?

Table 6-5: Questionnaire – Number of Valid Responses to Question 17

Valid responses	657	Missing responses	96	Total	753
-----------------	-----	-------------------	----	-------	-----

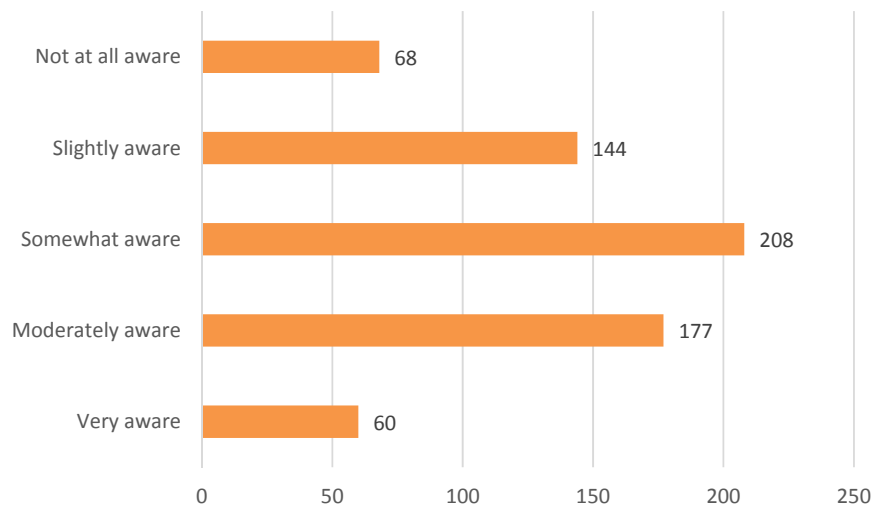


Figure 6-10: Questionnaire Results – Personal BIM Awareness

Just over 90% of the responded indicated they have some level of awareness of BIM (between somewhat aware and very aware), which is below the 97% of BIM awareness presented in the NBS National BIM Report 2017 (NBS, 2017b).

Question 18: How would you rate your personal level of knowledge of BIM uses for design?

Table 6-6: Questionnaire – Number of Valid Responses to Question 18

Valid responses	647	Missing responses	106	Total	753
-----------------	-----	-------------------	-----	-------	-----

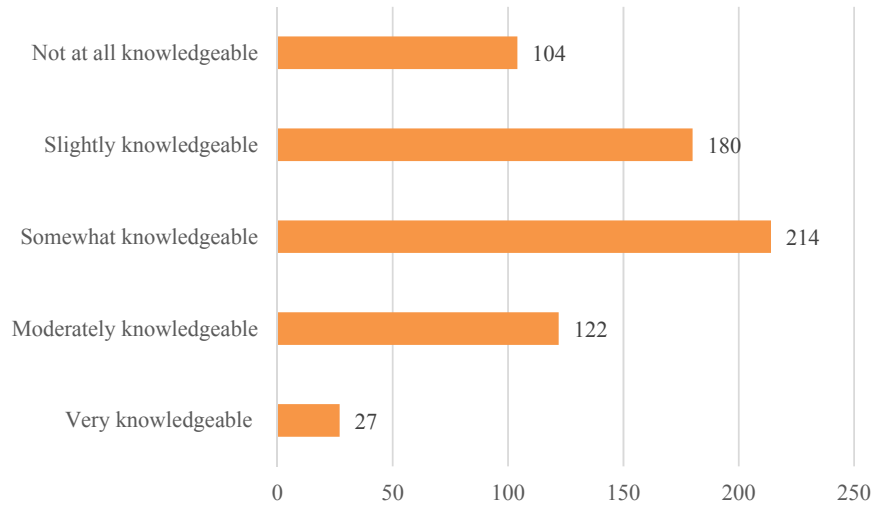


Figure 6-11: Questionnaire Results – Knowledge of BIM Uses for Design

Question 19: How would you rate your personal level of knowledge of BIM uses for construction?

Table 6-7: Questionnaire – Number of Valid Responses to Question 19

Valid responses	645	Missing responses	108	Total	753
-----------------	-----	-------------------	-----	-------	-----

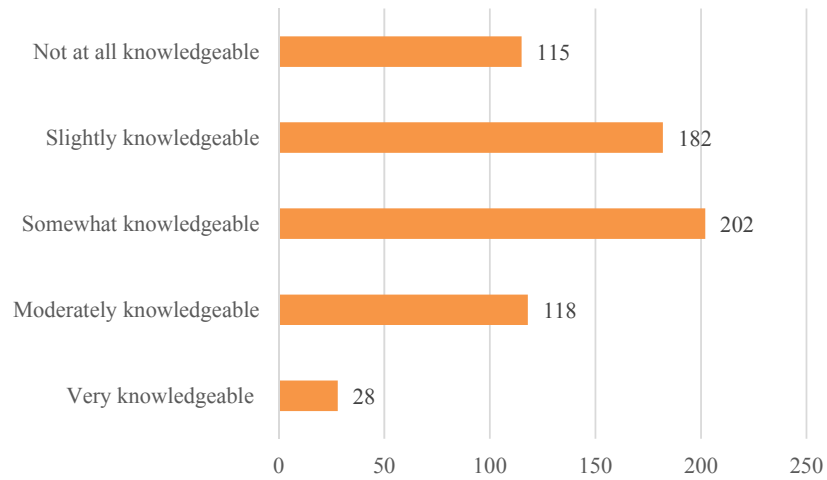


Figure 6-12: Questionnaire Results – Knowledge of BIM Uses for Construction

Question 20: How would you rate your personal level of knowledge of BIM uses for FM?

Table 6-8: Questionnaire – Number of Valid Responses to Question 20

Valid responses	656	Missing responses	97	Total	753
-----------------	-----	-------------------	----	-------	-----

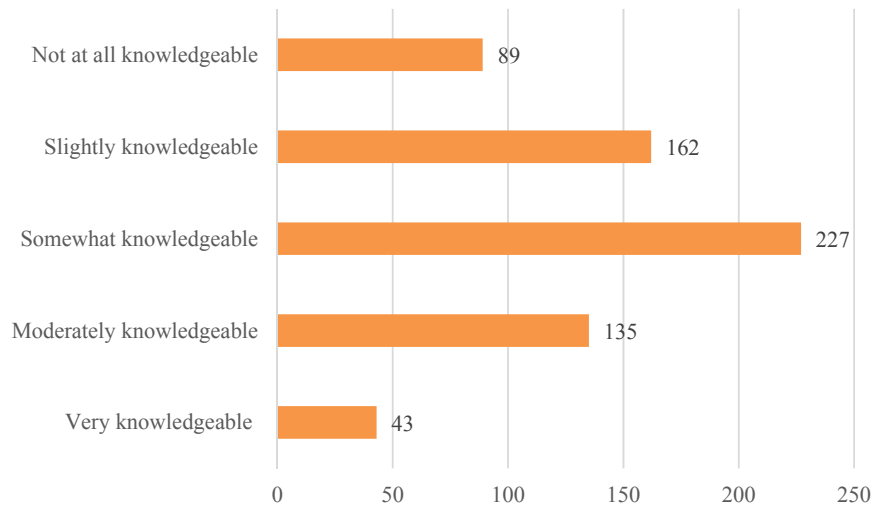


Figure 6-13: Questionnaire Results – Knowledge of BIM Uses for FM

The responses provided to questions 18, 19 and 20 show that knowledge of possible BIM uses during design, construction and FM are almost consistent. The majority has some level of knowledge (evaluated between slightly and very knowledgeable), with a total percentage that varies from 83.93% for design, 82.17% for construction and 86.43% for FM. The number of respondents that indicated they are very knowledgeable in the BIM uses for FM (6.55%) is higher compared to design (4.34%) and construction (4.17%). The results also highlight there is still a high percentage of participants who are not at all knowledgeable about possible BIM uses for design (16.07%), construction (17.83%) and FM (13.57%), although these results do show an improvement from the BIM4FM survey, where 35% of the respondents indicated that they were not aware of how BIM can be used within the built environment.

Question 21: Within your organisation, how would you rate the level of awareness of BIM?

Table 6-9: Questionnaire – Number of Valid Responses to Question 21

Valid responses	657	Missing responses	96	Total	753
-----------------	-----	-------------------	----	-------	-----

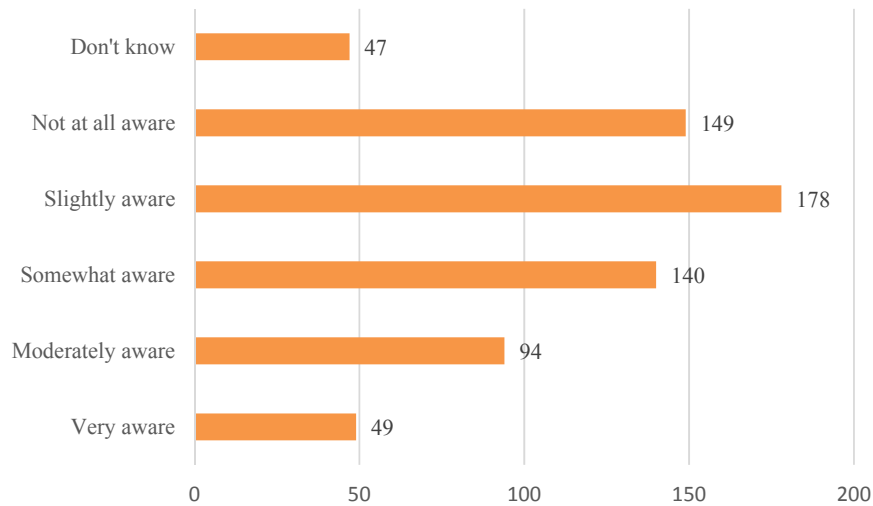


Figure 6-14: Questionnaire Results – Company Awareness of BIM

The respondents indicated that almost 70% of the companies they work for have some level of awareness of BIM (evaluated between slightly and very aware). Compared to the personal evaluation (question 17), the responses show that the number of companies that are not aware of BIM (22.7%) is higher than the respondents' personal awareness (10.35%), indicating that some of the participants have become aware of BIM outside their own organisation.

Question 22: Within your organisation, how would you rate the level of knowledge of BIM uses for design?

Table 6-10: Questionnaire – Number of Valid Responses to Question 22

Valid responses	650	Missing responses	103	Total	753
-----------------	-----	-------------------	-----	-------	-----

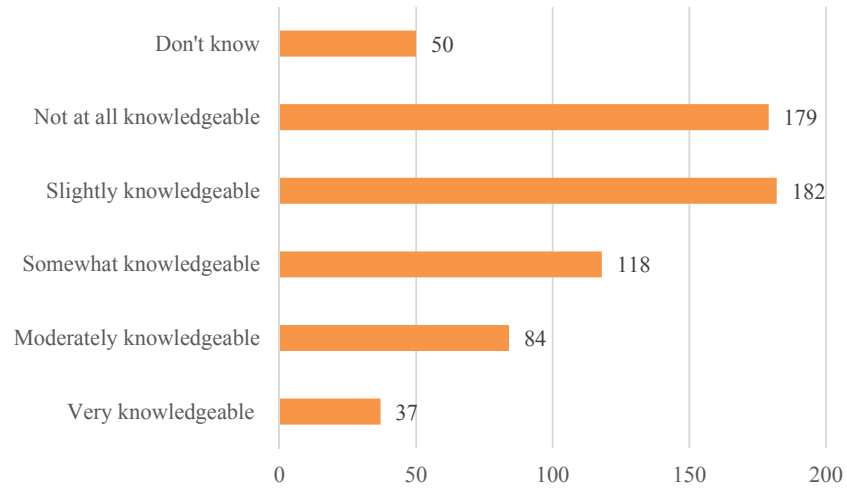


Figure 6-15: Questionnaire Results – Company Knowledge of BIM Uses for Design

Question 23: Within your organisation, how would you rate the level of knowledge of BIM uses for construction?

Table 6-11: Questionnaire – Number of Valid Responses to Question 23

Valid responses	648	Missing responses	105	Total	753
-----------------	-----	-------------------	-----	-------	-----

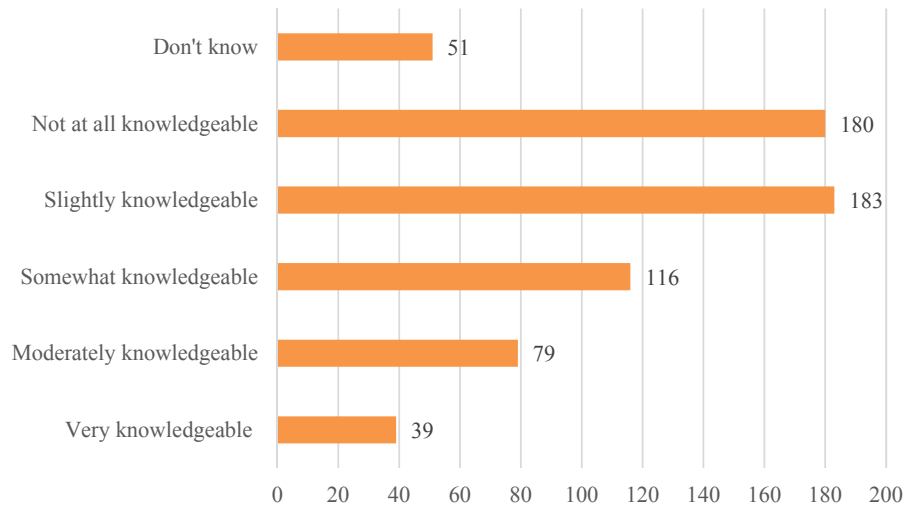


Figure 6-16: Questionnaire Results – Company Knowledge of BIM Uses for Construction

Question 24: Within your organisation, how would you rate the level of knowledge of BIM uses for FM?

Table 6-12: Questionnaire – Number of Valid Responses to Question 24

Valid responses	655	Missing responses	98	Total	753
-----------------	-----	-------------------	----	-------	-----

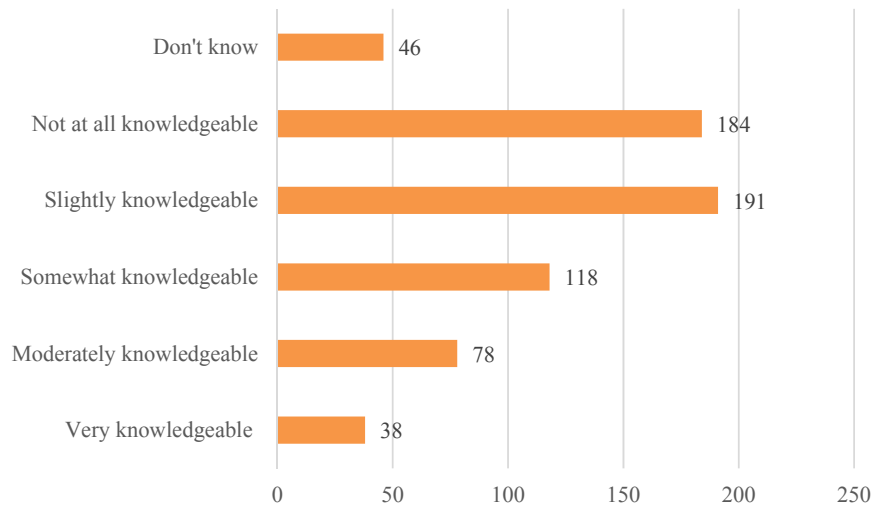


Figure 6-17: Questionnaire Results – Company Knowledge of BIM Uses for FM

The responses to questions 22,23 and 24 show a consistent level of knowledge across design, construction and FM at a company level. Although the levels of knowledge are lower compared to the personal knowledge of BIM uses at the different stages, 65% of the respondents indicated that their company has a level of knowledge (scored between slightly to very knowledgeable) in design, construction and FM uses of BIM. The percentage of companies that are not at all knowledgeable is significant, with 28.1% on FM applications of BIM.

6.5.3.2 Questionnaire section 3 part 2 – BIM applications and use

In this section of the questionnaire, respondents were asked questions about how using BIM would benefit their organisation together with their personal experience and BIM expertise. Questions 28, 29 and 30 were only presented to respondents that answered positively to question 26 “Have you ever used BIM?”. The participants that had never used BIM were asked about their organisation’s approach to BIM (question 27) and then moved directly to the next section (question 31).

Question 25: Which applications of BIM for FM would add value to your organisation?

Table 6-13: Questionnaire – Number of Valid Responses to Question 25

Valid responses	615	Missing responses	138	Total	753
-----------------	-----	-------------------	-----	-------	-----

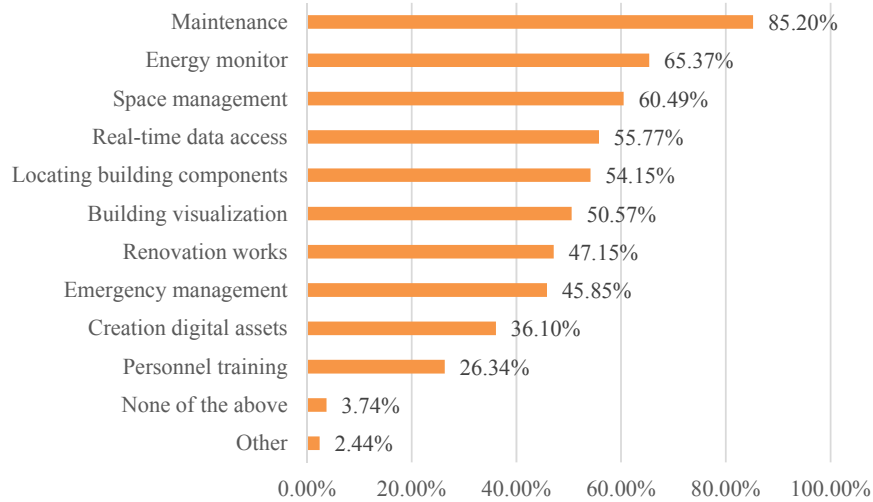


Figure 6-18: Questionnaire Results – BIM Applications for FM

The respondents were asked to point out which FM applications, among those identified by Becerik-Gerber et al. (2012) (section 5.3.3) would add value to their organisation. The results show that almost all respondents agree that BIM would be useful for maintenance (85.2%), which confirms the link between BIM and FM hard services. The respondents who indicated that BIM can have other uses did not provide details of the potential other uses and one of the respondents who selected “none of the above” specified that “As we manage existing rather than new building, BIM would be too costly to implement retrospectively.”

Question 26: Have you ever used BIM?

Table 6-14: Questionnaire – Number of Valid Responses to Question 26

Valid responses	537	Missing responses	216	Total	753
-----------------	-----	-------------------	-----	-------	-----

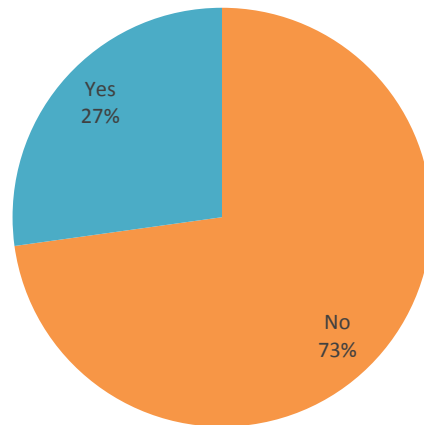


Figure 6-19: Questionnaire Results – Respondents That Have Used BIM

The responses to question 26, together with the answers provided in the previous questions, confirmed one of the barriers identified during the workshop. Although there is a high percentage of facilities managers who are aware of the possible uses of BIM, in particular during operations, the number of respondents who have actually used it is below 30%. The results show that the BIM awareness is still not sufficient to convince facilities managers to fully embrace BIM, as discussed during the workshop.

Question 27: Which of the following statements describe most closely your organisation’s approach regarding BIM?

Table 6-15: Questionnaire – Number of Valid Responses to Question 27

Valid responses	495	Missing responses	258	Total	753
-----------------	-----	-------------------	-----	-------	-----

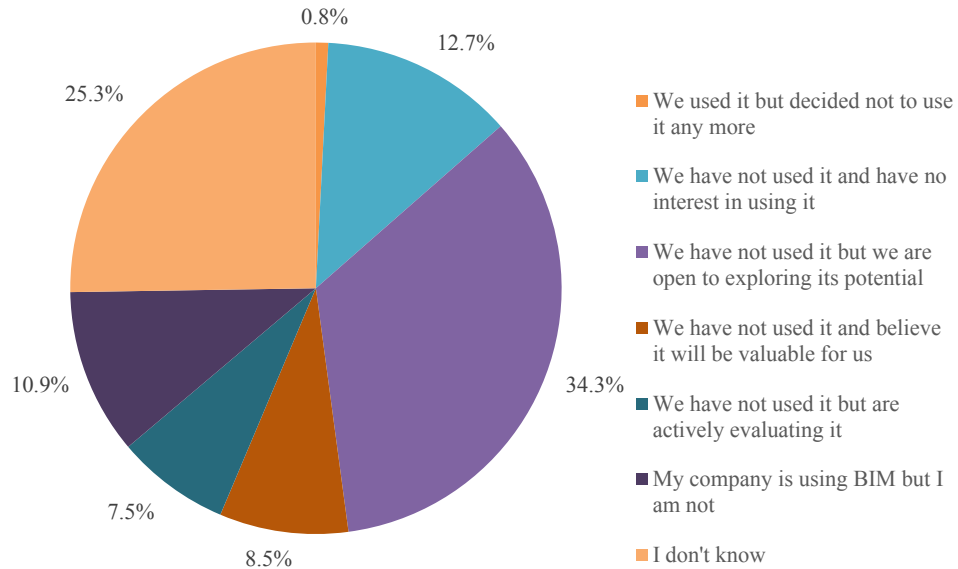


Figure 6-20: Questionnaire Results – Organisation’s Approach Regarding BIM

The range of responses provided for question 27 shows that there is no common organisational approach regarding BIM in the FM industry. Less than 1% of the respondents decided not to use BIM after trying it, whilst over 25% of the respondents did not know whether their organisation will use BIM in the future or not. A further 12.7% stated that they are not interested in using BIM – a result in line with the BIM4FM survey (2013), where 13.3% of the respondents indicated that their company was not planning to use BIM in the future. The other approaches show an opening to the potential implementation of BIM, with 34.3% open to exploring its potential, 8.5% believing it will be valuable and 7.5% actively evaluating it.

Question 28: How many years have you used BIM?

Table 6-16: Questionnaire – Number of Valid Responses to Question 28

Valid responses	146	Missing responses	607	Total	753
-----------------	-----	-------------------	-----	-------	-----

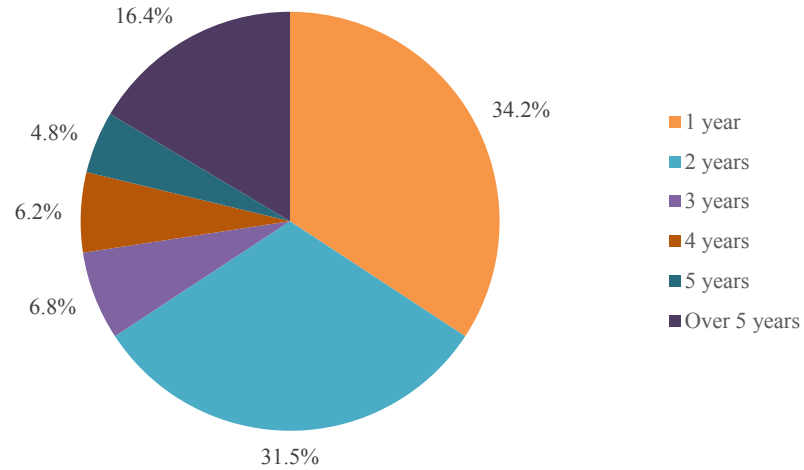


Figure 6-21: Questionnaire Results – Number of Years Used BIM

Question 29: How would you rate your expertise in using BIM?

Table 6-17: Questionnaire – Number of Valid Responses to Question 29

Valid responses	153	Missing responses	600	Total	753
-----------------	-----	-------------------	-----	-------	-----

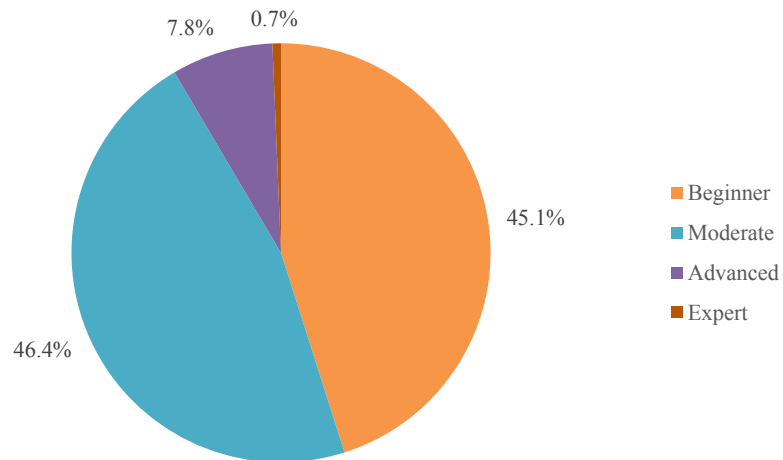


Figure 6-22: Questionnaire Results – Level of Experience using BIM

Question 30: What is the percentage of projects you are involved with that use BIM?

Table 6-18: Questionnaire – Number of Valid Responses to Question 30

Valid responses	148	Missing responses	605	Total	753
-----------------	-----	-------------------	-----	-------	-----

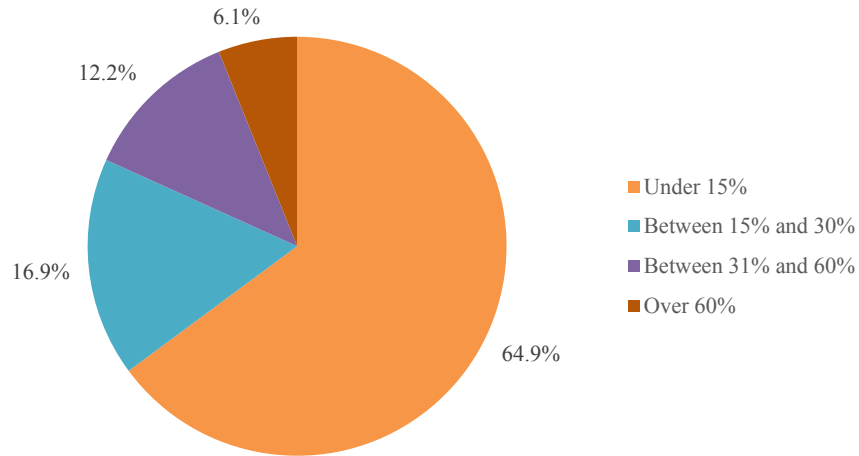


Figure 6-23: Questionnaire Results – Percentage of Projects Using BIM

The responses to questions 28, 29 and 30 confirm some of the points that emerged from the BIM workshop: BIM is still a new topic, especially in the FM industry, and the number of projects in which BIM is used is limited. The majority of respondents have used BIM for two years or less (65.7%), and rated their level of experience as beginner or moderate (91.5%). Although 34.2% of the respondents indicated that they have used BIM for three years or more, only 8.5% defined their level of experience as advanced and expert, which confirms that the use of BIM in FM is far from its full potential, even for facilities managers who have used it for many years. Further confirmation is found in the results for question 30, as over the 80% of the respondents use BIM for less than 30% of their projects, with 64.9% using it for less than 15%.

6.5.3.3 Questionnaire section 3 part 3 – Information model creation and use

Part 3 of the questionnaire focused on model creation and use both for existing (questions 31 and 32) and new buildings (questions 33 to 35)

Question 31: Has your organisation ever created models for existing building stock?

Table 6-19: Questionnaire – Number of Valid Responses to Question 31

Valid responses	154	Missing responses	599	Total	753
-----------------	-----	-------------------	-----	-------	-----

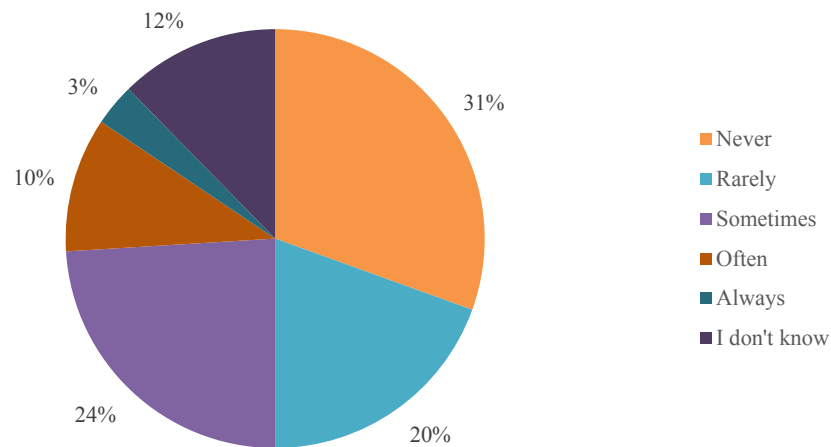


Figure 6-24: Questionnaire Results – Frequency of Models Created for Existing Buildings

As discussed during the workshop, implementing BIM for existing buildings is of great concern in FM, and the results confirm that creating BIM models for existing buildings is not a common process, with only 3% of the respondents reporting that models for existing buildings are always created.

Question 32: If your organisation has created information models for existing building stock, please indicate if your organisation is using the model for these purposes:

Table 6-20: Questionnaire – Number of Valid Responses to Question 32

Valid responses	88	Missing responses	665	Total	753
-----------------	----	-------------------	-----	-------	-----

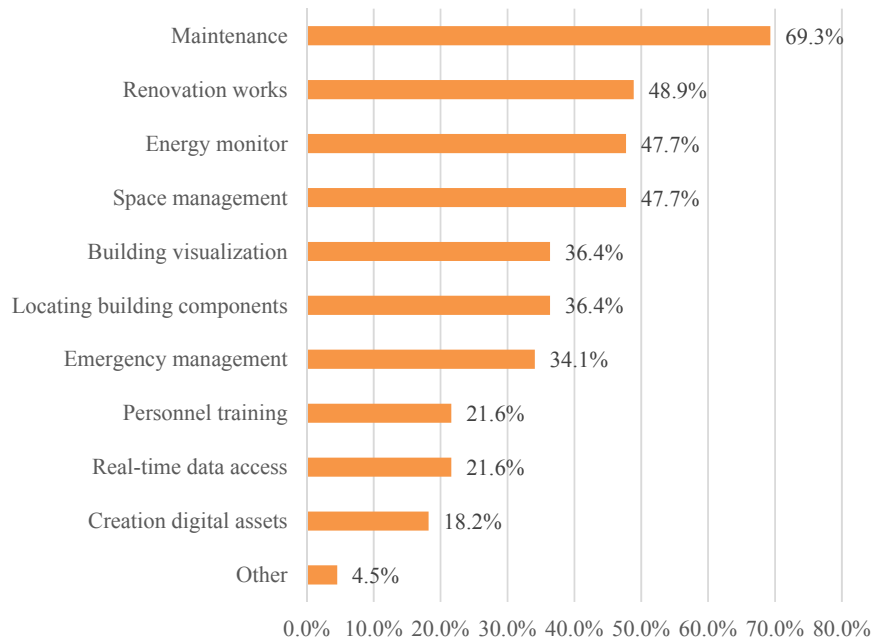


Figure 6-25: Questionnaire Results – Uses of BIM Created for Existing Buildings

The respondents indicate that BIM models created for existing buildings are mainly used for maintenance (69.3%), renovation works (48.9%), energy monitoring (47.7%) and space management (47.7%).

Question 33: How many times has your organisation been handed over building information models after construction completion?

Table 6-21: Questionnaire – Number of Valid Responses to Question 33

Valid responses	150	Missing responses	603	Total	753
-----------------	-----	-------------------	-----	-------	-----

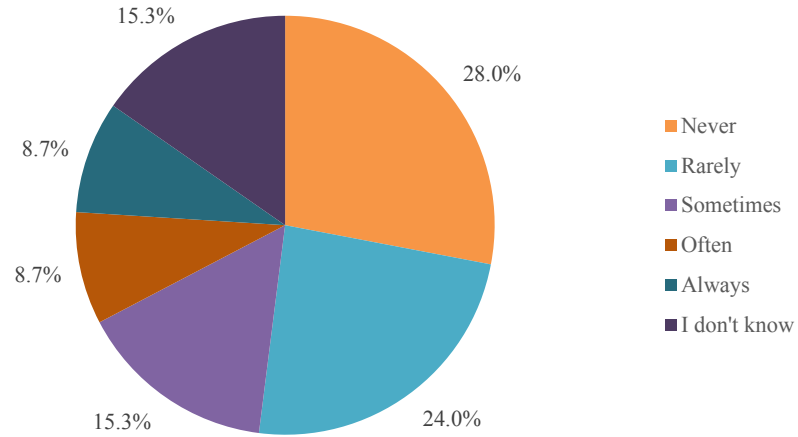


Figure 6-26: Questionnaire results – Frequency of Model Handover after Construction

Question 34: Is your organisation using the models received for FM purposes?

Table 6-22: Questionnaire – Number of Valid Responses to Question 34

Valid responses	123	Missing responses	630	Total	753
-----------------	-----	-------------------	-----	-------	-----

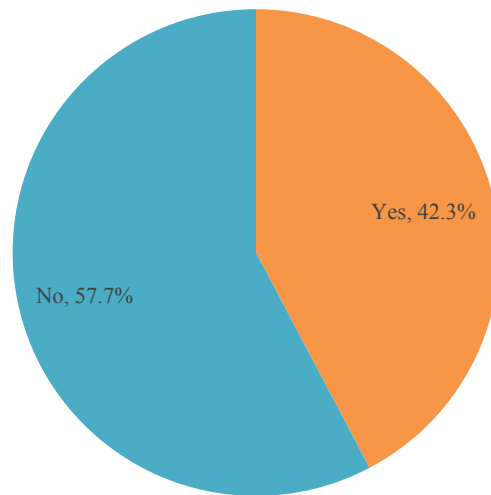


Figure 6-27: Questionnaire Results – Handover Models Used for FM

BIM models should be developed with the aim of handing them over to FM to support the operational stage of the building because of the reliable and validated information included in the model. The results presented from questions 33 and 34 show support this claim; however, this is not always the case. The number of models handed over to FM after construction is limited, with 52% of the respondents reporting they have never or rarely received models. Moreover, as shown in Figure 6-27, when models are handed over, they are not always used for FM purposes. These results, together with the lack of model development for existing buildings, confirm how BIM for FM is still at an initial stage of development and it is not currently in use for most of the buildings.

Question 35: If you answered YES to the previous question, please indicate if your organisation is using the model for these purposes:

Table 6-23: Questionnaire – Number of Valid Responses to Question 35

Valid responses	53	Missing responses	700	Total	753
-----------------	----	-------------------	-----	-------	-----

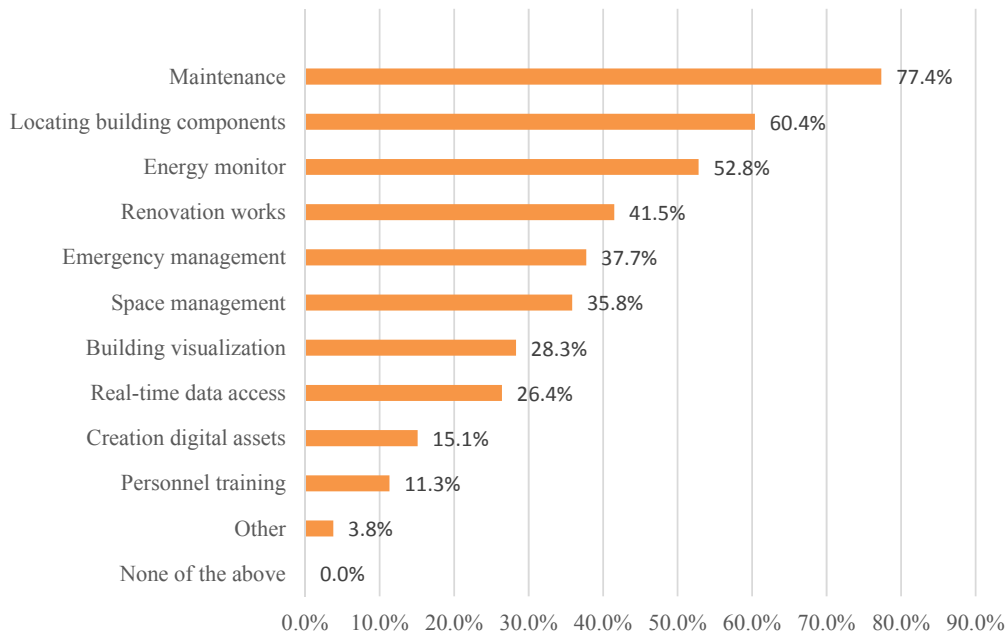


Figure 6-28: Questionnaire Results – Handover Models Uses for FM

The respondents indicated that the main use of BIM models handed over after the construction phase to FM is maintenance, confirming that BIM for FM has a larger potential in hard services.

The comparison of the uses of models handed over after construction with the uses of the models created for existing buildings (question 32) shows a general alignment between the answers, with the only exception being locating building components (Figure 6-29).

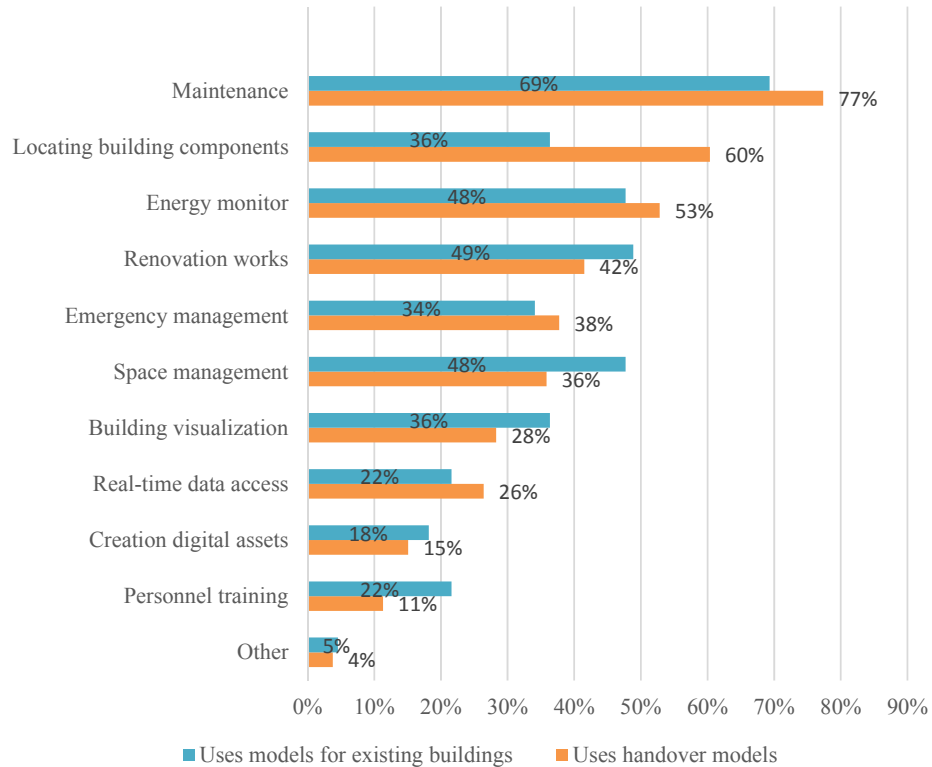


Figure 6-29: Comparison Uses Models Created for Existing Buildings and Models Handed Over

Whilst recording the location of building components can easily be done during design and construction and hence included in a BIM model that is handed over, identifying locations retrospectively whilst creating a model for an existing building is more complicated, especially for building components that are not directly accessible.

6.5.3.4 Questionnaire section 3 part 4 – BIM protocols and norms

The final part of the questionnaire aimed at providing insight into the knowledge and use of the key BIM protocols and norms among facilities managers.

Question 36: Are you aware/have you ever used any of the following?

Table 6-24: Questionnaire – Number of Valid Responses to Question 36

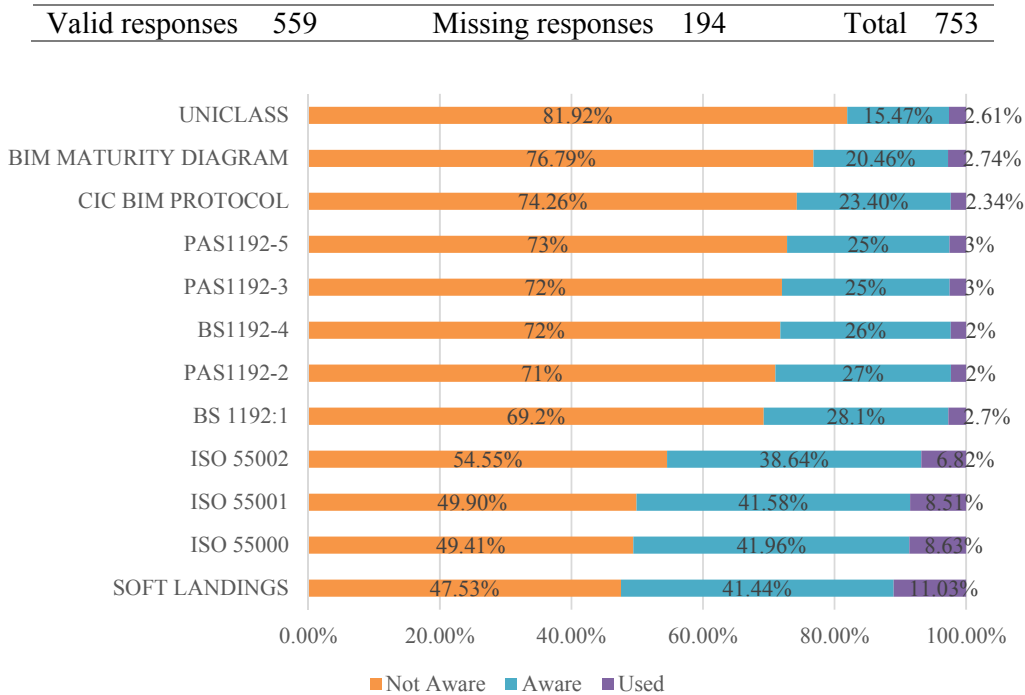


Figure 6-30: Questionnaire Results – FM Awareness and Use of BIM Standards

The last question of the survey focused on awareness and use of BIM standards, and the responses provided highlight how there is a general lack of knowledge within the FM industry of key BIM documents such as the eight pillars of BIM (section 5.2.1). The results also confirm that the proliferation of standards and policies is counterproductive, and the FM industry is not familiar with the standard BIM processes and procedure, as was observed during the workshop. Some of the standards directly related to FM, such as the ISO 55000 suite on asset management and soft landing, are more widely known, whilst PAS 1192-3, a key BIM document that focuses on the operational phase, is known by 25% of the respondents and was used by only 3%.

6.5.4 Discussion of questionnaire findings

The purpose of the questionnaire was to analyse the FM relation with BIM and validate some of the results of the workshop. Although for the study there were not specific targets, the participants were from different roles, markets and organisations, providing a comprehensive overview of the FM industry and showing no bias towards any specific group.

The results of the questionnaire confirmed many of the points discussed during the workshop. Although the FM industry is aware of BIM (question 17) and its potential uses, not only for design and construction but also for operations (questions 18-20), the use of BIM for FM is limited (questions 26, 28 to 30). Respondents reported being more aware of and knowledgeable about BIM than their companies (questions 21-24), although most companies have an interest in implementing BIM in the future (question 27). Maintenance is always indicated as the most common use of BIM for FM, both as potential added value (question 25) and in real projects (questions 32 and 35).

One of the reasons why the uptake of BIM is still slow compared to other parts of the construction industry is that models developed during design and construction are not always handed over to FM after practical completion (question 33). Another reason is the immaturity of the FM industry regarding BIM, both in terms of understanding of the protocols and norms underpinning a BIM project (question 36) and practical use and expertise (questions 28 to 30). Not even half of the models handed over after construction are used during operations (questions 34), and only a small number of models are created for existing buildings (question 31).

6.6 Conclusion

This chapter presented the results and the analysis of the pilot study and questionnaire survey carried out to understand the relationship between FM and BIM. Both the workshop and the survey confirmed that there are benefits in implementing BIM for FM and that the FM industry is aware of BIM and its uses. Nevertheless, BIM during operation is not as widely utilised as during design and construction, owing to several issues confirmed by both the workshop and the questionnaire results.

Firstly, while the possible benefits of using BIM for FM are known, there is a lack of practical evidence preventing the FM industry from embracing the process. Consequently, models handed over after construction are not used and models for existing buildings are not created, providing facilities managers with limited opportunities to utilise BIM during building operations.

Although standards and policies have been created to support the industry in the BIM implementation, the questionnaire showed an overall immaturity of the FM industry in terms of BIM, and a lack of knowledge of the existing standards. As discussed during the workshop, there is a need for a unique industry standard that will align with not only the FM industry, but also all the stakeholders involved in the processes of design, construction and management of a building.

Lastly, as the percentage of new buildings is lower compared with the existing building stock, the issue of creating information models for existing buildings needs to be addressed to support the development and use of BIM during FM. Furthermore, the different FM strategies for managing buildings will need to be taken into consideration, as they directly impact the breadth and depth of information that will need to be included in a specific model. Because information overload is a risk, a data strategy is needed that clearly identifies which information should be included in the BIM model.

Chapter 7 RetroBIM Framework for Existing Buildings

The results from the workshop and the questionnaire presented in Chapter 6 confirm that facilities managers are currently not engaged in BIM, and that although there is a general awareness of it and its potential, there is still limited use of BIM in the FM industry. Moreover, as facilities managers work with buildings during operations, the problem of implementing BIM models for existing estates is important, and can arguably also be one of the reasons as to why facilities managers are not as advanced as designers and constructors in applying BIM.

7.1 Building information modelling for existing buildings

Although it would be ideal to have as-constructed information models available for every building, most of the existing estates have been built before the “BIM era,” and although the number of projects using BIM nowadays is growing, it is still not being applied to all new constructions. Technology allows for the creation of as-built 3D models that can be used during buildings operation phase but, according to Kassem et al. (2015), a lack of client demand to implement models for FM together with “a shortage of BIM skills and understanding by FM professional [...] is creating a vicious circle inhibiting BIM adoption in FM applications.”

Nowadays, the process most commonly used to create an as-built 3D model is scan-to-BIM through 3D laser scanning (Hajian & Becerik-Gerber, 2010). 3D laser scanning is an imaging technology that has been in use since 1990. With millimetre accuracy, the 3D laser scanning allows the creation of detailed data about a building (Bosché, Guillemet, Turkan, Haas, & Haas, 2014). The technology is faster and more accurate than traditional surveys methodologies (Lijing & Zhengpeng, 2008), offers a large range of possible applications and it is currently the most accurate approach to creating 3D models for existing buildings (Gimenez, Hippolyte, Robert, Suard, & Zreik, 2015). However, there are some potential difficulties in the scan-to-BIM process: indoor scans are not as accurate and fully automated as for external shapes (Valero, Adan, & Cerrada, 2015; Xiong, Adan, Akinci, & Huber, 2013), complex design can make the process more difficult and the huge amount of data created during the scanning often leads to slowdown or failure of the process (Jung, Hong, Jeong, Kim, Cho, Hong & Heo, 2014). Moreover, the equipment required for the

scanning has high costs and requires intensive data processing and modelling (Volk et al., 2014).

Although the process of obtaining detail-rich BIM is time consuming and labor intensive, recent research has focus on the development of automated methods (Jung, Stachniss, & Kim, 2017). For the first applications of BIM for existing buildings the scanned models were combined with prior available drawings (Bruno, De Fino, & Fatiguso, 2018). whilst more recently the models are integrated with photogrammetry, which detects more easily the type of surface scanned (Volk et al., 2014). Primitive shapes such as walls and pipes can be converted in automatic to parametric objects through a series of software add-ons although the percentage of shapes automatically or semiautomatically recognised is low and manual modelling of parametric objects continues to be the most used technique (Bruno et al., 2018). However, owing to the rapidly evolving nature of the technology industry, it is possible that in the near future the scan-to-BIM process will become more efficient and accessible in terms of costs.

As confirmed by the questionnaire responses (section 6.5.3), the creation of models for existing buildings is still limited, and specifically in terms of the scan-to-BIM methodology this is due to the complexity of the process (data capturing, processing and model creation), the effort (Volk et al., 2014), time needed (Saidi, Choek, Framaszek, Brown, Swerdlow, Lipman & Goodrum, 2011), the advanced skills required and overall costs (Gimenez et al., 2015). Moreover, a 3D building model would only be a graphical representation of the building and not include information useful during operation. Researchers are looking for a methodology to convert point cloud into semantically rich BIM model, but this is not readily available as yet (Pătrăucean, Armen, Nahangi, Yeung, Brilakis, & Haas, 2015).

As facilities managers require not only graphic information but also associated data (Figure 6-1), creating BIM models for FM would need to address the different requirements within each project (Volk et al., 2014) and allow a level of flexibility to support the different building types, building uses, management strategies and users. This aspect was also identified as a barrier to the implementation of BIM for FM during the focus group (section 6.2.2). Hence, the identification of a unique set of information that could be used to create models for every building during the

operational phase is not possible, as every building will in fact require different information stored and recorded during its life-cycle (Carbonari, Ashworth, & Stravoravdis, 2015). Moreover, acquiring the data needed for managing the buildings is a major obstacle for the implementation of information models for FM (Ebbesen, 2015).

To be able to extend the benefits of BIM into FM and beyond new constructions, there is the need for a new approach to support the development of information models of existing buildings that would provide facilities managers with the information they require.

7.2 RetroBIM framework

The RetroBIM framework was created to provide a structured approach aimed at simplifying the development process of BIM models for existing buildings and providing facilities managers with the opportunity to create models tailored to their building, management strategies and users.

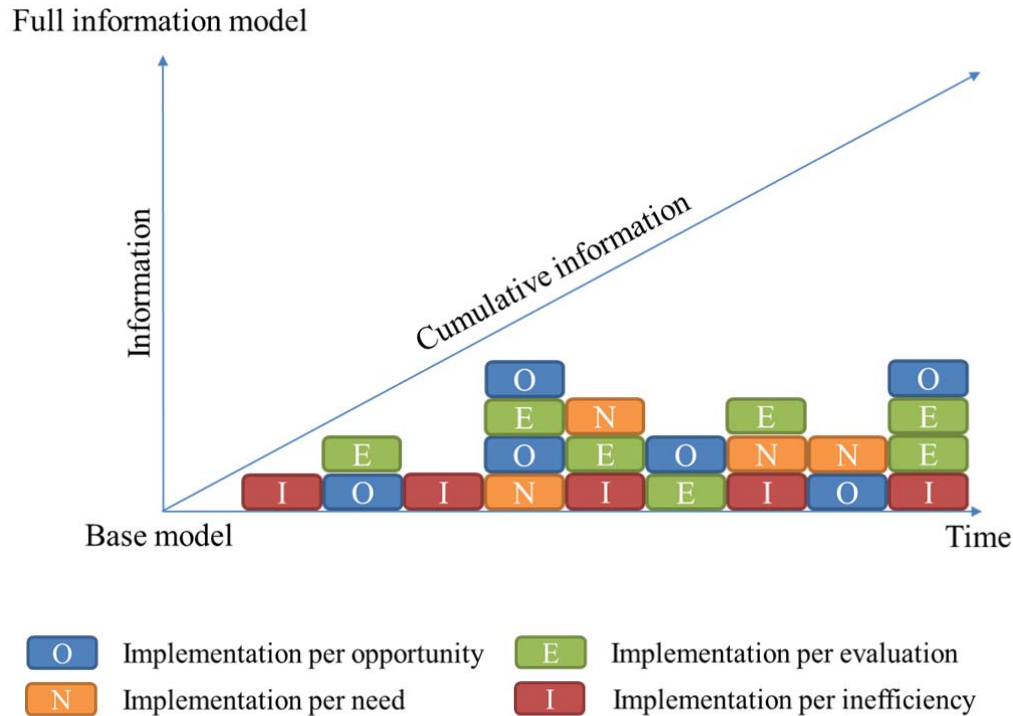


Figure 7-1: RetroBIM Framework

The framework begins with the base model, a 3D representation of the building, and provides a methodology to populate the model with information necessary to operate and maintain the building and to answer both short-term and long-term strategy needs and day-to-day operations. Over time, additional information can be included in the model, becoming a tool that can support facilities managers by providing appropriate information based on each organisation's and building's needs.

A previous version of the RetroBIM framework was included in the paper 'Building Information Model for Existing Buildings for Facilities Management: RetroBIM Framework' published in the International Journal of 3-D Information Modeling 5(1) (see Appendix 6 for full text).

7.3 RetroBIM information implementation

Although facilities managers rely mainly on non-graphical information for managing a building, graphical data is still required during building operations, therefore the starting point for the RetroBIM framework is a 3D model of the facility, called a base model. The base model is a simplified representation of a building with only external walls and, if possible, internal partitions, doors and windows. These elements can be included in the model without real specifications by using the default setting available in the software suite. The main function of the base model is to act as a starting point for the implementation of the model that will develop further over time.

The base model can be developed using existing 2D floor plans, through a survey of the property or through scan-to-BIM. To achieve the full capability linked to a BIM model, it is vital to include information related to the asset within the model and going beyond the 3D representation of the building. Every model is unique and includes specific information, hence it is important that the framework and the implementation process reflects this requirement for flexibility. The model develops over time, as shown in Figure 7-1, and the implementation can occur in four different ways:

- implementation per opportunity;
- implementation per need;
- implementation per evaluation; and
- implementation per inefficiency.

7.3.1 Implementation per opportunity

The implementation per opportunity occurs when new information about the building or part of the building becomes available and therefore should be included in the model (Figure 7-2).

Examples of implementation per opportunity are:

- a new system is installed/replaced;
- systems maintenance;
- small projects; and
- Capital Expenditure (CAPEX) projects.

Full information model

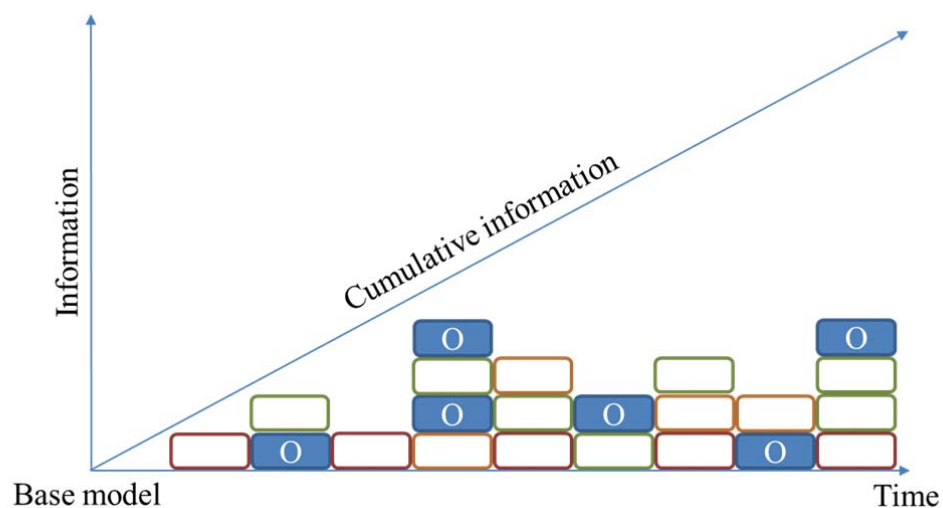


Figure 7-2: RetroBIM Framework – Implementation per Opportunity

New systems are replaced/installed

Every part of the building has a mean life and, at some point during the operative phase, almost every item will be replaced. The new piece of kit installed, be it a boiler, a light bulb or a pipe, should be included in the model, together with all the relevant information about warranties, maintenance and operations.

Systems maintenance

When systems are maintained the new information should be included in the model, creating a history of each asset and supporting the development of a more detailed maintenance plan over time.

Small projects within the building

When a building undergoes small changes such as modification or renovation, the new information should be included in the model, so that updated as-built information is always available through the model. Small projects may also allow one to access systems that are generally not directly accessible, such as pipes within walls, and including this information will enable the development of a more detailed model.

CAPEX projects

For CAPEX projects, the model should be implemented during the different project phases following the methodology defined in the PAS 1192:3.

7.3.2 Implementation per need

Some information is used more often than others when managing a facility. If the facilities manager identifies a set of information that is used regularly, it would be beneficial to include the information within the model (Figure 7-3).

Full information model

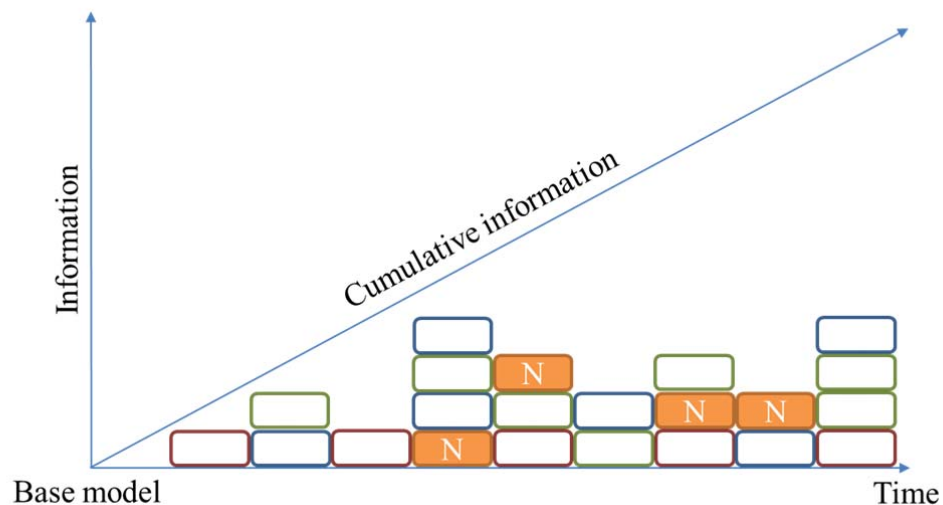


Figure 7-3: RetroBIM Framework – Implementation per Need

The facilities manager of an industrial building might need to specific health and safety regulations and the model can include the information that is more often needed for that type of assessment. In the same way, a landlord might need to include details about the finishes of the common areas within the premises because these are more needed while providing services to the tenants.

7.3.3 Implementation per evaluation

As one of the key functionality of BIM is to enable the evaluation of different scenarios, this should be used for facilities management. During the life of the building, managers generally base their decisions on a limited amount of information, which is often not updated. The model, even at the initial stages of implementation, can be used to evaluate how the building would react to a series of changes, and help facilities managers to make more informed decisions (Figure 7-4).

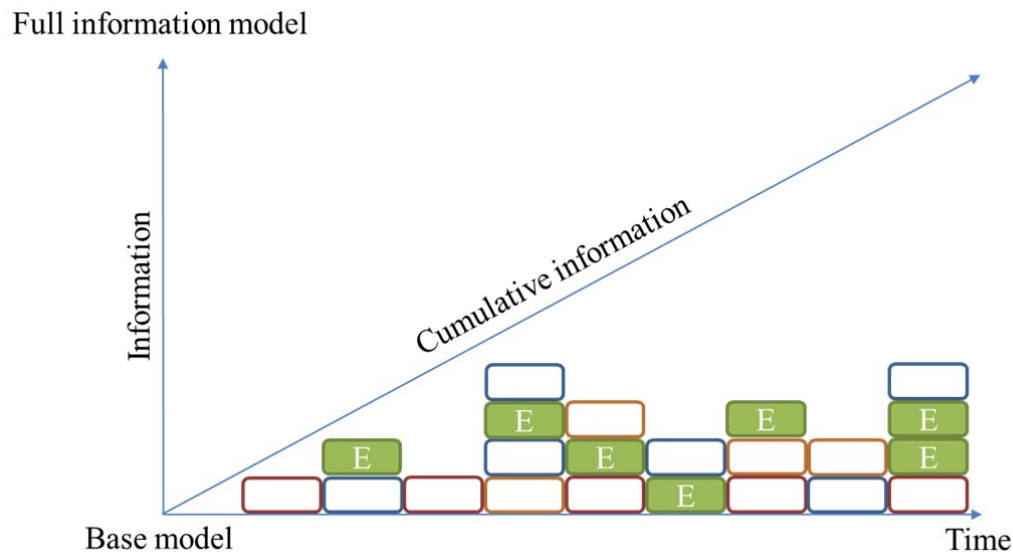


Figure 7-4: RetroBIM Framework – Implementation per Evaluation

For example, is possible to evaluate the impact of replacing the existing glazing with a more efficient type and base the decision on actual considerations and simulations done on the building itself. The model can also, for example, be used for evaluating new layout or room arrangements and test the different options.

7.3.4 Implementation per inefficiency

For a long time, the construction industry has been challenged to improve its efficiency (Oman & Dulaimi, 2015). In (1998) Sir John Egan together with the Construction Task Force wrote the “Rethinking Construction Report” with the aim of improving the quality and efficiency of UK construction. One of the substantial changes they suggested to enable improvements and achieve a modern construction industry was the use of technology. More recently, as part of the Construction 2025 strategy, the UK Government envisions the construction industry in 2025 as efficient and technologically advanced. The same applies for FM, and technology is now considered a part of the facility infrastructure (Best, Langston, & De Valence, 2003). To improve efficiency in FM, technology should have a two-fold role, as highlighted by Best et al. (2003):

- Enable strategic decision, supported by statistically significant information derived from real data;
- Supports the day-to-day operation by providing relevant and real-time data.

As BIM can support FM both at the strategic and operational level, its applications should be utilised to improve efficiency. Therefore, the fourth possible implementation of the RetroBIM framework is through the inefficiency analysis, which ensures a periodic implementation of the model and a continuous use of BIM for enhanced FM practices (Figure 7-5).

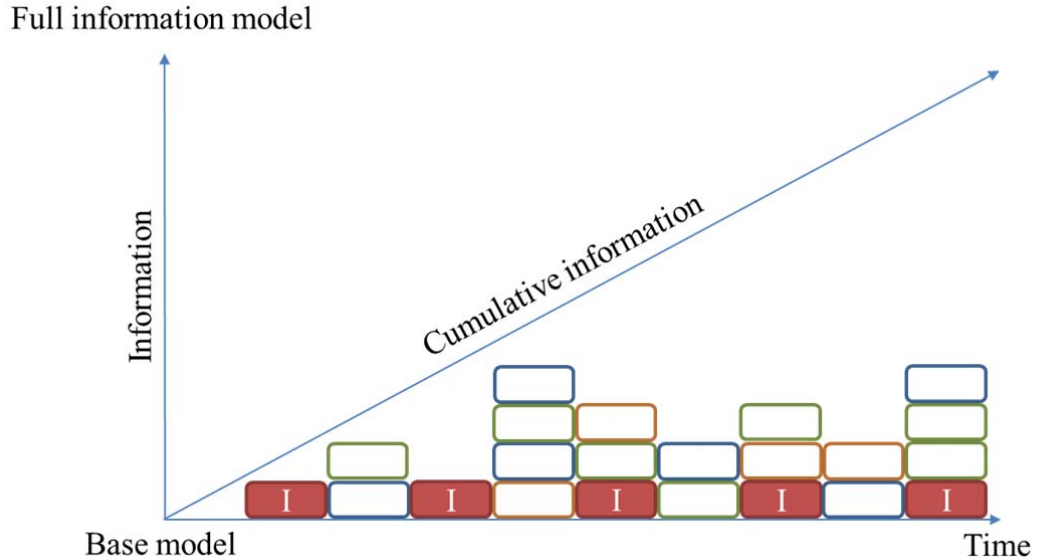


Figure 7-5: RetroBIM Framework – Implementation per Inefficiency

The implementation per inefficiency is based on the evaluation of 68 different tasks that are part of a facilities manager’s role and responsibility and the identification of how BIM can support the performance of each task and improve its efficiency. The tasks, identified through literature investigation and analysis of over 300 FM job descriptions, have been divided into 11 groups:

Table 7-1: RetroBIM Framework – FM Tasks for Inefficiency Analysis

Group	Tasks
Property management	Property management strategies Day-to-day operation Information management Asset management Asset record Evaluation business performance Space management
Service provision	Catering Cleaning Help desk Post Utilities Logistics Telecommunications
Procurement	Market intelligence Contractor registers Bid process Tender process

	<ul style="list-style-type: none"> Outsource management Raise purchase orders
Budget management	<ul style="list-style-type: none"> Invoices Cost control Whole-life costs Capital projects
Client-stakeholders' management	<ul style="list-style-type: none"> Relationship management Satisfaction surveys Client reporting Post-occupancy evaluation
Security	<ul style="list-style-type: none"> Access control Asset protection Keyholding Guarding CCTV
Safety, health and environment	<ul style="list-style-type: none"> Strategy development Emergency procedures Safe working practices Risk management Improving wellbeing Waste management Building certifications Measuring performance Staff involvement Compliance statutory requirements
Risk management	<ul style="list-style-type: none"> Crisis strategy development Business continuity strategy Business impact analysis Staff training Risk identification Risk analysis
Maintenance	<ul style="list-style-type: none"> Preventative maintenance Reactive maintenance Maintenance programming Condition assessments Development maintenance strategy Evaluation maintenance strategy Analyse maintenance data Completion of maintenance reports
Contract management	<ul style="list-style-type: none"> Service-level agreements Specifications Contract management Performance management Mobilisation Supplier management

Project management	Project development Monitor project progress Budget allocation Budget management Task schedule Assessment project output
--------------------	---

As part of the questionnaire, which is presented in Chapter 6 (section 6.5), the respondents were asked to validate the list of FM tasks to ensure all tasks performed by facilities managers have been included. The respondents had the opportunity to add tasks to the list provided. The following tasks were subsequently included into the list:

Table 7-2: RetroBIM Framework – Additional FM Tasks for Inefficiency Analysis

Group	Tasks
Property management	Benchmarking Management Building Management Systems (BMS) Evaluation building performance
Service provision	Pest control Transport Fleet management
Safety, health and environment	Energy management
Project management	Moves and relocations

7.3.4.1 Tasks mapped against Industry Foundation Classes

To understand what information included in a BIM model would be useful for FM, each FM tasks was mapped against Industry Foundation Classes (IFC). IFC is defined as “a neutral and open specification that is not controlled by a single vendor or group of vendors” (Underwood & Isikdag, 2010) and supports the exchange of geometric and non-geometric information between stakeholders, providing software interoperability across different architecture, engineering and construction platforms (Ghaffarianhoseini et al., 2017). The IFC, developed by the buildingSMART alliance, is a conceptual data schema that defines all components of a building (Vanlande, Nicolle, & Cruz, 2008) and aims to integrate information required by different stakeholders (Kang & Hong, 2015). The specification includes terms, concepts and data originated within the construction and FM industries (buildingSMART alliance, n.d.). The IFC4add1, released in July 2015, can hold interdisciplinary information about the geometry and associated data of the different elements in a building information model, and can be used to exchange file format for BIM data (Sun, Liu,

Gao, & Han, 2015) between different software applications used in AEC (Kang & Hong, 2015). The purpose of IFC is to standardise sharing and data access in information models while enabling interoperability among heterogeneous software (Mitchell & Schevers, n.d.). The standard is supported by most BIM software vendors (Lin, Liu, Gao, Han, Lai & Gu, 2013). The COBie file required by the UK Government for the publicly funded projects, as part of the BIM mandate, is a subset of IFC (NBS, 2012), hence the decision to map the tasks against IFC instead of COBie as it is a more comprehensive dataset.

The IFC model represents a series of four conceptual layers, providing an increasingly specialised functionality.

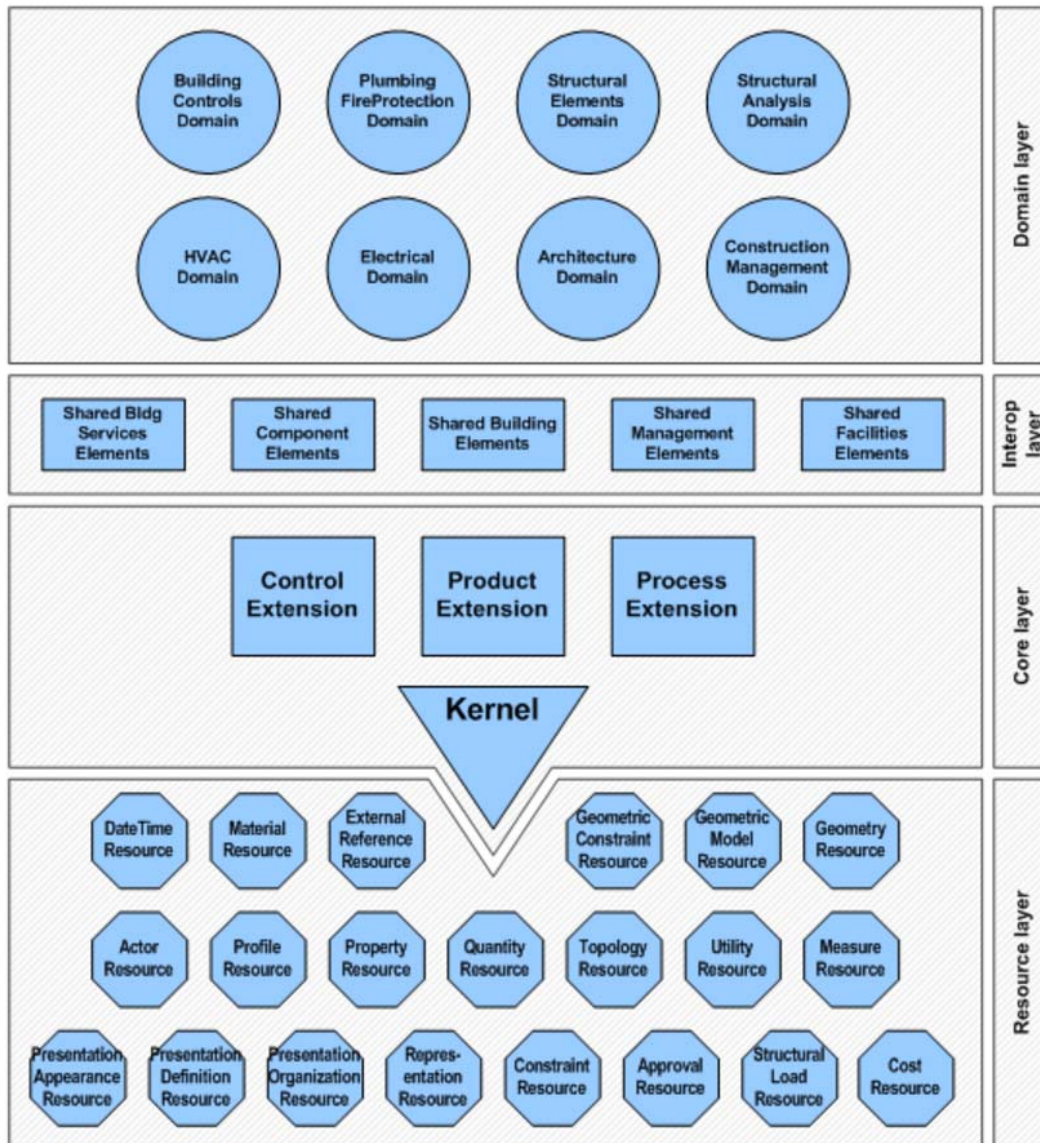


Figure 7-6: IFC Data Schema Architecture with Conceptual Layers (BuildingSMART, n.d.)

The layers, as described by BuildingSmart (n.d.), are:

- Resources layer – the lowest layer includes all individual schemas containing resource definitions.
- Core layer – the next layer includes the kernel schema and the core extension schemas, containing the most general entity definitions. All entities defined at the core layer, or above, carry a globally unique identification and optional owner and history information.

- Interoperability layer – the next layer includes schemas containing entity definitions that are specific to a general product, process or resource specialisation used across several disciplines. These definitions are typically utilised for inter-domain exchange and sharing of construction information
- Domain layer – the highest layer includes schemas containing entity definitions that are specialisations of products, processes or resources specific to a certain discipline. These definitions are typically utilised for intra-domain exchange and sharing of information.

The FM domain is defined by the IFCSharedFacilitiesElements schema, together with IFCProcessExtension, IFCSharedMgmtElements and IFCFacilitiesMgmtDomain, providing a set of elements that can be used to share information concerning facilities management.

Each building element (or entity, as defined in the IFC) is identified in a unique way through a hierarchical structure that starts from the IFCRoot. The first level of specialisation from the IFCRoot comprises three fundamental entity types: the object definition (IFCObjectDefinition), the relationship definition (IFCRelationship) and the property definition (IFCPropertyDefinition). The object definition includes all physically tangible items, such as wall, beam or covering. The IFCRelationship handles the relationships among objects, while the property definition generalises all the characteristics of the different objects. This first level of specialisation develops further in several subtype trees, as illustrated in Figure 7-7, which presents an example of a hierarchical tree definition of a boiler.

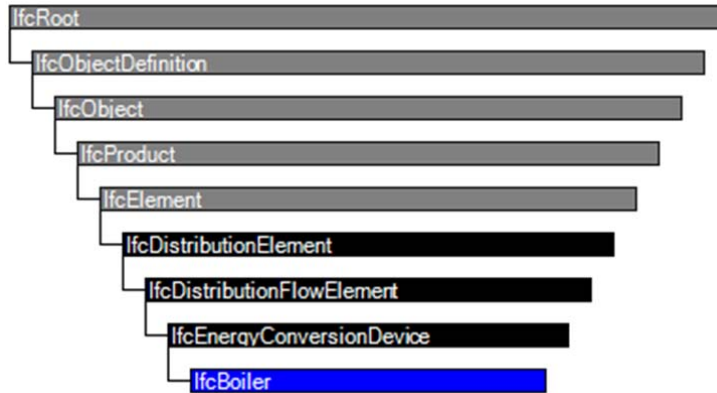


Figure 7-7: IFCBoiler Hierarchy (BuildingSMART, n.d.)

The different entities have also sets of the specification, which not required to be implemented, that can be used to provide specific information related to each item.

For example, every boiler insert in the model can be described by five different groups of information: object typing, property sets for objects, quantity sets, material constituents and post nesting. The object typing defines details such as the boiler type (e.g. water, steam, etc.); quantity sets describes values for the length, area, volume, etc. of the boiler; the material constituents provides details on the material from which the casing is constructed; and the port nesting indicates possible connection to other objects such as pipes. Figure 7-8 summarises the property sets that can be added to the boiler in a model.

Condition	Boiler Type Common	Electrical Device Common	Environmental Impact Indicators
Assessment Date	Reference	Power Factor	Reference
Assessment Condition	Pressure Rating	Number of Poles	Functional Unit Reference
Assessment Description	Heat Transfer Surface Area	Has Protective Earth	Unit
	Water Storage Capacity	IP Code	Expected Service Life
	Is Water Storage Heater	Rated Current	Total Primary Energy Consumption Per Unit
	Nominal Energy Consumption	Rated Voltage	Water Consumption Per Unit
	Nominal Part Load Ratio	Nominal Frequency Range	Hazardous Waste Per Unit
	Water Inlet Temperature Range	Conductor Function	Non Hazardous Waste Per Unit
	Outlet Temperature Range	Insulation Standard Class	Climate Change Per Unit
	Status		Atmospheric Acidification Per Unit
	Operating Mode		Renewable Energy Consumption Per Unit
	Energy Source		Non Renewable Energy Consumption Per Unit
			Resource Depletion Per Unit
			Inert Waste per Unit
			Radioactive Waste Per Unit
			Stratospheric Ozone Layer Destruction Per Unit
			Photochemical Ozone Formation Per Unit
			Eutrophication Per Unit
			Life Cycle Phase

Environmental Impact Values	Manufacturer Occurrence	Manufacturer Type Information	Service Life	Warranty
Total Primary Energy Consumption	Acquisition Date	Global Trade Item Number	Mean Time Between Failure	Warranty Identifier
Water Consumption	Bar Code	Article Number	Service Life Duration	Warranty Start Date
Hazardous Waste	Serial Number	Model Reference		Warranty End Date
Non Hazardous Waste	Batch Reference	Model Label		Is Extended Warranty
Climate Change	Assembly Place	Manufacturer		Warranty Period
Atmospheric Acidification		Production Year		Warranty Content
Renewable Energy Consumption		Assembly Place		Exclusions
Non Renewable Energy Consumption				
Resource Depletion				
Inert Waste				
Radioactive Waste				
Stratospheric Ozone Layer Destruction				
Photochemical Ozone Formation				
Eutrophication				
Lead In Time				
Duration				
Lead Out Time				

Figure 7-8: IFC Boiler Property Sets

The mapping process of the FM tasks against the IFC was limited to the entities that can be implemented alone in a model without the need of supporting information. The single entities contained in the IFC were considered both for direct use during the performance of the task and as supporting information for analysis. The complete list of IFC entities useful for each task can be found in Appendix 4.

As the results of the questionnaire show (section 6.5.3), the FM industry believes that the possible applications of BIM for FM are mainly linked to hard services and maintenance. By excluding the possible applications and uses of BIM for soft services, the usefulness of BIM would be limited to only a part of the tasks normally performed by facilities managers. Although the link might not be direct, all FM tasks would benefit from some of the information included in a model, and task efficiency can be improved by integrating the information included in a BIM model with the

information provided by other tools, such as SAP, CAFM systems or human resources database.

7.3.4.2 Inefficiency implementation process

The inefficiency implementation process starts with an assessment performed by the facilities managers of the efficiency of the FM tasks and the selection of the information currently available in the model of the building (input).

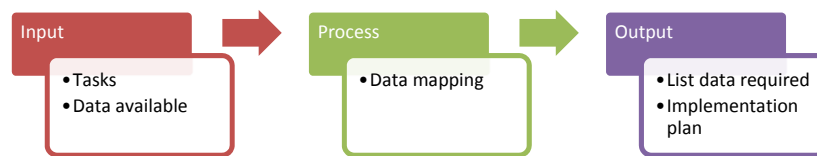


Figure 7-9: RetroBIM Framework – Inefficiency Implementation Process

The tasks indicated as inefficient are mapped (process) against the IFC, and the process returns the list of information required to improve the selected inefficiencies (Appendix 4) together with a suggested implementation plan (output).

The implementation plan is based on the level of inefficiency of the different tasks indicated by the facilities managers and the amount of information required to support the specific task. Through the analysis of these two factors it is possible to identify which tasks should be implemented first as part of the model and support the achievement of more efficient facilities managers. In the graphical representation of the implementation plan (Figure 7-10) each FM task is plotted within the graph based on the number of entities required and the level of efficiency indicated by the facilities manager.

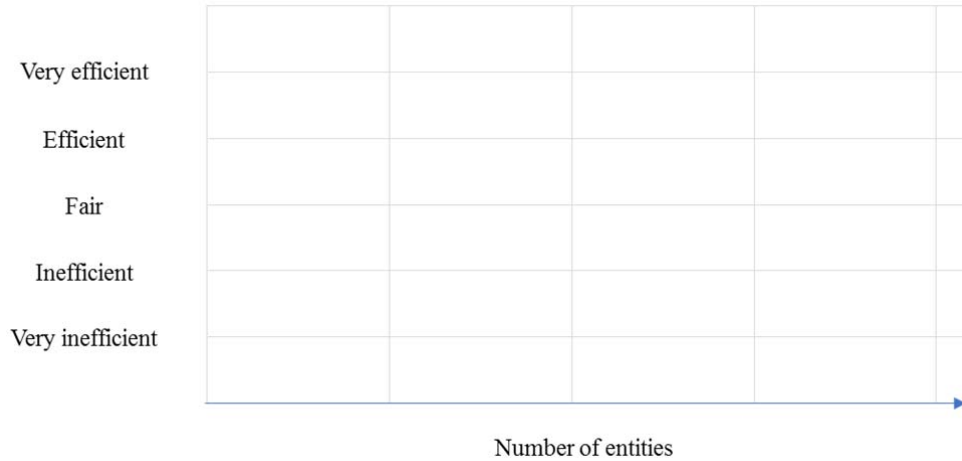


Figure 7-10: Implementation plan graphical representation

The plan is then divided in four different areas, numbered from I to IV (Figure 7-11), which identify the order by which the tasks should be implemented.

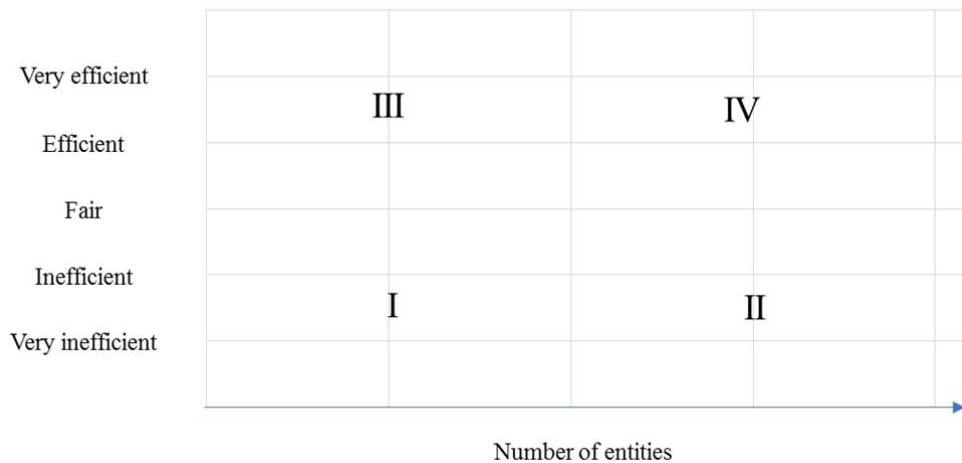


Figure 7-11: Implementation plan areas

The tasks located near I should be implemented first as they are evaluated as highly inefficient but require a limited amount of information to be implemented. Following I are the tasks located near II and III: although the tasks near II are more inefficient than the task in III, they require a higher volume of information. The decision to implement items from II and III can be based on the opportunity to maximise the number of tasks that can be improved by implementing the least amount of information. In fact, some of the tasks can be automatically covered by implementing information in the model for other tasks. Lastly, the tasks near IV should be

implemented as they are less inefficient than the other tasks and require more information. As the model grows over time, the information included in the model by opportunity, need, evaluation and previous inefficiencies analysis would help reduce the amount of data required to improve other inefficiencies, thus reducing time and effort for implementation and covering more tasks.

Two previous versions of the implementation plan were included in the papers ‘Improving FM task efficiency through BIM: a proposal for BIM implementation’ published in the Journal of Corporate Real Estate volume 20, issue 1 and ‘Building information model implementation for existing buildings for facilities management: framework and two case studies’ published as part of Building Information Modeling (BIM) in Design, Construction and Operations Southampton: WIT Press (see Appendix 6 for full text).

In the example, below seven tasks were rated as follows:

- asset management – very inefficient;
- cost control – very inefficient;
- whole-life costs – inefficient;
- post – inefficient;
- staff training – efficient;
- development maintenance strategy – efficient; and
- condition assessment – very efficient.

By plotting the tasks against the amount of information required (Figure 7-12) and diving the tasks in four groups (Figure 7-13), it is possible to identify the implementation plan.

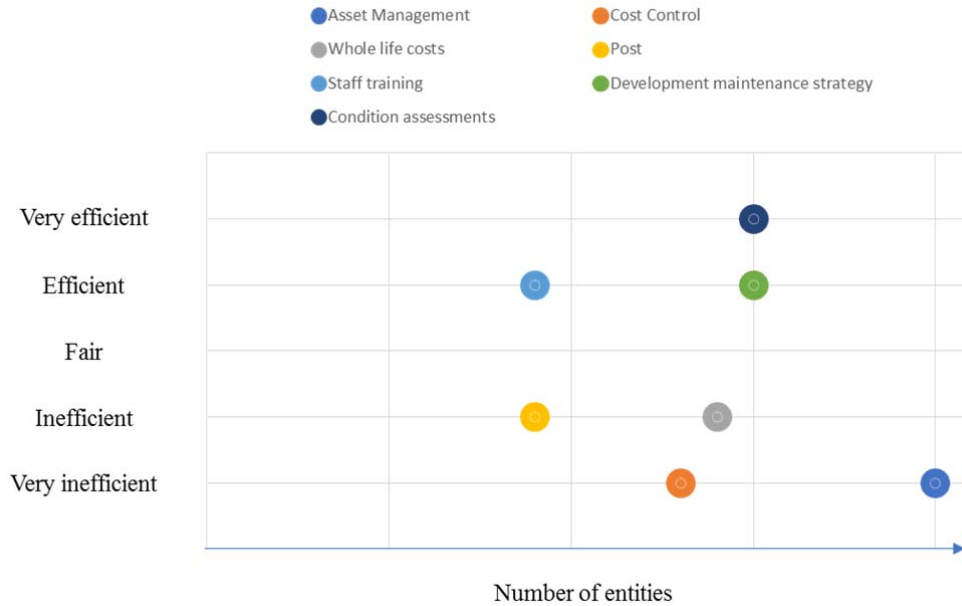


Figure 7-12: Example: Inefficient Tasks and Information Required Map



Figure 7-13: Example: Inefficiency Implementation Plan

In the example presented in Figure 7-13, the initial focus should be on Post, as it was indicated as an inefficient task and requires limited amount of information compared to other tasks in the plan (area near I). The facilities manager should then focus on cost contro, whole lift costs, asset management (area II) and staff training (area III) and decide among these tasks which should be implemented first as their level of inefficiency is different but they also require different number of entities. The tasks

that should be considered lastly are the one in the zone IV, condition assessment and development of maintenance strategy, as both marked as efficient or above and with a high number of entities required.

7.3.4.3 Inefficiencies in facilities modelling – Questionnaire results

Together with the validation of the FM tasks, the respondents to the questionnaire presented in Chapter 6 (section 6.5) were also asked to rate the efficiency of the tasks they perform using a 5-points Likert scale ranging from very inefficient to very efficient. The objective of the question was to understand, through the participants' evaluation of the different tasks, the perception of efficiency and inefficiency of the facilities manager's tasks. The Likert scale was used to measure (DeVellis, R.F., 2011) and summarise attitude (Cooper & Schindler, 2013) the varying the opinions of the respondents.

The result of the evaluation shows that all the tasks were rated very inefficient or inefficient by some of the participants, with a percentage that varied between 27% and 3%. The tasks defined as most efficient are those regulated by norms or laws, such as compliance with statutory requirements, safe working practices, emergency procedures and risk management (Figure 7-14).

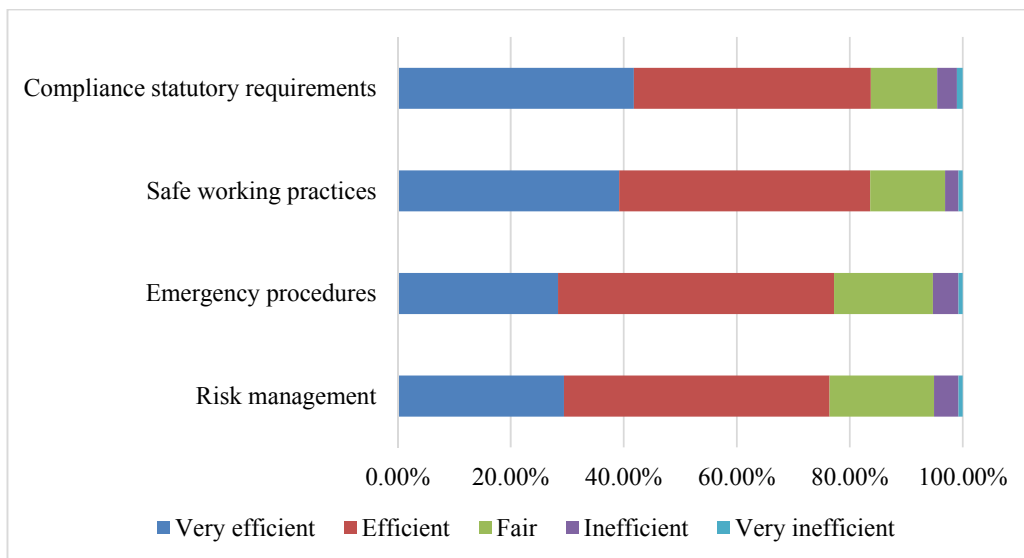


Figure 7-14: Questionnaire Results – Most Efficient FM Tasks

In contrast, the tasks identified as the most inefficient (Figure 7-15) are those not regulated by norms.

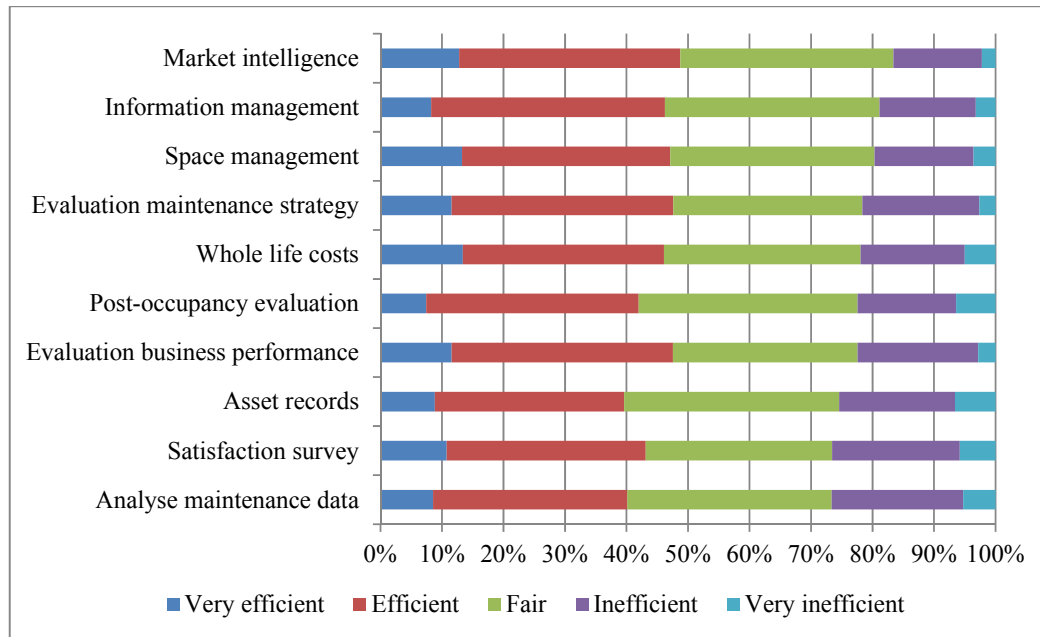


Figure 7-15: Questionnaire Results – Most Inefficient FM Tasks

Some of the tasks perceived as most inefficient by facilities managers, such as information management, space management, whole-life costs, asset record and analysis of maintenance data, would benefit by a direct use of BIM, confirming that BIM would enhance current FM practices. Moreover, as indicated previously, BIM can provide helpful information for the performance of all the tasks identified and, through the RetroBIM implementation model, can be made available for the entirety of the building stock.

7.4 RetroBIM applications

The purpose of the RetroBIM framework is to provide Facilities Managers with a methodology they can apply to develop tailored information models for existing buildings. The framework is design to support the development of information within the model over time, with the aim of including always more information that would support the building operation. Nevertheless, although not completed, each model developed through the process can have different applications. Right from the beginning of the development, with the base model, the simple 3D representation of

the building shell and partitions can be used to support functions such as space management, room management and provide guidance on the different room locations. With the incremental level of information included, the use of the model became then two-fold: as single source of information for a building, the model can be used as asset register and incremental data depository but also used to analyse the building and its use, providing facilities managers with a powerful tool that would be otherwise not available to them.

7.5 RetroBIM validation

The aim of the validation was to understand the potential usefulness and practicality of the RetroBIM within the FM industry. The participants invited to validate the framework (Table 7-3) were all subject-matter experts, with a deep understanding of BIM and FM practices.

Table 7-3: RetroBIM Validation Participants

ID	Job	Number of years worked in the industry
1	Director Consultant	30
2	BIM and FM Consultant	7
3	Director Facilities Management	23
4	Director Facilities Management	30
5	Director BIM and Digital Innovation	25
6	Director Consultant	19
7	BIM Lecturer	27
8	Director Consultant	30
9	Director Facilities Management	25
10	Director BIM Consultant	12

During the validation, the participants were asked to rate, using a 5-point Likert scale, the following statements:

- the framework facilitates the implementation of information models for existing buildings;
- the framework is potentially useful; and
- the framework is practical to be implemented in the industry.

The reviewers were also asked to whether they could identify benefits for implementing the framework and possible barriers to the framework implementation.

The majority of the reviewers (60%) agreed that the framework facilitates the implementation of BIM models for existing buildings and commented:

- “The framework puts a good overall strategy towards the implementation” (reviewer 2).
- “The base model populated (iteratively) with information over time makes it less daunting for clients (and their subcontractors) to develop a retrospective model” (reviewer 5).
- “This framework will act as a trigger for the continuous update of the model” (reviewer 7).
- “A cumulative approach to building a model for an existing building is a sound approach” (reviewer 10).

The RetroBIM framework was defined as potentially useful by 90% of the reviewers, who also commented:

- “The framework shows a clear roadmap to building information over time” (reviewer 3).
- “I like the incremental nature of the framework” (reviewer 9)

Based on a theoretical evaluation of the framework, 50% of the reviewers agreed that the framework is practical enough to be implemented in the industry and added:

- “The framework sets out a great process to follow, but needs more work in terms of whomever is going to be involved in implementing the process” (reviewer 2).
- “It is simple to follow” (reviewer 3).
- “It recognises that the data will not be available for an existing building so has to be built over time” (reviewer 8).
- “I think the incremental nature is a bonus” (reviewer 9).

The reviewers agreed there are benefits to implementing the framework:

- “Yes, it is very beneficial. It also highlights how that information could be used which I also believe is very beneficial” (reviewer 2).
- “[It is a] useful guide in the creation of retrospective models. [It provides] [o]pportunities for consistency in the creation of retrospective models and to continually evaluate the effectiveness of the framework over time” (reviewer 5).
- “[The tools offers a] [s]tructured approach that can be built into asset plans as part of normal FM and property management and capital programmes” (reviewer 6).
- “The categorisation of the different strands and stimuli for the update will enhance the client focus upon differing FM needs” (reviewer 7).
- “Yes, as all buildings have to be managed and to obtain optimised performance you need data” (reviewer 8).
- “Digitalisation of building stock would improve all activities related to building O&M” (reviewer 9).

The reviewers also identified a series of potential barriers to the framework implementation:

Clients

“The biggest barrier would be getting a well-educated client that does see the benefit of the framework, and at the end of the day, a big part of that must be about how that will impact his business and how much money will it save him, and if that is highlighted and explained quite well, anything after that will be possible and achievable” (reviewer 2).

“A client who does not apply the rigour of FM will not bother to use this tool” (reviewer 7).

Cost of implementing information

“1. Potential cost issues – if the existing asset information needs to be completely updated to meet the client's requirements for a retrospective model, is the client willing to pay for it? 2. Roles and responsibilities – clarification required. 3. Measurement of success – what does a good implementation look like?” (reviewer 5).

“Older properties with a lack of information – high front end cost” (reviewer 6).

“Lack of reliable information on existing buildings, and high opportunity cost to obtain such accurate information” (reviewer 9).

Developing the base model

“Capturing the geometry of the building needs to be elaborated. If this is problematic then it will be a barrier” (reviewer 4).

“Establishing the initial base line will be a once-off expense but increasingly the costs of creating the base line model are dropping as more technological solutions become available. The other barrier might be the age/obsolescence of the property this would need to be considered before commencing with this framework – there has to be enough useful life time left in the building to benefit from the investment” (reviewer 8).

The results of the validation process have demonstrated that the RetroBIM framework is suitable for implementing BIM models for existing buildings. The reviewers have identified a series of barriers that would need to be addressed before a practical implementation of the framework.

7.6 RetroBIM and the sustainability performance and reporting tool

The uses of BIM to support the sustainability performances and reporting tool are compatible with the implementation of the RetroBIM framework. The different evaluation methods identified as part of the tool can be utilised to implement additional information within the model whilst assessing the sustainability performance of the building.

7.7 Conclusion

As not all new buildings are designed and built using BIM and creating models for the existing estates is not a common process, there is a restricted availability of BIM models during operation. The use of BIM for FM purposes is very limited and not as advanced as other parts of the construction industry. The RetroBIM framework proposed in this chapter provides a methodology, which can be applied by facilities managers, that would support the implementation of BIM models tailored for FM needs. The model developed would not only support the operation of the building but would also act as an enabler for the interpretation and analysis of the information, expanding the possible uses of BIM for FM beyond maintenance. The implementation of the RetroBIM framework would allow facilities managers to perform the evaluation included in the sustainability tool to all buildings, supporting the enhancement of sustainability in FM.

Through the validation process, the subject matter experts have confirmed that the framework would facilitate the implementation of BIM models for existing buildings and that the approach is useful and practical enough to be implemented. In the next chapter, the sustainability performance and reporting tool and the RetroBIM framework are tested on three case studies to verify the flexibility of the two systems and understand how potential users perceive them.

Chapter 8 Case studies

Following the development and validation of the sustainable performance and reporting tool and RetroBIM framework, three case studies were used to provide real project examples and assess the effects and effectiveness of the two tools with potential users. The three case studies represent buildings at different stages of the building life-cycle, where FM services are managed by an internal team (65 Gresham Street), outsourced to a service provider (Belmont House) or partly self-delivered and partially outsourced (Dreadnought Library). The case studies were selected to ensure that the tools are flexible enough to accommodate the needs of different buildings and can be used without limitation for every building during operations, as discussed in section 2.4.5.

The initial development of the base model for two of the three case studies was included in the paper ‘Building Information Model for Existing Buildings for Facilities Management: RetroBIM Framework’ published in the International Journal of 3-D Information Modeling and Building information model implementation for existing buildings for facilities management: framework and two case studies’ published as part of Building Information Modeling (BIM) in Design, Construction and Operations (see Appendix 6 for full text).

8.1 65 Gresham Street

Located in the City of London, 65 Gresham Street is a multi-tenant office building. The second and third floors are leased to GVA (Figure 8-1) and the +4,600m² were fully refurbished in 2015. The two floors, connected via an internal staircase, host 500 members of staff in open plan space and provide an area dedicated to clients, offering multiple meeting rooms.



Figure 8-1: Case Study 1 – GVA

The office is managed by an internal team composed of two members who oversee both soft and hard services. All services are delivered by external companies. The results presented below were collected through an interview with both members.

8.1.1 Sustainability performance and reporting tool

8.1.1.1 Phase 1 – Strategic review

During the Phase 1 of the sustainability performance and reporting tool it was confirmed that all the key elements included in the strategic review are in place at GVA, therefore the evaluation continued with the phase 2.

Table 8-1: Case Study 1 – Strategic Review of Sustainability Performance and Reporting Tool

Questions	Answer
Does FM comply with all applicable legal requirements on sustainability?	Yes
Does FM have a defined FM strategy in terms of sustainability?	Yes
Is this translated into achievable objectives and targets?	Yes
Is there an action plan developed to achieve the objectives and targets?	Yes
Are long- and short-term priorities for this strategy defined?	Yes
Does FM create corrective action plans when	Yes

sustainability performance is below expectations or does not achieve targets?	
Are strategy and linked objectives and targets communicated within the organisation?	Yes
Are there resources available for implementing these initiatives?	Yes
Does FM comply with relevant standards and code of practices for sustainability?	Yes
Are stakeholders aware of the strategy?	Yes
Are stakeholders involved in the development and implementation of the strategy?	Yes
Do stakeholders receive reports on the performance and progression of these strategies?	Yes

8.1.1.2 Phase 2 – Objectives evaluation

In the objectives analysis included in phase 2 of the tool, GVA has identified a total of 32 very high priorities and 35 high priorities.

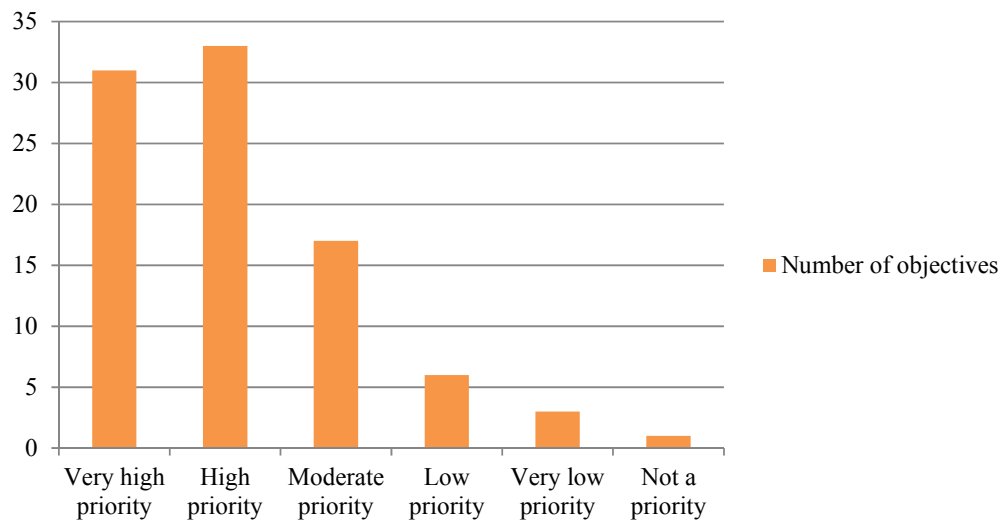


Figure 8-2: Case Study 1 – Priority of Objectives of Sustainability Performance and Reporting Tool

Very high priority

Table 8-2: Case Study 1 – Very High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Building	CO2 emissions Sustainability accreditation
Business ethics	Code of conduct and staff compliance (fiscal duties, ethical behaviours, etc.)
Clients	Alignment with client's sustainability requirements Support client toward sustainability
Employees	Commitment to Human Rights Evaluate and review employees' wellbeing and working conditions Review employees' perceptions, expectations and suggestions
Innovation	Commitment to continual improvement and enhanced sustainable performances
Operation	Supply relevant training on health and safety to employees Develop and maintain an environmental management system Develop defined processes to respond to environmental emergencies Monitor health and safety performance data Define and meet health and safety targets Establish internal reviews to achieve sustainability improvements Implement measures to avoid landfill Implement measures to increase recycling Implement measures to reduce waste quantities Select environmentally friendly alternatives (vehicles, materials, resources, etc.) Reduce the likelihood of environmental incidents Reduce the likelihood of health and safety incidents Reduce the likelihood of "near miss" incidents Undertake environment risk assessment to minimise environmental impact Undertake health and safety audits Climate change impact Use new and renewable energy sources Use renewable and ecological resources Prefer sustainable products

Supply chain	<p>Ensure supply chain complies with Modern Slavery Act</p> <p>Ensure supply chain is committed to Human Rights</p> <p>Ensure supply chain maintain ethical behaviours</p>
--------------	--

High priorities

Table 8-3: Case Study 1 – High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Building	<p>Emissions to air</p> <p>Electricity usage</p> <p>Energy usage</p> <p>Water usage</p> <p>Emissions to water</p>
Business ethics	Treat supply chain with respect without abuse of position
Community	<p>Develop initiatives to combat employment issues (long-term unemployment, apprenticeships, etc.)</p> <p>Establish communication channels with local authorities for sustainability matters</p> <p>Respect community traditions</p> <p>Support local communities (financially or otherwise)</p>
Employees	<p>Ensure employees receive fair remuneration</p> <p>Provide employees with work benefits</p> <p>Ensure equality of opportunities for employees</p> <p>Respect employees' traditions</p> <p>Create initiatives to enhance sustainability among employees</p> <p>Create initiatives to motivate and facilitate employees' commitment to sustainability</p> <p>Evaluate employees' awareness of sustainability aspects linked with their activities</p> <p>Implement employees' complaints procedure and ensure employees are aware of it</p> <p>Support workforce training and career development</p> <p>Ongoing sustainability training for workforce</p>
Innovation	Supply chain collaboration to achieve innovation

Operation	GHGs emissions from employees' transportation Implement initiatives to improve employees' sustainable impact (habits, processes, behaviours, etc.) Utilise locally sourced materials Utilise locally sourced services Material efficiency Develop a responsible sourcing policy Use sustainability criteria when sourcing resources
Supply chain	Work with businesses of different size (small, medium, etc.) Ensure supply chain alignment with strategy and values Assess sustainability performance of supply chain Assess sustainability capability of supply chain during procurement Develop strategic partnerships with supply chain

The analysis of the responses (Figure 8-3) shows that GVA have very high and high priorities in each of the eight categories.

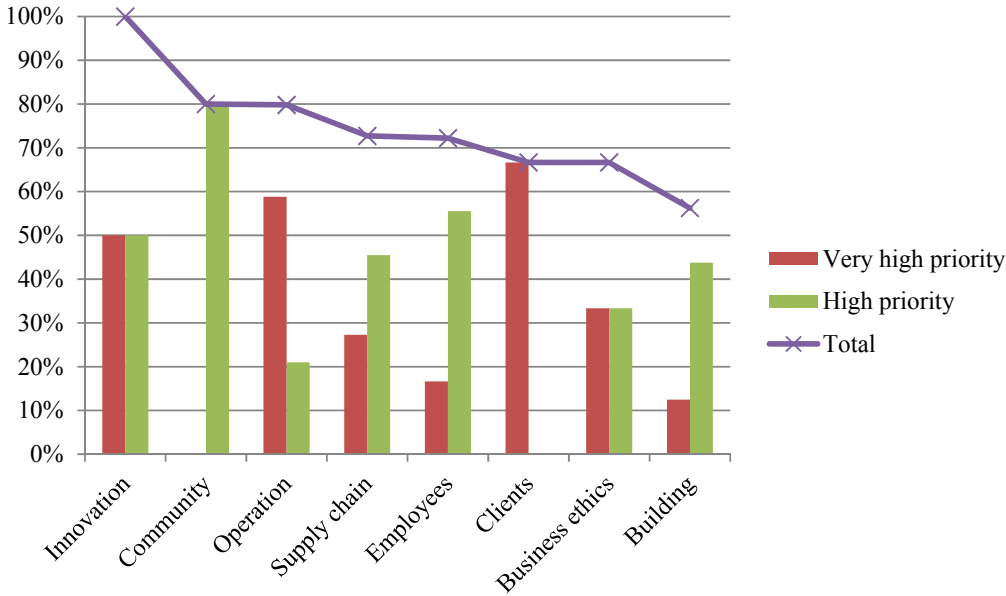


Figure 8-3: Case Study 1 – Priorities Analysis of Sustainability Performance and Reporting Tool

The analysis of the priorities shows how innovation is a key aspect for GVA, as all objectives were indicated as very high or high priorities. It is also interesting to note

how almost 70% of the objectives included in the clients category were indicated as very high priorities, showing the company focuses on clients and the relationship with clients in achieving shared sustainability goals. Community achieved 80% of high priorities whilst operation almost 60% of very high priorities, and all the categories scored more than 50% between high and very high priorities, demonstrating how GVA's involvement in sustainability is well rounded and considers all the aspects included in FM.

8.1.1.3 Phase 3 – Sustainability policy and strategy map

The strategy map supports an organisation in reviewing whether the sustainable priorities are in line with the sustainable direction set through the sustainability policy.

As part of the sustainability policy, GVA commits to two goals (Appendix 5):

- reduce and offset the operational CO₂ emissions; and
- reduce the environmental impact of the supply chain.

Moreover, the policy also states a series of objectives for the company:

- purchase 100% renewable electricity, where there is control of the energy contract (and there is a renewable electricity tariff available);
- set environmental procurement criteria and engage the supply chain;
- specify environmental fit-out criteria, including minimum SKA rating of Silver on all major fit-outs
- continue to run an environmental management system certified to ISO 14001;
- enable colleagues to operate in a way that minimises the environmental impact through education and changing processes through education and changing processes;
- offset the CO₂ from the office energy use and car travel via the woodland carbon scheme; and
- continue to improve the accuracy of our data and reporting.

The analysis of GVA's goals and objectives against the priorities identified in phase 2 provides an insight into how the FM department is aligning with the company's

sustainability vision. For the purpose of the analysis, objective 5 was omitted as it is not relevant to the FM but applicable to GVA core business.

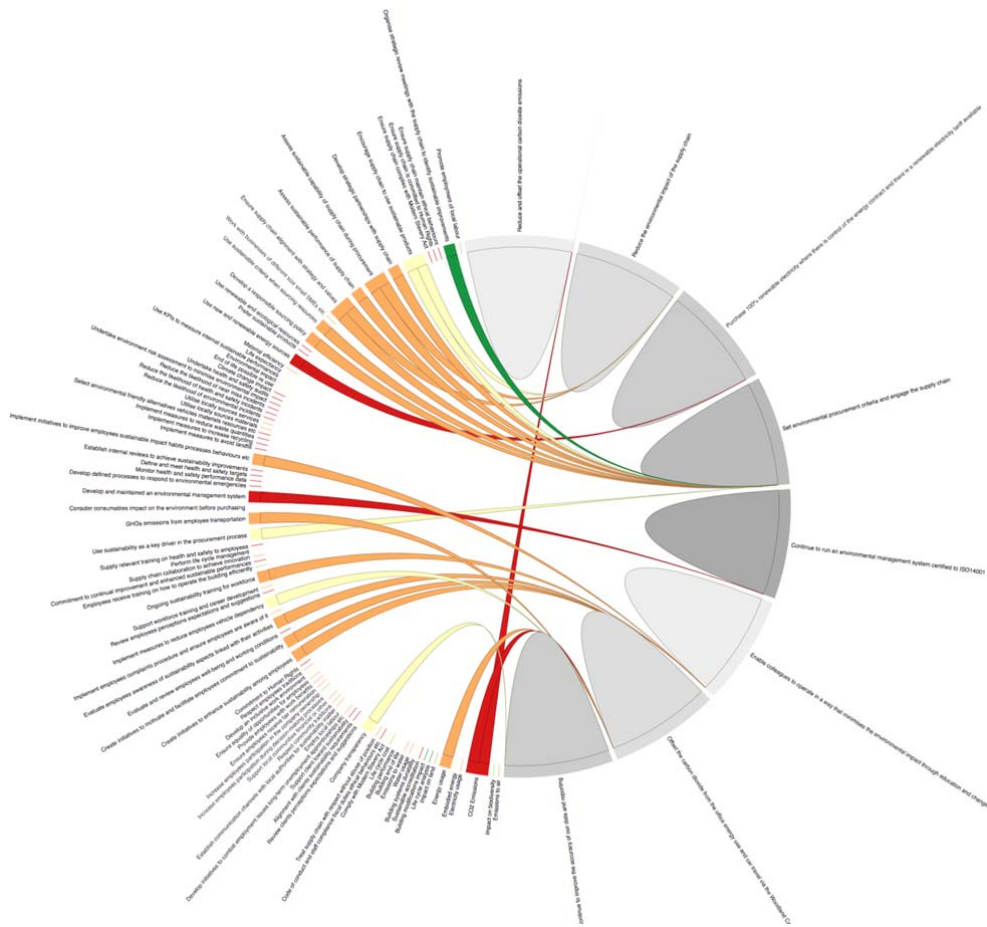


Figure 8-4: Case Study 1 – Strategy Map

The analysis shows there is a good alignment between GVA’s sustainability policy and the FM department, although some of the objectives should be priorities to achieve a full alignment.

Table 8-4: Case Study 1 – Strategy Map Objective 1

Corporate Goal	Objective	Priority
Reduce and offset the operational carbon dioxide emissions	CO2 emission	Very high priority

Reduce and offset CO₂ emission is indicated as a corporate goal, and FM aligns with this, as CO₂ emission is a very high priority.

Table 8-5: Case Study 1 – Strategy Map Objective 2

Corporate Goal	Objectives	Priority
Reduce the environmental impact of the supply chain	Ensure supply chain alignment with strategy and values	High priority
	Assess sustainable capability of supply chain during procurement	High priority
	Encourage supply chain to use sustainable products	Moderate priority

Although reducing the environmental impact of the supply chain is set as a corporate goal, the FM Department has only a partial alignment. Encouraging the supply chain to use sustainable products, which have a direct impact on the environment, was indicated only as a moderate priority whilst the other supply chain objectives were high priorities.

Table 8-6: Case Study 1 – Strategy Map Objective 3

Corporate Goal	Objectives	Priority
Purchase 100% renewable electricity, where there is control of the energy contract (and there is a renewable electricity tariff available)	Use new and renewable energy sources	Very high priority

The use of new and renewable energy sources is a high priority for FM and aligns with the corporate goal of using 100% renewable electricity.

Table 8-7: Case Study 1 – Strategy Map Objective 4

Corporate Goal	Objectives	Priority
Set environmental procurement criteria and engage the supply chain	Use sustainability as a key driver in the procurement process	Moderate priority
	Develop a responsible sourcing policy	High priority
	Use sustainability criteria when sourcing resources	High priority
	Ensure supply chain alignment with strategy and values	High priority
	Assess sustainability performance of supply chain	High priority

	Assess sustainability capability of supply chain during procurement	High priority
	Develop strategic partnerships with supply chain	High priority
	Encourage supply chain to use sustainable products	Moderate priority
	Organise strategic review meetings with the supply chain to identify sustainability improvements	Very low priority

Corporate objective 2 is reinforced by objective 4, which specifies not only that environmental criteria should be set but that the supply chain should be engaged. The FM department partially aligns with the objective, as the use of sustainability as a key driver in the procurement process and encouraging the supply chain to use sustainable products are only moderate priorities and the engagement of the supply chain through strategic review meetings to identify sustainable improvements is a very low priority.

Table 8-8: Case Study 1 – Strategy Map Objective 6

Corporate Goal	Objectives	Priority
Continue to run an environmental management system certified to ISO 14001	Develop and maintain an environmental management system	Very high priority

The environmental management system is one of the corporate goals and FM completely aligns to it as it is a very high priority.

Table 8-9: Case Study 1 – Strategy Map Objective 7

Corporate Goal	Objectives	Priority
Enable colleagues to operate in a way that minimises the environmental impact through education and changing processes through education and changing processes	Create initiatives to enhance sustainability among employees	High priority
	Create initiatives to motivate and facilitate employees' commitment to sustainability	High priority

	Evaluate employees' awareness of sustainability aspects linked with their activities	High priority
	Ongoing sustainability training for workforce	High priority
	Implement initiatives to improve employees' sustainable impact (habits, processes, behaviours, etc.)	High priority

The FM department recognises the importance of enabling staff to minimise the environmental impact as a corporate goal and has set all the relevant objectives as high priorities.

Table 8-10: Case Study 1 – Strategy Map Objective 8

Corporate Goal	Objectives	Priority
Offset the carbon dioxide from the office energy use and car travel	CO ₂ emission	Very high priority
	Energy usage	High priority
	Implement measures to reduce employees' vehicle dependency	Moderate priority
	GHGs emissions from employees' transportation	High priority

To achieve a full alignment with the corporate objective to offset CO₂ from the office energy use and car travel, the FM department should recognise implement measures to reduce vehicle dependency as a higher priority.

Table 8-11: Case Study 1 – Strategy Map Objective 9

Corporate Goal	Objectives	Priority
Continue to improve the accuracy of our data and reporting	Company transparency	Moderate priority

As GVA aims is to improve the accuracy of the data and reporting, transparency and amount of information available should be a higher priority for the FM department in order to support the core business in achieving the goal.

The strategy map also shows that many of the objectives indicated as high or very high priority by the FM department do not have a direct link to any goal or objective

set at corporate level, demonstrating that the FM department's commitment towards sustainability is wider than what requested at corporate level. As not all objectives linked with corporate goals are indicated as high priorities, this should be reviewed to ensure a full alignment. Therefore, any high or very high priorities identified should then be fed back at corporate level and used as suggestions to show how the sustainability initiatives can be broadened.

8.1.2 RetroBIM

8.1.2.1 Base model

As part of an internal project, GVA used a 3D mobile laser scanner to develop a 3D model of the office space.

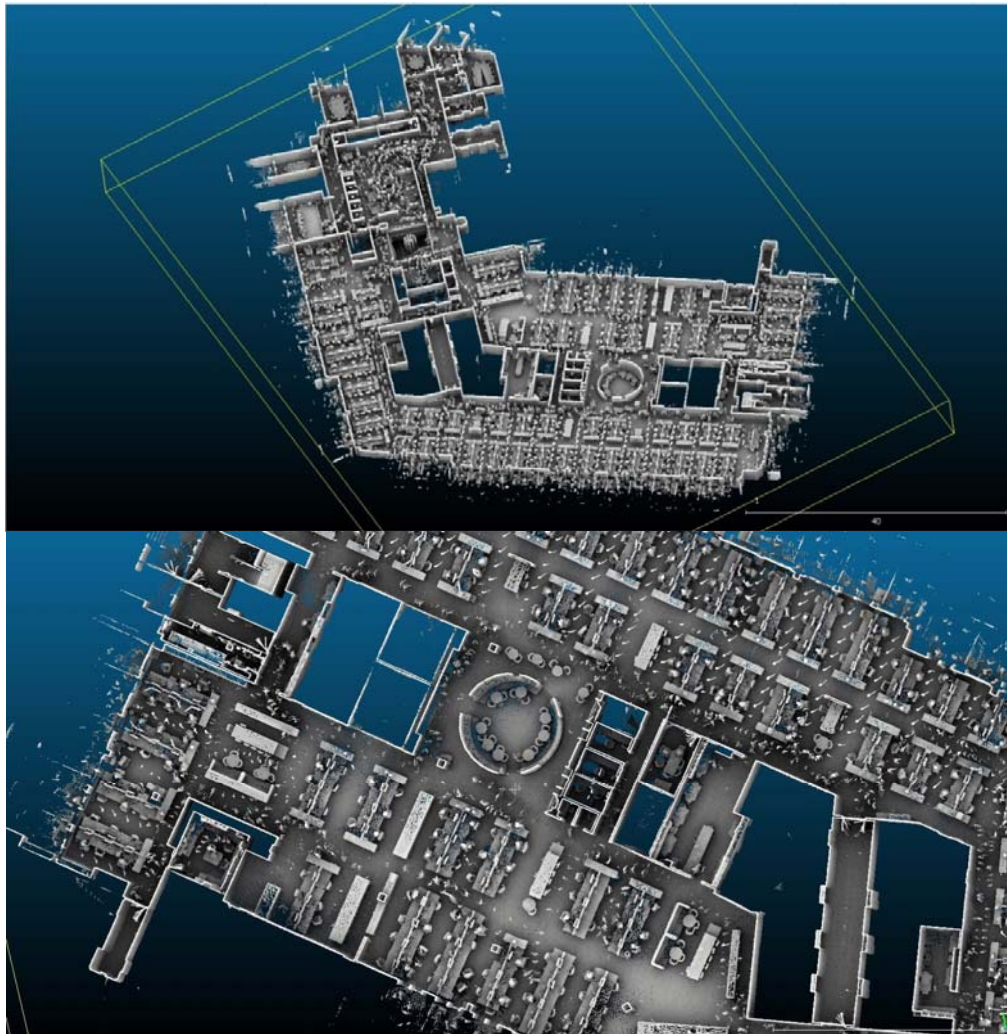


Figure 8-5: Case Study 1 – RetroBIM Base Model

The scanning process and model development was performed by a third party. The scanning process was completed over one day whilst the model development is in process and will take approximately three weeks to complete. The declared accuracy achieved in the model is to 1cm. The cost for the scanning and development was not provided.

8.1.2.2 Data implementation

During the interview GVA identified the following information as part of a potential implementation of the RetroBIM framework:

Opportunity – Recently GVA undertook some fabric changes and there is a plan to implement further changes in the future. Moreover, the layout of the executive area has been modified and a meeting room has been recently readapted to client-facing area.

Need – There is a need to arrange floor plans and desk layouts to facilitate the location of an issue when reported to the helpdesk. The company operates a hot desk policy and knowing the location of the desk will support the delivery of the FM services.

Analysis – Every year GVA performs a utilisation analysis by team, manually identifying which area is occupied by which team. The RetroBIM framework would support this process and facilitate the analysis, saving the FM team time each year.

Inefficiencies

Out of the tasks included in the inefficiencies analysis GVA scored 15 tasks as fair, 21 as efficient and 32 as not applicable to the business.

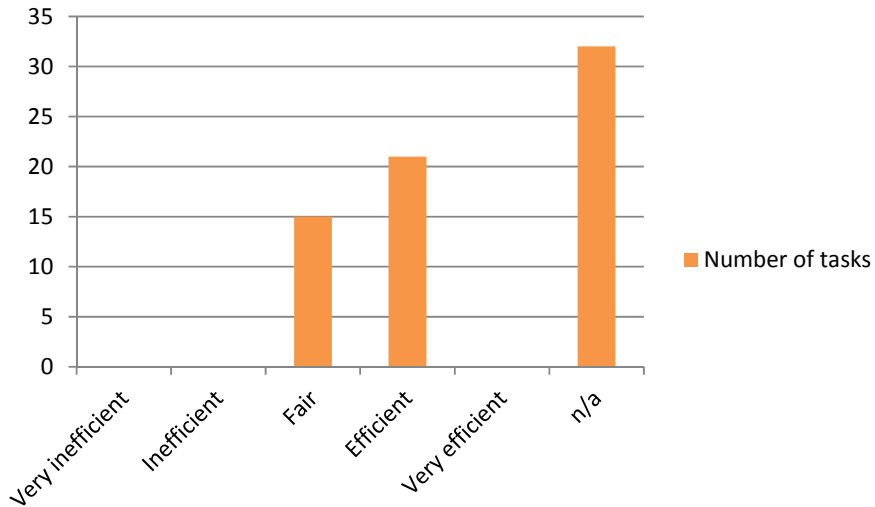


Figure 8-6: Case Study 1 – RetroBIM Inefficiency Analysis

Through the evaluation of the FM tasks, it is possible to identify GVA's implementation plan (Figure 8-7).

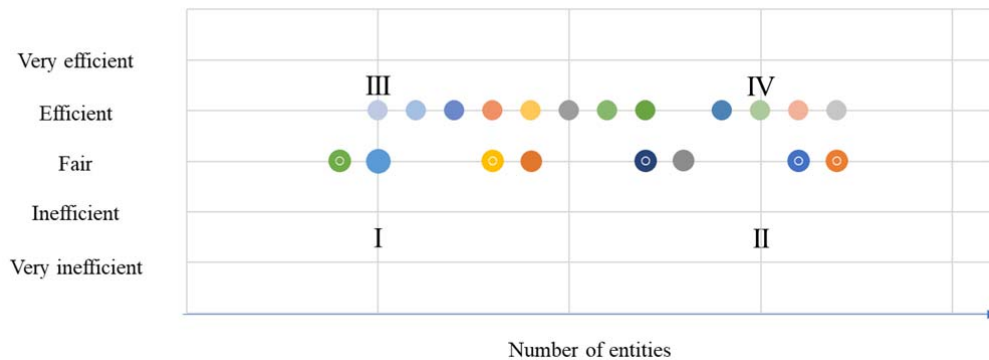


Figure 8-7: Case Study 1 – Implementation Plan RetroBIM

The implementation per inefficiency in the BIM model should start with the information that would support the tasks located near I: contractor registers, CCTV, staff involvement, keyholding, invoicing, building certification, completion of maintenance reports, improving wellbeing and staff training. Following the tasks in I, GVA would need to evaluate whether to implement support for the tasks in II, which are fairly efficient but require a larger amount of information, or the tasks in III, which are efficient but require a smaller amount of information.

8.1.2.3 BIM for the sustainability performance and reporting tool

Among the very high priorities identified by GVA as part of the sustainability performance and reporting tool, BIM would be beneficial for:

- reducing CO₂ emissions;
- evaluating and reviewing employees' wellbeing and working conditions;
- reducing the likelihood of environmental incidents;
- reducing the likelihood of health and safety incidents; and
- reducing the likelihood of “near miss” incidents.

To support the delivery of these objectives, BIM could be used to evaluate the different scenarios and information should be implemented according to the analysis performed and what is already included in the model.

8.2 Belmont House

Belmont House (Figure 8-8) is a 4100 m² building in Guisborough currently leased to the Redcar and Cleveland Borough Council. The building consists of three floors, and each floor combines open spaces, private offices and meeting rooms with a total of 103 rooms. The ground floor is partially used to provide public services while the first and second floors are for staff use only.



Figure 8-8: Case Study 2 – Belmont House

Since 2002 the building has been managed by BAM FM, and some services, such as reception and small maintenance, are delivered by the internal team whilst BAM subcontracts all the other services. The data for the case study were collected through an interview with the site manager and responsible for the contract delivery.

8.2.1 Sustainability performance and reporting tool

8.2.1.1 Phase 1 – Strategic review

Although BAM confirmed that all the key elements of the strategic review are in place, they specified that the elements can be further improved as they are currently at a basic level of maturity. BAM recognised that before focusing on the specific objectives, there is a need to improve the key elements.

Table 8-12: Case Study 2 – Strategic Review of Sustainability Performance and Reporting Tool

Questions	Answer
Does FM comply with all applicable legal requirements on sustainability?	Yes
Does FM have a defined FM strategy in terms of sustainability?	Yes
Is this translated into achievable objectives and targets?	Yes
Is there an action plan developed to achieve the objectives and targets?	Yes
Are long- and short-term priorities for this strategy defined?	Yes
Does FM create corrective action plans when sustainability performance is below expectations or does not achieve targets?	Yes
Are strategy and linked objectives and targets communicated within the organisation?	Yes
Are there resources available for implementing these initiatives?	Yes
Does FM comply with relevant standards and code of practices for sustainability?	Yes
Are stakeholders aware of the strategy?	Yes
Are stakeholders involved in the development and implementation of the strategy?	Yes
Do stakeholders receive reports on the performance and progression of these strategies?	Yes

8.2.1.2 Phase 2 – Objectives evaluation

As part of the phase 2 analysis, BAM identified 13 very high priorities and 28 high priorities.

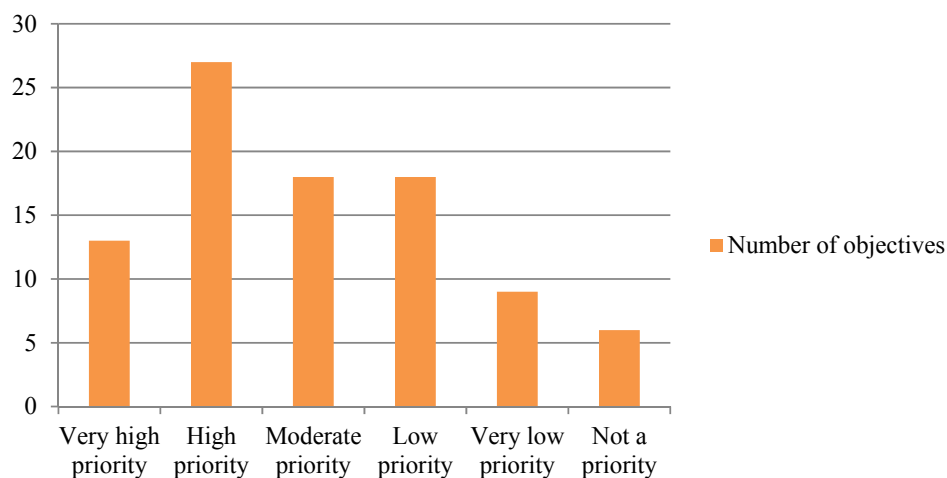


Figure 8-9: Case study 2 – Priority of Objectives of Sustainability Performance and Reporting Tool

Very high priority

Table 8-13: Case Study 2 – Very High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Building	Electricity usage Life-cycle analysis Building systems durability Water usage
Business ethics	Code of conduct and staff compliance (fiscal duties, ethical behaviours, etc.) Treat supply chain with respect without abuse of position
Community	Develop initiatives to combat employment issues (long-term unemployment, apprenticeships, etc.)
Employees	Commitment to Human Rights
Operation	Perform life-cycle management Supply relevant training on health and safety to employees Monitor health and safety performance data Define and meet health and safety targets Reduce the likelihood of “near miss” incidents

High priority

Table 8-14: Case Study 2 – High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Building	CO2 emission Energy usage Sustainable accreditation Life cycle cost
Clients	Review clients' perceptions, expectations and suggestions Alignment with client's sustainability requirements Support client toward sustainability
Community	Employ local labour
Employees	Ensure equality of opportunities for employees Implement employees' complaints procedure and ensure employees are aware of it
Operation	Develop and maintain an environmental management system Develop defined processes to respond to environmental emergencies Implement measures to avoid landfill Implement measures to increase recycling Implement measures to reduce waste quantities Select environmental-friendly alternatives (vehicles, materials, resources, etc.) Utilise locally sourced materials Utilise locally sourced services Reduce the likelihood of environmental incidents Reduce the likelihood of health and safety incidents Undertake health and safety audits Material efficiency Use new and renewable energy sources Use renewable and ecological resources Prefer sustainable products
Supply chain	Develop strategic partnerships with supply chain Ensure supply chain complies with the Modern Slavery Act

The analysis of the priorities identified clearly shows BAM's focus areas in terms of sustainability.

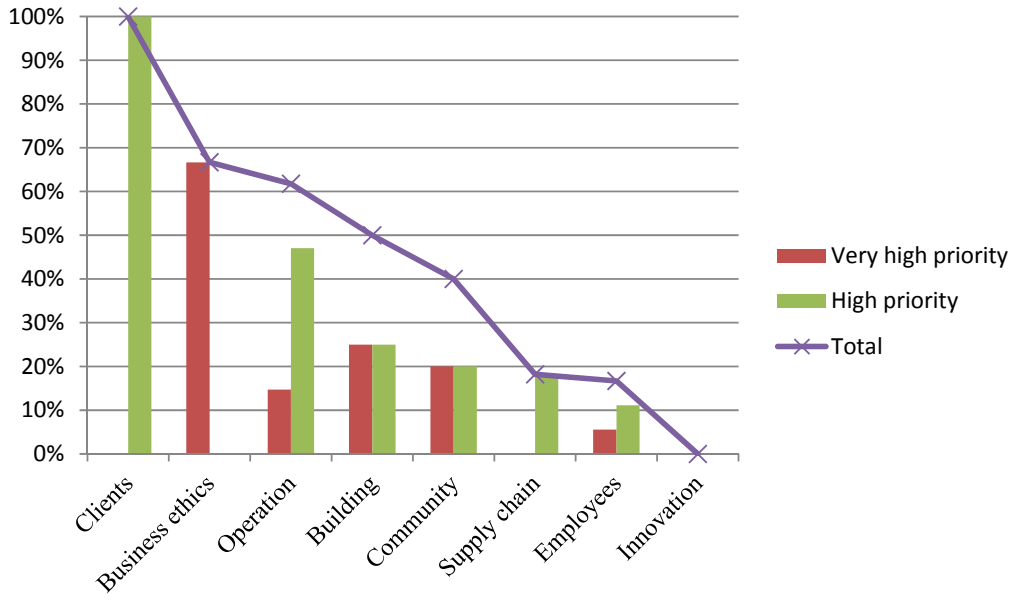


Figure 8-10: Case Study 2 – Priorities Analysis of Sustainability Performance and Reporting Tool

Out of the eight categories included in the analysis, only four scored had more than 50% of the objectives identified as being very high or high priority, whilst the others achieved less than 40%. Clients and business ethics are two key aspects for BAM, with all clients' objectives indicated as high priority and almost 70% of business ethics as very high priority. It is interesting to note that none of the objectives included in innovation were indicated as very high or high priorities.

8.2.1.3 Phase 3 – Sustainability policy and strategy map

As part of their commitment towards sustainability, BAM (Appendix 5) has identified a series of key areas:

- Responsible business: we conduct our activities according to rigorous ethical, professional and legal standards.
- Customers: we strive to exceed client expectations.
- Community: we promote good community relationships.
- Education: we act as an ambassador for the construction industry.
- Employees: we are committed towards our employees (Health and Safety, Equality and diversity, Learning and development).
- Supply chain: we procure responsibly.

- Energy: we strive to reduce our climate change impact.
- Resources: we will improve resource efficiency.
- Environment: we will limit our environmental impact.
- Innovation: we innovate to identify balanced sustainable solutions.
- Prosperity: we believe that sustainability leads to economic prosperity.

The strategy map allows to verify whether the priorities set by the FM are aligned with the corporate direction set in the policy. For the purpose of the analysis, area 11 was omitted as it is not an objective or target.

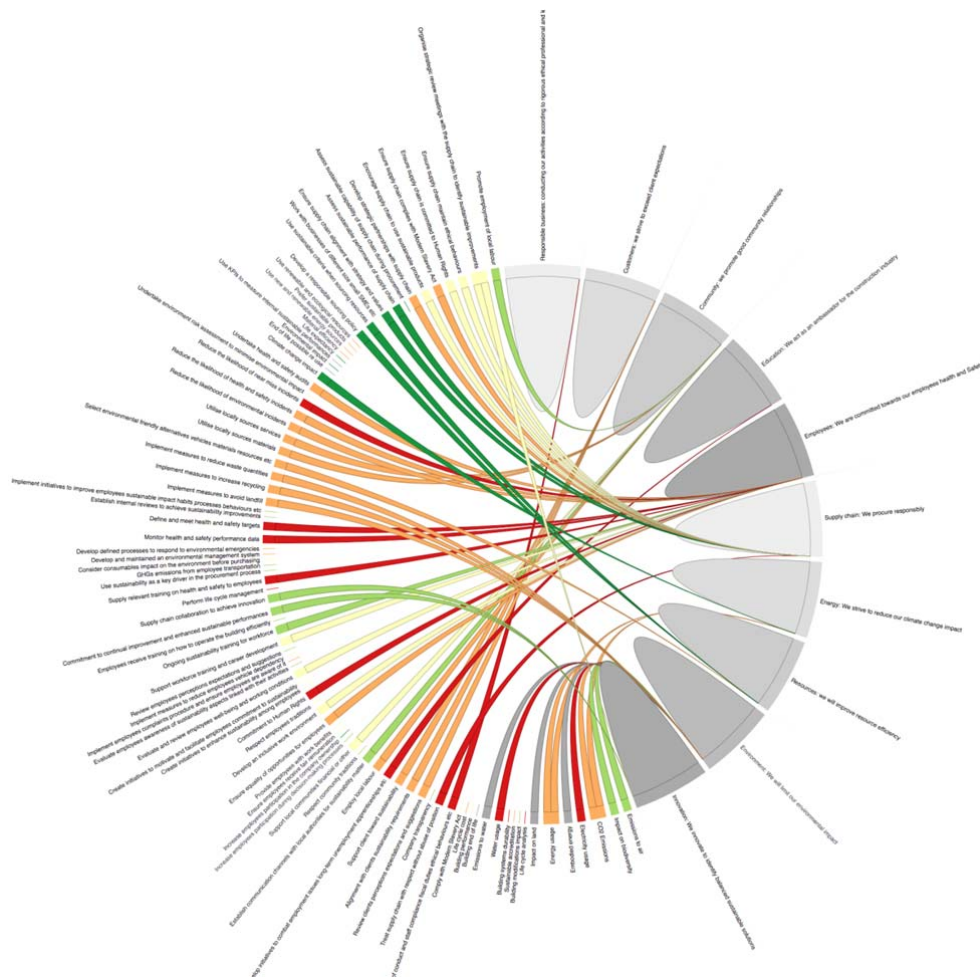


Figure 8-11: Case Study 2 – Strategy Map

The analysis of the strategy map shows that there is generally a good alignment between BAM’s sustainability policy and the priorities identified, but the delivery of

some of the corporate goals, such as supply chain, environment and innovation, could be improved by a prioritisation of the objectives.

Table 8-15: Case Study 2 – Strategy Map Objective 1

Corporate Goal	Objectives	Priority
Responsible business: we conduct our activities according to rigorous ethical, professional and legal standards	Code of conduct and staff compliance (fiscal duties, ethical behaviours, etc.)	Very high priority

BAM and their FM staff recognise the importance of being a responsible business, hence the code of conduct of staff and staff compliance is a very high priority.

Table 8-16: Case Study 2 – Strategy Map Objective 2

Corporate Goal	Objectives	Priority
Customers: we strive to exceed client expectations	Review clients' perceptions, expectations and suggestions	High priority
	Alignment with client's sustainability requirements	High priority
	Support client toward sustainability	High priority

From the analyses, clients emerged as an area of priority for the FM department, confirming the alignment with the corporate goal of exceeding client expectations.

Table 8-17: Case Study 2 – Strategy Map Objective 3

Corporate Goal	Objectives	Priority
Community: we promote good community relationships	Employ local labour	High priority
	Establish communication channels with local authorities for sustainability matter	Low priority
	Support local communities (financially or otherwise)	Moderate priority
	Utilise locally sourced materials	High priority
	Utilise locally sourced services	High priority
	Promote employment of local labour (supply chain)	Low priority

The alignment with the corporate goal of promoting food community relationships could be improved by the facilities manager. Although employing local labour and utilising locally sourced materials and services are high priorities, other objectives are not recognised as important, including establish communication channels with local authorities for sustainability matters, which was evaluated as a low priority.

Table 8-18: Case Study 2 – Strategy Map Objective 4

Corporate Goal	Objectives	Priority
Education: we act as an ambassador for the construction industry	Develop initiatives to combat employment issues (long-term unemployment, apprenticeships, etc.)	Very high priority

BAM’s commitment towards education is confirmed by the facilities manager who identified developing initiatives to combat employment issues as a very high priority.

Table 8-19: Case Study 2 – Strategy Map Objective 5

Corporate Goal	Objectives	Priority
Employees: we are committed towards our employees	Ensure equality of opportunities for employees	High priority
	Develop an inclusive work environment	Moderate priority
	Commitment to Human Rights	Very high priority
	Evaluate and review employees’ wellbeing and working conditions	Moderate priority
	Support workforce training and career development	Moderate priority
	Ongoing sustainability training for workforce	Low priority
	Supply relevant training on health and safety to employees	Very high priority
	Monitor health and safety performance data	Very high priority
	Define and meet health and safety targets	Very high priority
	Reduce the likelihood of environmental incidents	High priority

	Reduce the likelihood of health and safety incidents	High priority
	Reduce the likelihood of “near miss” incidents	Very high priority
	Undertake health and safety audits	High priority

The commitment towards the employers has three main areas of focus in BAM’s sustainability policy: health and safety, equality and diversity and learning and development. The FM aligns with the health and safety focus, defining the related objectives as very high or high priorities. The equality and diversity focus is partially supported by FM, as equality of opportunity for employees is a high priority and commitment to Human Rights a very high priority, and the development of an inclusive work environment and the employees’ wellbeing are moderate priorities. To ensure a complete alignment with the corporate goal, FM should focus on the learning and development of the employees, as it is indicated as a moderate priority.

Table 8-20: Case Study 2 – Strategy Map Objective 6

Corporate Goal	Objectives	Priority
Supply chain: we procure responsibly	Treat supply chain with respect without abuse of position	Very high priority
	Ensure supply chain alignment with strategy and values	Very low priority
	Assess sustainability performance of supply chain	Very low priority
	Develop strategic partnerships with supply chain	High priority
	Encourage supply chain to use sustainable products	Moderate priority
	Ensure supply chain complies with the Modern Slavery Act	High priority
	Ensure supply chain is committed to Human Rights	Moderate priority
	Ensure supply chain maintain ethical behaviours	Moderate priority

	Organise strategic review meetings with the supply chain to identify sustainable improvements	Moderate priority
--	---	-------------------

The policy specifies that BAM works with “subcontractors and suppliers to ensure they operate in a safe and environmentally responsible way.” Although the FM department recognises the importance of treating the supply chain with respect, ensuring they comply with Modern Slavery Act and become strategic partners, other aspects are not identified as high priorities. In particular, the FM department indicated that ensuring the supply chain alignment with strategy and values and assessing sustainability performance of supply chain are very low priorities, even though both objectives are required to ensure the policy goal for the supply chain is met.

Table 8-21: Case Study 2 – Strategy Map Objective 7

Corporate Goal	Objectives	Priority
Energy: we strive to reduce our climate change impact	CO2 emission	High priority
	Energy usage	High priority
	Climate change impact	Very low priority

Among the objectives linked with the corporate goal, the FM department should prioritise the evaluation of climate change impact as it links directly with the energy corporate goal.

Table 8-22: Case Study 2 – Strategy Map Objective 8

Corporate Goal	Objectives	Priority
Resources: we will improve resource efficiency	Select environmental-friendly alternatives (vehicles, materials, resources, etc.)	High priority
	Develop a responsible sourcing policy	Very low priority
	Use sustainability criteria when sourcing resources	Very low priority

Although improving resource efficiency is one of BAM’s goal, only one of the associated objectives is recognised as a high priority. To fully align with the corporate requirement, FM could develop and utilise a responsible sourcing policy and use

sustainability criteria when sourcing resources, which are both currently very low priorities.

Table 8-23: Case Study 2 – Strategy Map Objective 9

Corporate Goal	Objectives	Priority
Environment: we will limit our environmental impact	Emissions to air	Low priority
	Impact on biodiversity	Low priority
	CO ₂ emission	High priority
	Electricity usage	Very high priority
	Embodied energy	Not a priority
	Energy usage	High priority
	Impact on land	Not a priority
	Water usage	Very high priority
	Emissions to water	Not a priority
	Implement measures to avoid landfill	High priority
	Implement measures to increase recycling	High priority
	Implement measures to reduce waste quantities	High priority

The FM department’s alignment with the environmental corporate goal is only partial: the importance of some of the objectives is recognised, such as electricity and water usage, but other aspects that are directly linked with the environmental impact as seen as a low priority or not a priority. The FM department should make some objectives such as emissions to air, impact on biodiversity, embodied energy and impact on land and water high priorities to ensure alignment with corporate guidance.

Table 8-24: Case Study 2 – Strategy Map Objective 10

Corporate Goal	Objectives	Priority
Innovation: we innovate to identify balanced sustainable solutions	Commitment to continual improvement and enhanced sustainability performances	Low priority
	Supply chain collaboration to achieve innovation	Low priority
	Organise strategic review meetings with the supply chain to identify sustainability improvements	Moderate priority

Innovation as a support to develop sustainable solutions is not recognised by the FM department as a priority, although it is clearly stated as part of BAM's sustainability policy. The misalignment provides an opportunity for FM to better prioritise these objectives and achieve a full support to the corporate goal.

8.2.2 RetroBIM

8.2.2.1 Base model development

In order to create the model (Figure 8-12), the building was surveyed using a laser distance measurer. The survey took eight hours to complete and, to ensure accuracy, every measurement was taken three times and recorded. The average value of each measurement was then used to create the final model.

The building has a linear design and the process of developing the model took approximately seven hours and 30 minutes, with an average of 547 m² every hour. The main difficulty encountered was the creation of the glazing, which was overcome by creating intermediate levels between the first and second floors and between second floor and the roof.

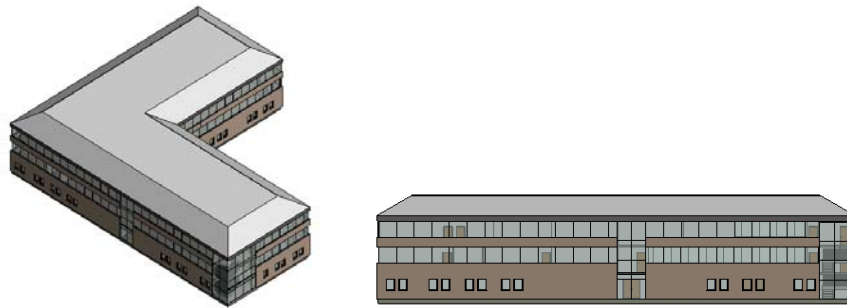


Figure 8-12: Case Study 2 – RetroBIM Base Model

8.2.2.2 Data implementation

During the interview BAM, identified the following as part of the potential implementation of the RetroBIM framework:

Opportunity – Some rooms have recently been renovated and the information linked could have been implemented in the model.

Need – As BAM manages tenders for the building, they identified all the flooring types divided per room areas as helpful information to be included in the model that can then be easily extracted when needed for the tenders.

Analysis – The client has asked BAM to change all lighting to LED and the model could be used to evaluate the different lighting solutions and the implication of implementing the client’s requirement.

Inefficiencies and development plan

From the list of FM tasks included in the inefficiency analysis, BAM scored 7 tasks as inefficient and 24 as fairly efficient.

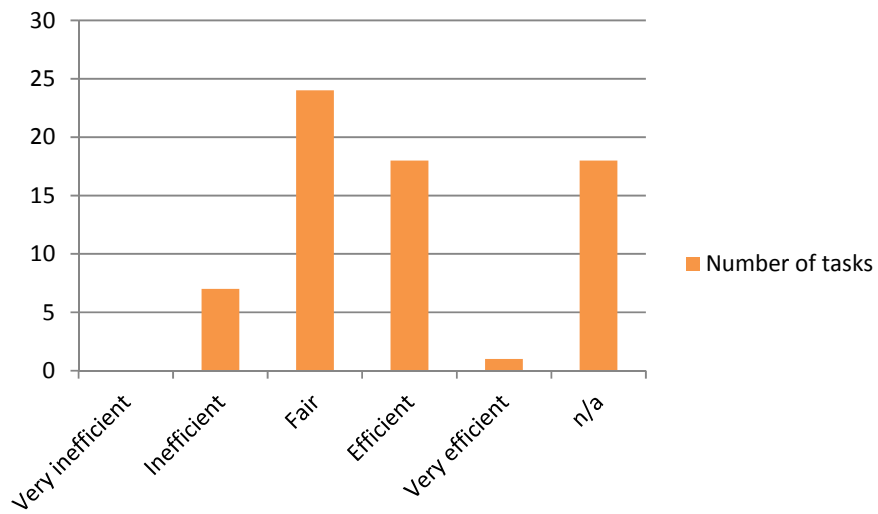


Figure 8-13: Case Study 2 – RetroBIM Inefficiency Analysis

The evaluation of the FM tasks provided BAM’s implementation plan for the RetroBIM framework.

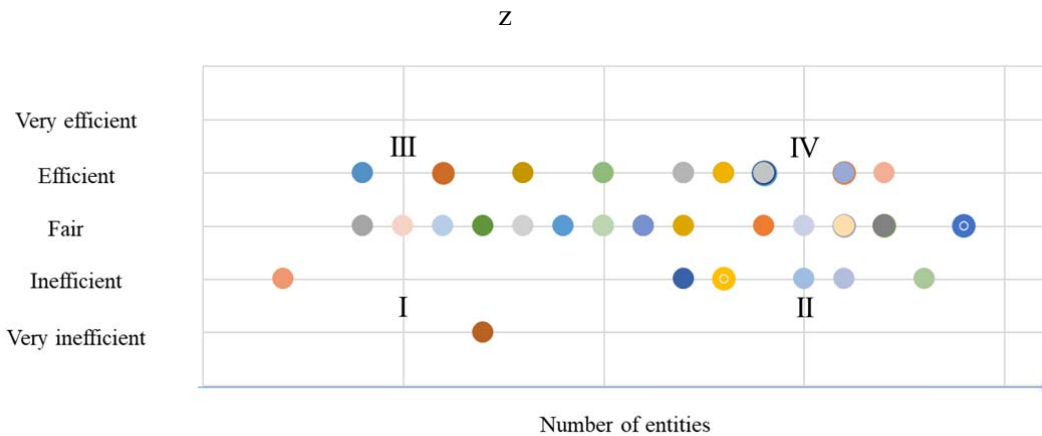


Figure 8-14: Case Study 2 – Implementation Plan RetroBIM

As part of the inefficiency analysis, BAM has identified few tasks as being very inefficient or inefficient. As shown in the implementation plan, some of them are located near I, which should be BAM's initial focus as the information implemented in the model would support the delivery of these tasks (raise purchase orders, staff involvement, supplier management, client reporting, contract management and service level agreement). The implementation of the information to support the tasks near II and III would need to be evaluated based on the information included in the model, although the number of inefficient tasks in II could probably be prioritised although they require more information than the tasks in III.

8.2.2.3 BIM for the sustainability performance and reporting tool

As part of the sustainability performance and reporting tool, BAM identified as very high priorities the following objectives that would benefit from the use of BIM, as the information model would provide relevant information and support the evaluation of different scenarios:

- electricity usage;
- life-cycle analysis;
- building system durability; and
- water usage.

Moreover, the visualisation capability of BIM would also support the delivery of health and safety training to employees (a very high priority). The information

implementation should be identified evaluating the information required and that which is already included in the model.

8.3 The Dreadnought Library

The Dreadnought Library (Figure 8-15) is a Grade II listed building over 1000m², part of the University of Greenwich. Built between 1764 and 1786, the building was originally part of the Royal Naval Hospital (Male, n.d.) and was used until 2016 as library space and information resource. The building is currently under refurbishment and it will be converted into a new student hub facility.

The University's FM team is responsible for all the buildings, including the Dreadnought Library, and manage a dedicated FM helpdesk. All the services are subcontracted to external companies. The data for the case study was collected through an interview with one member of the in-house FM team.



Figure 8-15: Case Study 3 – Dreadnought Library

8.3.1 Sustainability performance and reporting tool

8.3.1.1 Phase 1 – Strategic review

The strategic review confirmed that the University of Greenwich has all the key elements necessary to deliver sustainability and implement sustainable initiatives,

although some elements are at a basic level of maturity and would need to be improved before focussing on the specific objectives.

Table 8-25: Case Study 3 – Strategic Review of Sustainability Performance and Reporting Tool

Questions	Answer
Does FM comply with all applicable legal requirements on sustainability?	Yes
Does FM have a defined FM strategy in terms of sustainability?	Yes
Is this translated into achievable objectives and targets?	Yes
Is there an action plan developed to achieve the objectives and targets?	Yes
Are long- and short-term priorities for this strategy defined?	Yes
Does FM create corrective action plans when sustainability performance is below expectations or does not achieve targets?	Yes
Are strategy and linked objectives and targets communicated within the organisation?	Yes
Are there resources available for implementing these initiatives?	Yes
Does FM comply with relevant standards and code of practices for sustainability?	Yes
Are stakeholders aware of the strategy?	Yes
Are stakeholders involved in the development and implementation of the strategy?	Yes
Do stakeholders receive reports on the performance and progression of these strategies?	Yes

8.3.1.2 Phase 2 – Objectives evaluation

During the objectives evaluation, the University of Greenwich identified one very high priority and 12 high priorities.

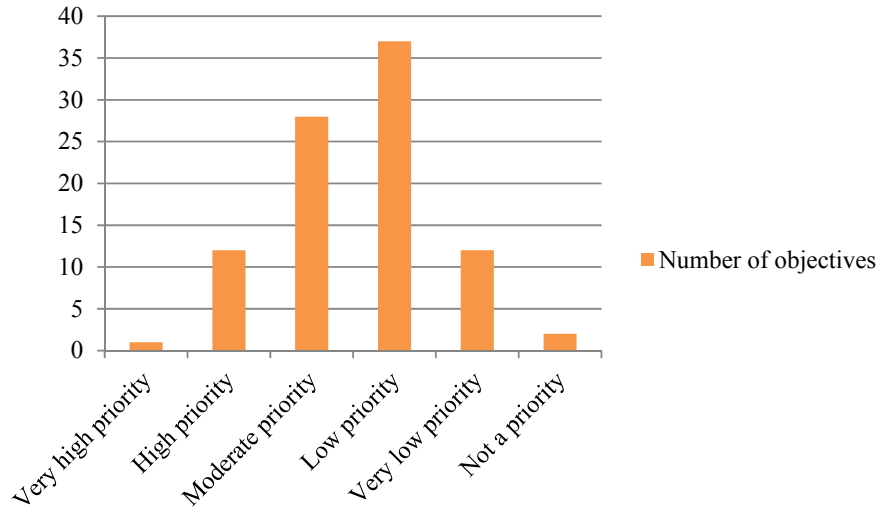


Figure 8-16: Case Study 3 – Priority of Objectives in Sustainability Performance and Reporting Tool

Very high priority

Table 8-26: Case study 3 – Very High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Operation	Supply relevant training on health and safety to employees

High priority

Table 8-27: Case Study 3 – High Priorities of Sustainability Performance and Reporting Tool

Categories	Objectives
Building	Building end of life
Business ethics	Treat supply chain with respect without abuse of position
Employees	Commitment to Human Rights Implement measures to reduce employees' vehicle dependency
Operation	Develop and maintain an environmental management system Develop defined processes to respond to environmental emergencies Monitor health and safety performance data Implement initiatives to improve employees' sustainable impact (habits, processes, behaviours, etc.) Reduce the likelihood of environmental incidents

	Reduce the likelihood of health and safety incidents Develop a responsible sourcing policy Use sustainability criteria when sourcing resources
--	--

The analysis of the very high and high priorities identified by the University of Greenwich shows how the focus is mainly on business ethics, operation, employees and buildings. None of the objectives included in clients, community, innovation and supply chain were identified as a priority in the analysis.

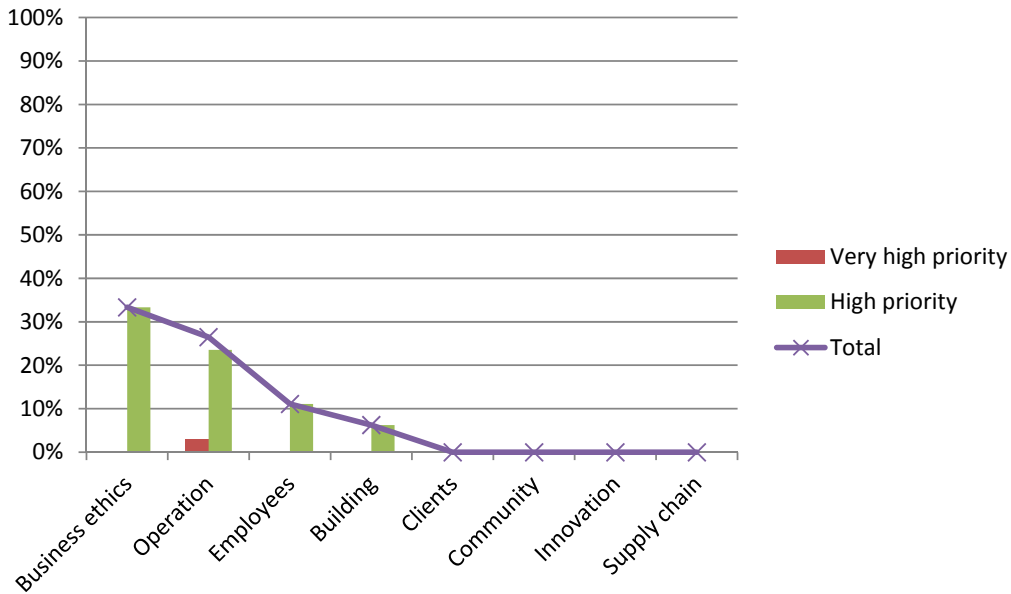


Figure 8-17: Case Study 3 – Priorities Analysis of Sustainability Performance and Reporting Tool

Although the University of Greenwich has a strong focus on sustainability and the University received different sustainable awards in the recent years (University of Greenwich, n.d.), the nature of the buildings in the Greenwich campus limits the number of initiatives that can be developed by the FM team. The majority of the buildings are listed, including the Dreadnought Library, hence initiatives that would require modifications to the fabric or building systems cannot be implemented. This situation is reflected in the limited number of very high and high priorities identified by FM, which mainly focus on four of the eight categories (business ethics, operations, employees and building).

8.3.1.3 Phase 3 – Sustainability policy and strategy map

Included in the sustainability policy (Appendix 5), the University of Greenwich has a series of key sustainability impacts and objectives:

- education and research for sustainable development;
- energy and CO₂;
- waste and natural resources;
- procurement;
- food;
- water;
- transport;
- construction and refurbishment;
- cultural and natural heritage;
- community involvement;
- staff and student wellbeing; and
- training, awareness and communication.

By analysing the key sustainability impacts and objectives set by University of Greenwich and the priorities identified by the FM department, it is possible to verify their alignment through the strategy map. For the purpose of the analysis, objective 1 was not included as not relevant to FM.

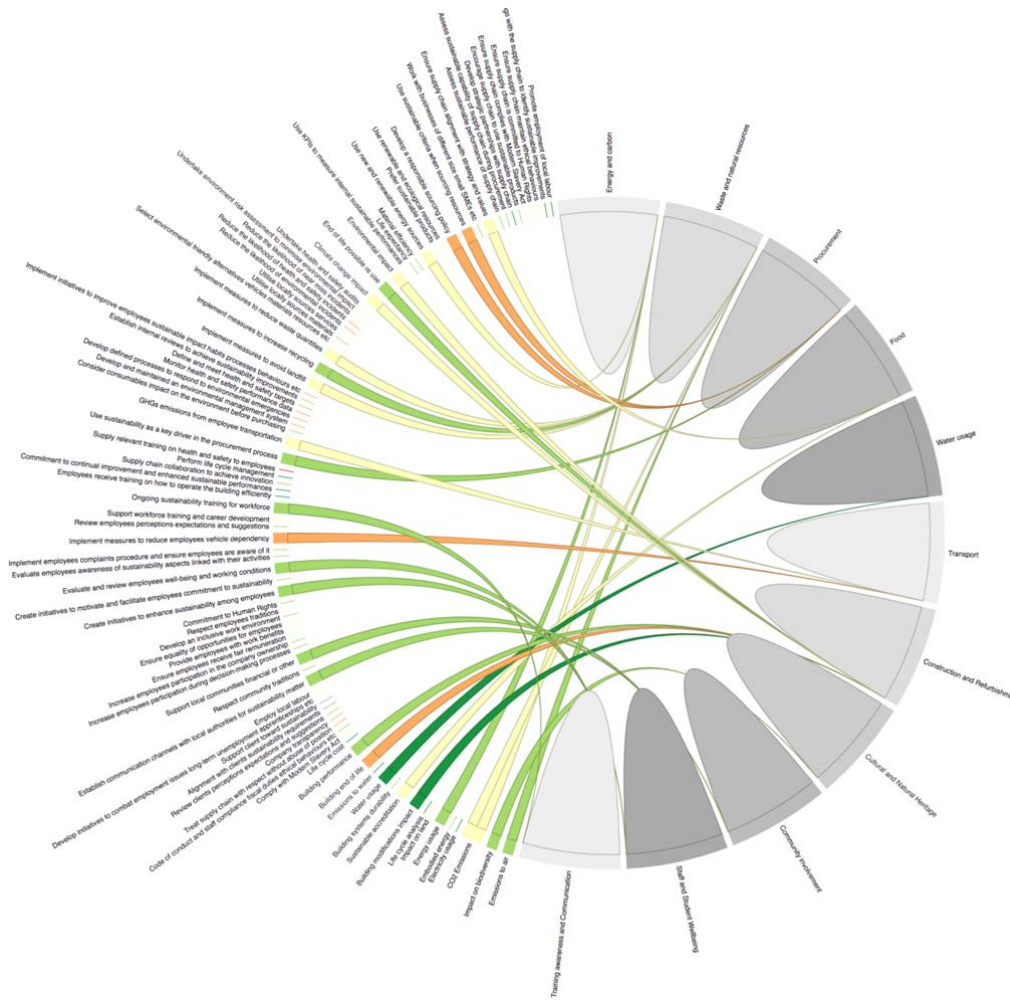


Figure 8-18: Case Study 3 – Strategy Map

The overview provided by the strategic map shows how the alignment between the sustainability policy and FM priorities can be improved in several areas. Many of the corporate goals included in the sustainability policy are not recognised as high priorities by FM, causing a misalignment between the two parties.

Table 8-28: Case Study 3 – Strategy Map Objective 2

Corporate Goal	Objectives	Priority
Energy and carbon	CO2 emission	Moderate priority
	Energy usage	Low priority
	Use of new and renewable energy sources	Moderate priority

Although University of Greenwich is committed to reducing energy use, energy and CO₂ are not high priorities for the FM team. Moreover, the policy clearly states that

the University should purchase renewable energy, which is only a moderate priority for FM.

Table 8-29: Case Study 3 – Strategy Map Objective 3

Corporate Goal	Objectives	Priority
Waste and natural resources	Emissions to air	Low priority
	CO2 emission	Moderate priority
	Implement measures to avoid landfill	Moderate priority
	Implement measures to increase recycling	Low priority
	Implement measures to reduce waste quantities	Moderate priority

The FM team does not align with the direction set by the policy to prevent pollution and promote a “zero waste” principle: some of the related objectives are moderate priorities but they should be higher to ensure the necessary support in achieving the University’s aim.

Table 8-30: Case Study 3 – Strategy Map Objective 4

Corporate Goal	Objectives	Priority
Procurement	Use sustainability as a key driver in the procurement process	Low priority
	Develop a responsible sourcing policy	High priority
	Use sustainability criteria when sourcing resources	High priority

Although sustainability is not used as a driver in the procurement process, the FM team recognises the importance for the University of responsible sourcing and the use of sustainable criteria when sourcing, and classifies the related objectives as high priorities.

Table 8-31: Case Study 3 – Strategy Map Objective 5

Corporate Goal	Objectives	Priority
Food	Sustainable accreditation	Moderate priority
	Ensure supply chain alignment with strategy and values	Moderate priority

The University of Greenwich has a Sustainable Food Policy and different food-related accreditations. However, the objectives related to food are only moderate priorities for the FM team.

Table 8-32: Case Study 3 – Strategy Map Objective 6

Corporate Goal	Objectives	Priority
Water	Water usage	Very low priority

The University is committed to reducing water use and establishing utilities monitoring, but the FM team, which is responsible for utilities and water usage, identified the objective as a very low priority.

Table 8-33: Case Study 3 – Strategy Map Objective 7

Corporate Goal	Objectives	Priority
Transport	Implement measures to reduce employees' vehicle dependency	High priority
	GHGs emissions from employees' transportation	Moderate priority

The FM team partially aligns with the corporate goal of transport by recognising the need for implementing measures to reduce vehicle dependency. The FM team should work on considering the GHGs emissions from employees' transportation and develop initiatives to reduce such emissions.

Table 8-34: Case Study 3 – Strategy Map Objective 8

Corporate Goal	Objectives	Priority
Construction and refurbishment	Building modifications impact	Very low priority
	Building end of life	High priority
	Building performance	Low priority
	Climate change impact	Moderate priority
	End of life possible re-use	Low priority
	Environmental impact	Moderate priority

Although the direction set by the University of Greenwich for construction and refurbishment has direct implications on the FM team, the related objectives are only partially recognised as moderate or high priorities. As the University aims at incorporating principles of sustainable development, climate mitigation and

adaptation in new building and refurbishment projects, these should be prioritised by the FM team.

Table 8-35: Case Study 3 – Strategy Map Objective 9

Corporate Goal	Objectives	Priority
Cultural and natural heritage	Impact on biodiversity	Low priority

The FM team defined the impact on biodiversity a low priority although the policy supports the protection of wildlife on campus.

Table 8-36: Case Study 3 – Strategy Map Objective 10

Corporate Goal	Objectives	Priority
Community involvement	Establish communication channels with local authorities for sustainability matter	Low priority
	Support local communities (financially or otherwise)	Low priority

Similar to other corporate goals, the relationship with the community is a low priority for the FM team, in contrast with what set in policy.

Table 8-37: Case Study 3 – Strategy Map Objective 11

Corporate Goal	Objectives	Priority
Staff and student wellbeing	Create initiatives to enhance sustainability among employees	Low priority
	Evaluate and review employees' wellbeing and working conditions	Low priority

The University commitment towards staff and student wellbeing is not recognised as a priority by the FM team, which does not create initiatives to enhance sustainability among employees or evaluate employees' wellbeing and working conditions.

Table 8-38: Case Study 3 – Strategy Map Objective 12

Corporate Goal	Objectives	Priority
Training, awareness and communication	On-going sustainability training for workforce	Low priority

Finally, as part of the policy, the University of Greenwich indicates the desire to increase awareness and understanding of sustainability amongst students and staff

through learning opportunities and training. Nevertheless, the FM team identified the objective of providing on-going sustainability training for workforce as a low priority.

8.3.2 RetroBIM

8.3.2.1 Base model

The creation of the model was based on floor maps and elevation in use by the University of Greenwich to manage the facility. The simple geometry of the building helped to complete the model in approximately three hours, with an average of 333 m² completed every hour.

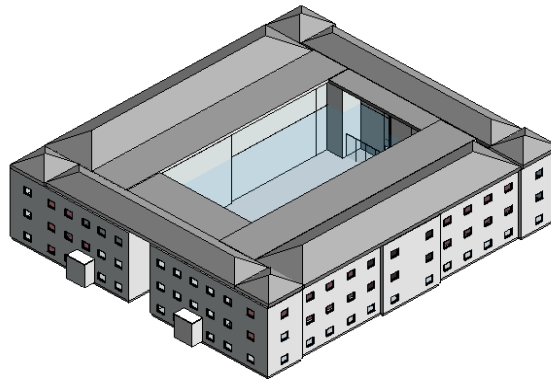


Figure 8-19: Case study 3 – RetroBIM Base Model

8.3.2.2 Data implementation

For the implementation of the RetroBIM model, the University of Greenwich identified the following information:

Opportunity – The server rooms will remain intact and running during the refurbishment but some of the systems will be replaced, such as the conditioning units and fire suppressant. The information should be implemented in the model.

Need – As the building will have multiple uses and users, the location of furniture and power sockets would be helpful as it would support any future space planning and moves within the building

Analysis – The University of Greenwich would benefit from the possibility of running lighting analysis on the different design suggested and identify the most suited based on the users’ needs.

Inefficiencies and development plan

From the FM tasks included in the inefficiency analysis, University of Greenwich identified nine tasks as very inefficient and 35 as inefficient.

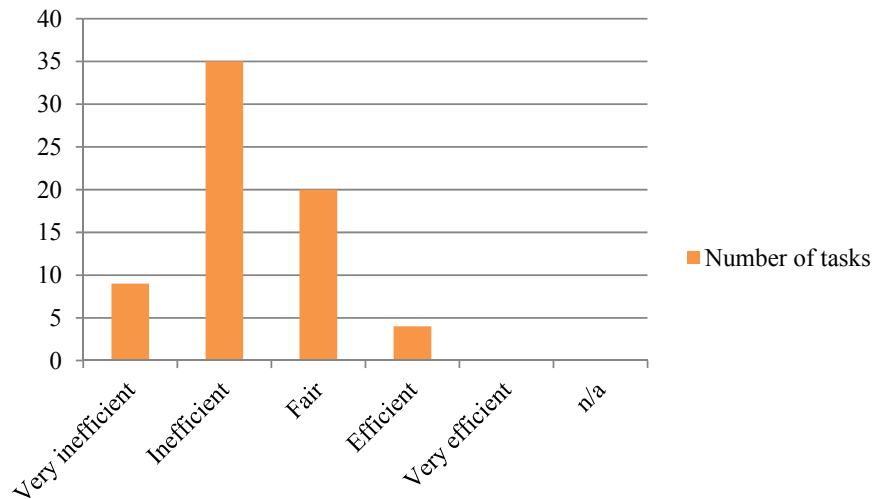


Figure 8-20: Case study 3 – RetroBIM Inefficiency Analysis

To continue the development of the RetroBIM framework, University of Greenwich should focus on the tasks in quadrant I of the implementation plan.

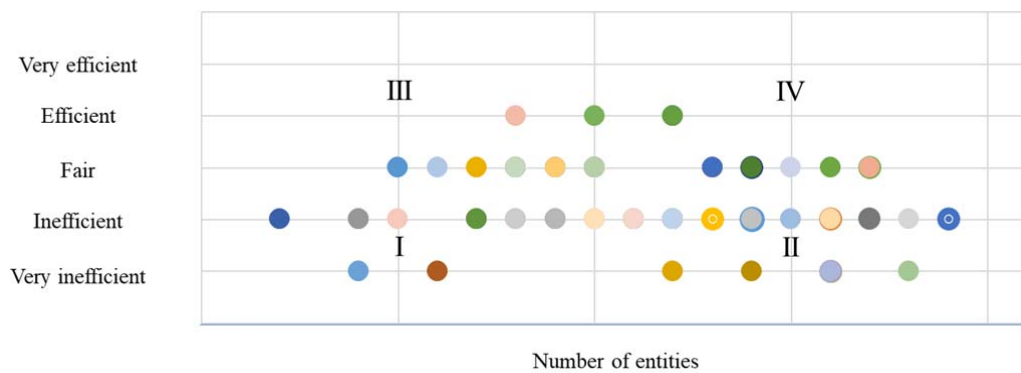


Figure 8-21: Case study 3 – Implementation Plan RetroBIM

Many of the tasks included in the University of Greenwich's implementation plan for the RetroBIM framework are located near I and II. The FM team should focus on implementing the information required for tasks such as bid process, supplier management, service-level agreement and business impact analysis in the RetroBIM model. Once implemented, the information would enable the team to work more efficiently.

8.3.2.3 BIM for the sustainability performance and reporting tool

Owing to the limitations linked to the buildings, the University of Greenwich would probably have limited benefits in implementing BIM with the purpose of evaluating different options as part of the sustainability performance and reporting tool. Nevertheless, the information model would be useful for supplying relevant training on health and safety to employees, which is the only very high priority identified by the University of Greenwich as part of the sustainability performance and reporting tool.

8.4 Case studies feedback

The three case studies provided general feedback on the sustainability performance and reporting tool and the RetroBIM framework, which answers a series of pre-defined questions.

Sustainability performance and reporting tool

The three case studies agreed that the tool would be helpful and support the implementation of sustainable initiatives. The respondent from BAM added that "it would be [a] really good [tool] as we don't have anything like that and there is no push within the FM organisation in pushing sustainability." The representative from GVA highlighted that the tool can support smaller organisations in identifying what can be achieved, and bigger organisation, such as GVA, in reviewing whether there are the sufficient resources available to implement everything the company committed to and track the performance over time. The interviewees also confirmed they would implement the tool and that the tool is practical enough to be implemented in the FM industry. The three case studies identified different benefits in implementing the sustainability tools, such as having an impact on the environment in which we live (BAM), being able to measure where one is and to improve sustainability (University

of Greenwich) and support ISO accreditation (GVA). In terms of barriers, all the interviewees spoke about the time pressure that characterises FM. The BAM respondent mentioned the need for client engagement to be able to improve initiatives as a potential barrier, whilst University of Greenwich indicated the limited resources and general short-sightedness that requires one to prove potential payback in two years or less are barriers.

RetroBIM framework

Similar to the evaluation of the sustainability performance and reporting tool, the interviewees were asked to provide a feedback on the RetroBIM framework.

The interviewees agreed that the RetroBIM framework would be useful and support the integration of BIM and existing buildings. Respondents from both GVA and University of Greenwich confirmed they would implement the tool and use it to manage their facilities, whilst the representative from BAM would do so if it is a client's requirement and/or if there is a long-term contract in place. Otherwise, for short-term contracts the benefits would not justify the use of resources needed to implement it. The benefits identified are access to live information that is reliable and a populated model, which would save the time currently spent on retrieving information by going through the documentation or surveying an area. All interviewees identified the time needed to create the model and the resources necessary to maintain the model and verify the information as barriers for the implementation of the framework. The interviewee from BAM also added the need for the clients to understand the benefits of using BIM in operation.

8.5 Conclusion

The three case studies presented in this chapter were used to partially test and further validate the sustainability performance and reporting tool and the RetroBIM framework. The analysis of the information collected through the interviews confirms that both tools are capable of accommodating the requirements and standards of different buildings and users. Moreover, the feedback received from the interviewees confirms that the use of the two tools would be beneficial and support both the

delivery of sustainable FM and the implementation of BIM for existing buildings, which would provide useful, reliable information for managing the buildings.

Chapter 9 Conclusions

The motivation for the research was a concern regarding the marginal positive impact of FM on sustainability and the lack of opportunities the FM industry provides to support sustainable developments (Price et al., 2011). The research began by investigating sustainability at operational level, to understand how sustainability is integrated in the FM role as well as the barriers for the implementation of sustainable initiatives. The results were then integrated, together with the analysis of sustainable policies, in the sustainability performance and reporting tool, which was designed to support FM in evaluating sustainable performance and achieving sustainability goals. The tool was developed to fulfill the current need for practical tools for supporting sustainable FM (Elmualim et al., 2010). Part of the tool called for the use of BIM for evaluating some of the sustainability objectives, which raised the issue of how BIM can be integrated with FM.

BIM has in fact several applications and has been utilised for some time now, especially for design and construction. However, its use in FM is still limited and research mainly focuses on new builds (Volk et al., 2014) hence one of the barriers to its use is the creation of information models for existing buildings. Thus, to extend the benefit of BIM into operation, the RetroBIM framework was created, proving a new approach to the implementation of information models that can be tailored to the needs of management and the building. The sustainability tool and the RetroBIM framework were validated by industry experts, who provided positive feedback on the applicability and usefulness of both. The tool and framework were then partially tested on three case studies in order to confirm their flexibility.

9.1 Achievement of research aims and objectives

The research aims were to develop a sustainability measurement system specific to facilities management and a new methodology to support the implementation of building information models for existing buildings in order to achieve better sustainability performance in facilities management with the support of Building Information Modelling. The aim was developed through a series of research objectives:

Objective 1 - Critically review sustainable FM in practice with a view to ascertaining the underlying problems and challenges

The research work began with an overview of how sustainable FM should align with the company direction and how, although the concept of sustainability in FM has broadened recently, the key areas of focus remain health and safety, waste management and energy management (Chapter 2).

The results of the interviews presented in Chapter 3 provided insight into how sustainability is dealt with at an operational level, and showed that although sustainability is perceived as an important aspect of FM, the delivery of such initiatives is limited by the availability of funds and the request for a return on investment of the initiatives implemented. The interviewees also highlighted that there is a disconnection between what is set at corporate level through sustainability policy and what is delivered at operational level. These difference were also confirmed by the lack of sustainable targets for the FM team and the supply chain, which makes sustainability intangible and hard to achieve rather than something fully implemented in the FM role.

Objective 2 – Establish the aspects that define sustainability in the facilities management industry

The analysis of sustainability policies of FM companies (Chapter 4) allowed for the identification of 13 themes and 122 sustainable FM objectives, which were integrated into the sustainable performance and reporting tool. The review of the policies confirmed that the concept of sustainability in FM is no longer limited to environmental aspects (energy and waste) but covers, among other areas, community, employees and supply chain.

Objective 3 – Investigate the FM relationship with BIM, exploring the benefits and barriers of integrating BIM into FM

As BIM is a new topic in FM, an expert focus group was used to identify benefits and barriers of integrating BIM into FM. The opportunity of accessing all information through a single model was recognised as a major benefit that would enhance FM practices, although there are some practical barriers that need to be overcome before FM will be able to fully benefit from BIM (such as lack of interest, need for training and a data strategy). One of the biggest obstacles for the integration of BIM in FM is the lack of information models for existing buildings. This challenge was confirmed by the results of the questionnaire survey. These results showed that the FM industry is aware of BIM but does not use it, partly because models are not handed over at the end of the construction phase and partly because only a small number of models are created for existing buildings.

Objective 4 – Verify the applicability of the sustainability tool and BIM framework

The applicability of the sustainability performance and reporting tool and of the RetroBIM framework were tested in three case studies. The case studies confirmed that both tools can deal with and can adapt to different requirements, both in terms of business and buildings. Lastly, the feedback provided by the case studies proved that the tools are beneficial and would positively impact facilities managers and their role.

Research aim 1 – Develop a tool to enable facilities managers to evaluate sustainable performance in their practices

The themes and objectives identified as part of objective 2 form the basis for the development of the sustainability performance analysis and reporting tool (Chapter 4). The tool has a two-fold purpose: provide support to facilities managers in identifying sustainability opportunities and verifying performance over time whilst ensuring alignment with the core business direction. The expert workshop used to develop the tool and the following validation process confirmed that the tool is useful, practical and can support the development of sustainability initiatives in FM, which was one of the two aims of the research project.

Research aim 2 – Develop a framework for the implementation of building information models for existing buildings

Chapter 7 presented the RetroBIM framework, which was created to provide facilities managers with a practical methodology for creating information models for existing buildings. The framework was designed to allow for a flexible approach that would meet the needs of different companies and different buildings, without prescribing a specific set of information that should be included and without the need of use of technologies such as scanning. The usefulness and practicality of the framework were also confirmed through the experts’ evaluation.

Table 9-1 presents a summary of the research aims and objectives and the outcomes of each of them:

Table 9-1: Research aims and objectives and outcomes

Research aims and objectives	Outcome
Objective 1 - Critically review sustainable FM in practice with a view to ascertaining the underlying problems and challenges	There is a disconnection between sustainability policies and what is delivered by FM. Sustainability is intangible and hard to achieve in facilities management
Objective 2 – Establish the aspects that define sustainability in the facilities management industry	Identification of 13 themes and 122 sustainable FM objectives
Objective 3 – Investigate the FM relationship with BIM, exploring the benefits and barriers of integrating BIM into FM	The FM industry is aware of BIM but does not use it due to lack of models availability, in particular for existing buildings.
Objective 4 – Verify the applicability of the sustainability tool and BIM framework	The case studies used as test confirmed that both tools are applicable and adaptable to different business and buildings needs
Research aim 1 – Develop a tool to enable facilities managers to evaluate sustainable performance in their practices	Development of the Sustainability performance analysis and reporting tool
Objective 1 - Critically review sustainable FM in practice with a view to ascertaining the underlying problems and challenges	There is a disconnection between sustainability policies and what is delivered by FM. Sustainability is intangible and hard to achieve in facilities management
Research aim 2 – Develop a framework for the implementation of building information models for existing buildings	Development of the RetroBIM framework

9.2 Contribution to knowledge

The results of the research presented within this thesis provide several contributions to knowledge:

- An understanding of sustainable FM at operational level through the interviews of facilities managers and what the current barriers and limitations are that prevent the implementation of sustainability initiatives during building operations. The results of the interviews and the analysis of sustainability policies revealed a gap on what is currently set at corporate level and what is delivered during operations in terms of sustainability.
- The development of the sustainability performance and reporting tool, which was designed to fill the deficit of sustainability measurement systems specific to FM and achieve better sustainability performance during building operations, covering all aspects of the triple bottom line and including the utilisation of BIM.
- The identification, through secondary data analysis and an expert workshop, of 92 FM-specific sustainable objectives with performance indicators and measurement tools that extend sustainable FM to all aspects of the triple bottom line.
- The development, as part of the sustainability tool, of a mapping process and visualisation that support the verification of alignment between FM sustainability priorities and corporate direction.
- An in-depth analysis of the FM use and understating of BIM in the UK through an expert focus group and a questionnaire survey, which received 753 valid responses. Part of the questionnaire results were included in the paper “Improving FM task efficiency through BIM: a proposal for BIM implementation” published in the Journal of Corporate Real Estate.
- The development of the RetroBIM framework, which was designed to address the lack of methodology for developing information models for existing buildings and extend the benefits of BIM into building operations. The RetroBIM framework was published in the paper “Building information model implementation for existing buildings for facilities management: Framework

and two case studies” included in Building Information Modelling (BIM) in Design, Construction and Operations (WIT Press).

- The development, as part of the RetroBIM framework, of a data mapping process that links tasks to IFC and provides an information implementation plan that prioritises information based on the inefficiency and on the amount of information required. The IFM implementation plan was published in the paper “Improving FM task efficiency through BIM: a proposal for BIM implementation” in the Journal of Corporate Real Estate.

9.3 Limitations of research

The research has the following limitations:

Data collection

The research focuses on facilities managers and FM organisations practicing in the UK. Owing to time and resource constraints, the sampling techniques used for data collection were snowball and self-selection.

RetroBIM

The RetroBIM framework was designed to address the issue of implementing BIM models for existing building and it is expected to be used by FM professionals as part of their role. The limitations of the framework arise from limited resource availability for the project to carry out extensive tests on the applicability of the framework and clear identification of practical issues during the implementation. More specifically, the framework is based on issues identified through data collection and, although the validity of the results is considered to be reasonable, some aspects such as the cost for implementing the framework and the time required have not been addressed in the study. Additionally, prior to applying the framework on a project, the inefficiency implementation would need to be further developed. Although the methodology presented for the implementation would remain valid, the mapping of the tasks against IFC would include a more granular level of details, which was not possible at this stage owing to the high volume of entities included in the IFC entity hierarchy and connected attributes.

Case studies

The case studies were used to partially test the sustainability performance and reporting tool and the RetroBIM framework. Owing to time limitations and difficulties in accessing the required information, the case studies provide only a review of the initial applicability of the two tools, which should be tested further to verify the practical benefits linked with their implementation, quantify the commitment required in terms of time of resources to be implemented and identify any limitations that did emerged during the development and validation process. A full test of the two tools would require access to FM information, which was not possible during this research, and sufficient time for reviewing performances and feedback as part of the tool, implementing the information as part of the RetroBIM framework.

9.4 Recommendations for future research

Based on the research and its limitations the following recommendations for future research have been identified:

1. The analysis of sustainability policies and the results from the FM interviews revealed a gap between corporate direction and FM in terms of sustainability. Further research should focus on understanding how companies perceived the FM contribution to the corporate sustainability agenda.
2. As the uptake of sustainability accreditations is limited during building operations, future research should investigate why companies are not using such accreditations to improve their sustainability performances.
3. As more information models will become available for new buildings, research should understand what information included in “as-built” models is needed for FM and what additional uses a complete model could have during operation.
4. The sustainability performance and reporting tool and the RetroBIM framework should be tested through a complete pilot study, which would verify the effectiveness of the tools and support the identification of their limitations.

References

- Aaltonen, A., Määttänen, E., Kyrö, R., & Sarasoja, A. L. (2013). Facilities management driving green building certification: a case from Finland. *Facilities*, 31(7/8), 328-342. doi: 10.1108/02632771311317475
- Acclaro Advisory. (n.d.). *The Sustainable FM Index*. Retrieved from <https://www.acclaro-advisory.com/sustainable-fm-index>
- Ackroyd, S. (2004). Methodology for management and organisation studies: Some implications of critical realism. In S. Fleetwood & S. Ackroyd (Eds.), *Critical Realist Applications in Organisation and Management Studies* London: Routledge.
- Akadiri, P. O., & Fadiya, O. O. (2013). Empirical analysis of the determinants of environmentally sustainable practices in the UK construction industry. *Construction Innovation*, 13(4), 352-373. doi: 10.1108/CI-05-2012-0025
- Alexander, K. (1996). *Facilities management: theory and practice*. London: E. & F. N. Spon.
- Alexander, K. (2004). *Facilities management : innovation and performance*. London: Spon.
- Alló, M., & Loureiro, M. L. (2014). The role of social norms on preferences towards climate change policies: A meta-analysis. *Energy Policy*, 73, 563-574. doi: <https://doi.org/10.1016/j.enpol.2014.04.042>
- Alvesson, M. (2009). *Reflexive methodology : new vistas for qualitative research* (2nd ed.. ed.). London: London : SAGE.
- Amaratunga, D., & Baldry, D. (2002). Moving from performance measurement to performance management. *Facilities*, 20(5/6), 217-223. doi: 10.1108/02632770210426701
- Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the built environment: application of “mixed” research approach. *Work Study*, 51(1), 17-31. doi: 10.1108/00438020210415488
- Andreewsky, E., & Bourcier, D. (2000). Abduction in language interpretation and law making. *Kybernetes*, 29(7/8), 836-845. doi: 10.1108/03684920010341991
- Ashworth, S. & Tucker, M. (2017), *FM Awareness of Building Information Modelling (BIM)*, BIFM
- Autodesk. (n.d.). *Building Information Modelling*. http://images.autodesk.com/apac_sapac_main/files/4525081_BIM_WP_Rev5.pdf.
- Azhar, S., Khalfan, M., & Maqsood, T. (2015). Building information modelling (BIM): now and beyond. *Construction Economics and Building; Vol 12, No 4 (2012): AJCEB Incorporating Special Issue on BIM*. doi: 10.5130/AJCEB.v12i4.3032

- Baaki, T. K., Baharum, M. R., & Ali, A. S. (2016). A review of sustainable facilities management knowledge and practice. *MATEC Web Conf.*, 66, 00075
- Baharum, M. R., & Pitt, M. (2009). Determining a conceptual framework for green FM intellectual capital. *Journal of Facilities Management*, 7(4), 267-282. doi: 10.1108/14725960910990026
- Barnes, P. (2013). *BIM in principle and in practice*. London: Ice Publishing.
- BEAM Society. (2016). *BEAM Plus Existing Buildings*.
- Becerik-Gerber, B., Jazizadeh, F., Li, N., & Calis, G. (2012). Application areas and data requirements for BIM-enabled facilities management. *Journal of Construction Engineering and Management*, 138(3), 431-442
- Berg, B. L. (2009). *Qualitative research methods for the social sciences* (7th ed. ed.). Boston, MA: Allyn & Bacon ; London : Pearson Education [distributor].
- Bernard, H. R. (1994). *Research Methods in Anthropology : Qualitative and Quantitative Approaches* (2Rev.ed. ed.): Sage Pubns.
- Berry, A. J., Broadbent, J., & Otley, D. (2005). *Management Control: Theories, Issues and Performance*: Macmillan Education UK.
- Best, R., Langston, C. A., & De Valence, G. (2003). *Workplace Strategies and Facilities Management*: Butterworth-Heinemann.
- BIFM. (2014). *Sustainability in Facilities Management Report 2014*. British Institute of Facilities Management.
- BIFM. (2015). *Sustainability in Facilities Management Report 2015*. British Institute of Facilities Management..
- BIM4FM. (2013). *Overview of survey results*.
- BIM task Group. (n.d.). *GSL Faqs*. Retrieved from <http://www.bimtaskgroup.org/gsl-faqs/>
- Blaikie, N. (1993). *Approaches to social enquiry*: Polity Press.
- Blair, E. (2015). A reflexive exploration of two qualitative data coding techniques. *Journal of Methods and Measurement in the Social Sciences*, 6(1), 14-29. doi: 10.2458/jmm.v6i1.18772
- Blumberg, B., Cooper, D. R. and Schindler, P. S. (2011), *Business Research Methods*, McGraw-Hill Education
- Bogdan, R., & Biklen, S. K. (2003). *Qualitative research in education : an introduction to theory and methods* (4th ed. ed.). Boston, MA ; London: Allyn and Bacon.
- Bosché, F., Guillemet, A., Turkan, Y., Haas, C. T., & Haas, R. (2014). Tracking the Built Status of MEP Works: Assessing the Value of a Scan-vs.BIM System. *Journal Computing in Civil Engineering*, 28

- Boyle, C. A. (2005). Sustainable buildings. *Proceedings of the Institution of Civil Engineers - Engineering Sustainability*, 158(1), 41-48. doi: 10.1680/ensu.2005.158.1.41
- Brad, S., & Fred, G. (2016). Sustainable facility development: perceived benefits and challenges. *International Journal of Sustainability in Higher Education*, 17(5), 601-612. doi: doi:10.1108/IJSHE-09-2014-0133
- BREEAM. (2016). *BREEAM In-Use International*. B. G. Limited.
- BREEAM. (2017). *BREEAM In-Use FactFile 2017*. Watford: B. Global.
- BREEAM. (n.d.). *Why choose BREEAM?* Retrieved from <http://www.breeam.com/discover/why-choose-breeam/>
- Brewerton, P. (2001). *Organizational research methods : a guide for students and researchers*. London: London : SAGE.
- Bruno, S., De Fino, M., & Fatiguso, F. (2018). Historic Building Information Modelling: performance assessment for diagnosis-aided information modelling and management. *Automation in Construction*, 86, 256-276. doi: <https://doi.org/10.1016/j.autcon.2017.11.009>
- Bryde, D., Broquetas, M., & Volm, J. M. (2013). The project benefits of Building Information Modelling (BIM). *International Journal of Project Management*, 31(7), 971-980. doi: <http://dx.doi.org/10.1016/j.ijproman.2012.12.001>
- Bryman, A. (2012). *Social research methods* (4th ed.. ed.). Oxford: Oxford : Oxford University Press.
- Bryman, A., & Bell, E. (2011). *Business research methods* (3rd ed. ed.). Oxford: Oxford University Press.
- BSI. (2013). PAS 1192-2:2013 Specification for information management for the capital/delivery phase of construction projects using building information modelling.
- BSI. (2014a). BS 1192-4:2014 Collaborative production of information. Fulfilling employer's information exchange requirements using COBie. Code of practice.
- BSI. (2014b). PAS 1192-3:2014 Specification for information management for the operational phase of assets using building information modelling: The British Standards Institution.
- BSI. (2015). PAS 1192-5:2015 Specification for security-minded building information modelling, digital built environments and smart asset management.
- BuildingSMART. (n.d.). *Industry Foundation Classes IFC4 Official Release*. Retrieved from <http://www.buildingsmart-tech.org/ifc/IFC4/final/html/>
- BuildingSMARTAlliance. (2007). *United States National Building Information Modelling Standard Version 1 - Part 1: Overview, Principles, and Methodologies*.

- Burns, R. B. (2000). *Introduction to research methods* (4th ed.). London: SAGE.
- Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis : elements of the sociology of corporate life*: Ashgate, 1992.
- Carbonari, G., Ashworth, S., & Stravoravdis, S. (2015). How Facility Management can use Building Information Modelling (BIM) to improve the decision making process. *Journal fuer Facility Management*, 10(2015)
- Carpenter, D., & Meehan, B. (2002). Mainstreaming environmental management: Case studies from Australasian universities. *International Journal of Sustainability in Higher Education*, 3(1), 19-37. doi: 10.1108/14676370210414155
- Chalmers, P. (2014). *Climate Change: Implications for Buildings. Key Findings from the Intergovernmental Panel on Climate Change Fifth assessment Report*. <http://www.gbpn.org/sites/default/files/Template%20AR5%20-%20Buildings%20v10%20-%20Web%20Pages.pdf>.
- Charlesraj, V. P. (2014). *Knowledge-based building information modeling (K-BIM) for facilities management*.
- Chen, K., Lu, W., Peng, Y., Rowlinson, S., & Huang, G. Q. (2015). Bridging BIM and building: From a literature review to an integrated conceptual framework. *International Journal of Project Management*, 33(6), 1405-1416. doi: <https://doi.org/10.1016/j.ijproman.2015.03.006>
- Chen, W., Chen, K., Cheng, J.C.P., Wang, Q. & Gan, V.J.L. (2018), *BIM-based framework for automatic scheduling of facility maintenance work orders*, *Automation in Construction*, Volume 91, 15-30
- Chien, K.-F., Wu, Z.-H., & Huang, S.-C. (2014). Identifying and assessing critical risk factors for BIM projects: Empirical study. *Automation in Construction*, 45(Supplement C), 1-15. doi: <https://doi.org/10.1016/j.autcon.2014.04.012>
- CIBSE. (2011). *Campaign Grows for Roll out of DEC's in Energy Bill*. London: C. I. o. B. S. Engineers.
- CIOB. (2011). *Carbon action 2050 white paper*. <http://www.carbonaction2050.com/sites/carbonaction2050.com/files/document-attachment/CIOB%20Carbon%20Footprint.pdf>.
- CIOB. (n.d.). *Sustainability and Construction*. <https://www.scribd.com/document/34328756/Sustainability-in-Construction-CIOB-pdf>.
- City of London. (2016). *Offices in the City of London*. <https://www.cityoflondon.gov.uk/services/environment-and-planning/planning/development-and-population-information/land-use/Documents/office-info-2016-update.pdf>.
- Collis, J., Hussey, R., & Hussey, J. (2003). *Business research : a practical guide for undergraduate and postgraduate students* (2nd ed / Jill Collis and Roger Hussey. ed.). Basingstoke: Palgrave Macmillan.

- Committee on Climate Change. (2014). *Meeting Carbon Budgets – 2014 Progress Report to Parliament*.
- Construction Industry Council. (2013). Building Information Model (BIM) Protocol.
- Cooke, B., & Williams, P. N. (2009). *Construction planning, programming and control* (3rd ed. ed.). Oxford: Wiley-Blackwell.
- Cooper, D. R. and Schindler, P. S. (2013), *Business Research Methods: 12th Edition*. McGraw-Hill Higher Education
- Cotgrave, A., & Riley, M. (2012). *Total Sustainability in the Built Environment*: Palgrave Macmillan.
- Cotts, D. G., Roper, K. O., & Payant, R. P. (2010). *The Facility Management Handbook*: American Management Association.
- Creswell, J. W. (2013). *Qualitative inquiry and research design : choosing among five approaches* (3rd edition. ed.). Los Angeles: SAGE Publications.
- Crotty, M. (1998). *The foundations of social research : meaning and perspective in the research process*. London: London : SAGE.
- Danermark, B. (2002). *Explaining society : critical realism in the social sciences*. London ; New York: Routledge.
- de Melo, C. A., Jannuzzi, G. d. M., & Ferreira Tripodi, A. (2013). Evaluating public policy mechanisms for climate change mitigation in Brazilian buildings sector. *Energy Policy*, *61*, 1200-1211. doi: <https://doi.org/10.1016/j.enpol.2013.06.056>
- de Waal, A. (2007). *Strategic Performance Management: A Managerial and Behavioural Approach*: Palgrave Macmillan.
- Denzin, N. K., & Lincoln, Y. S. (2011). *The Sage handbook of qualitative research* (4th ed.. ed.). Thousand Oaks: Thousand Oaks : Sage.
- Department of Energy & Climate Change HM Government. (2014). *2013 UK Greenhouse Gas Emissions, Provisional Figures and 2012 UK Greenhouse Gas Emissions, Final Figures by Fuel Type and End-User*.
- DeVellis, R.F. (2011), *Scale Development: Theory and Applications*, SAGE Publications, Inc.
- Ding, G. K. C. (2008). Sustainable construction—The role of environmental assessment tools. *Journal of Environmental Management*, *86*(3), 451-464. doi: <https://doi.org/10.1016/j.jenvman.2006.12.025>
- Ding, L., Drogemuller, R., Akhurst, P., Hough, R., Bull, S. & Linning, C. (2009), *Towards sustainable facilities management*. In Newton, Peter, Hampson, Keith, & Drogemuller, Robin (Eds.) *Technology, Design and Process Innovation in the Built Environment*. Taylor & Francis, Oxon, Abingdon, pp. 373-392

- Dziak, M. (2015). *Balanced scorecard (BSC)*: Salem Press.
- Eadie, R., Browne, M., Odeyinka, H., McKeown, C., & McNiff, S. (2013). BIM implementation throughout the UK construction project lifecycle: An analysis. *Automation in Construction*, 36, 145 - 151. doi: <http://dx.doi.org/10.1016/j.autcon.2013.09.001>
- Easterby-Smith, M., Thorpe, R., & Jackson, P. R. (2012). *Management Research*: SAGE Publications.
- Eastman, T., Sacks, L., Sacks, R., & Liston, K. (2011). *BIM Handbook - a guide to building information modeling for owners, managers, designers, engineers and contractors*. Hoboken: John Wiley & Sons.
- Ebbesen, P. (2015). *Information Technology in Facilities Management - A Literature Review 14th EuroFM Research Symposium*. Glasgow.
- Eisenhardt, K., & Graebner, M. (2007). *Theory Building From Cases: Opportunities and Challenges* (Vol. 50).
- Elmualim, A., & Gilder, J. (2014). BIM: innovation in design management, influence and challenges of implementation. *Architectural Engineering and Design Management*, 10(3-4), 183-199. doi: 10.1080/17452007.2013.821399
- Elmualim, A., Shockley, D., Valle, R., Ludlow, G., & Shah, S. (2010). Barriers and commitment of facilities management profession to the sustainability agenda. *Building and Environment*, 45(1), 58-64. doi: <http://dx.doi.org/10.1016/j.buildenv.2009.05.002>
- Elmualim, A., Valle, R., & Kwawu, W. (2012). Discerning policy and drivers for sustainable facilities management practice. *International Journal of Sustainable Built Environment*, 1(1), 16-25. doi: <https://doi.org/10.1016/j.ijjsbe.2012.03.001>
- Elo, S. & Kyngäs, H. (2008), The qualitative content analysis process. *Journal of Advanced Nursing*, 62: 107-115.
- European Commission. (2012). *Climate Change*. https://ec.europa.eu/clima/sites/clima/files/docs/factsheet_climate_change_2014_en.pdf.
- Eynon, J. a. (2016). *Construction manager's BIM handbook*.
- Facilities Show. (n.d.). *About*. Retrieved from <https://www.facilitiesshow.com/about>
- Fellows, R., & Liu, A. (2008). *Research methods for construction* (3rd ed.). Chichester: Wiley-Blackwell.
- Force, C. T. (1998). *Rethinking Construction*.
- Frankfort-Nachmias, C., & Nachmias, D. (1996). *Research methods in the social sciences* (5th ed. ed.). London: Edward Arnold.

- Franz, C. R., & Robey, D. (1987). Strategies for research on information systems in organizations. A critical analysis of research purpose and time frame. In R. Boland & R. A. Hirschheim (Eds.), *Critical issues in information systems research*. Chichester: Wiley.
- Ghaffarianhoseini, A., Tookey, J., Ghaffarianhoseini, A., Naismith, N., Azhar, S., Efimova, O., & Raahemifar, K. (2017). Building Information Modelling (BIM) uptake: Clear benefits, understanding its implementation, risks and challenges. *Renewable and Sustainable Energy Reviews*, 75(Supplement C), 1046-1053. doi: <https://doi.org/10.1016/j.rser.2016.11.083>
- Gimenez, L., Hippolyte, J., Robert, S., Suard, F., & Zreik, K. (2015). Review: reconstruction of 3D building information models from 2D scanned plans. *Journal of Building Engineering*, 2, 24 - 35. doi: <http://dx.doi.org/10.1016/j.jobe.2015.04.002>
- Goering, P. N., & Streiner, D. L. (1996). Reconcilable differences: the marriage of qualitative and quantitative methods. *Canadian journal of psychiatry. Revue canadienne de psychiatrie*, 41(8), 491
- Graubner, C.-A., Pelzeter, A., & Pohl, S. (2016). A new approach to measure sustainability in German facility management. *Facilities*, 34(1/2), 28-42. doi: 10.1108/F-01-2014-0005
- Gray, D. E. (2016). *Doing Research in the Business World*: SAGE Publications.
- GSA. (2011). *GSA Building Information Modeling Guide Series: 08 – GSA BIM Guide for Facility Management. Version 1 – December 2011*.
- Gursel, I., Sariyildiz, S., Akin, O., & Stouffs, R. (2009). Modeling and visualization of lifecycle building performance assessment. *Advanced Engineering Informatics*, 23(4), 396-417
- Haapio, A., & Viitaniemi, P. (2008). A critical review of building environmental assessment tools. *Environmental Impact Assessment Review*, 28(7), 469-482. doi: <https://doi.org/10.1016/j.eiar.2008.01.002>
- Hajian, H., & Becerik-Gerber, B. (2010). Scan to BIM: factors affecting operational and computational errors and productivity loss *27th International Symposium on Automation and Robotics in Construction*.
- Harris, H. (2001). Content Analysis of Secondary Data: A Study of Courage in Managerial Decision Making. *Journal of Business Ethics*, 34(3), 191-208. doi: 10.1023/A:1012534014727
- Hinks, J., & McNay, P. (1999). The creation of a management by variance tool for facilities management performance assessment. *Facilities*, 17(1/2), 31-53. doi: 10.1108/02632779910248893
- Hinks, J., Wright, P., & Halford-Maw, W. (2012). *CRE & FM Future Forum*. Retrieved from <https://www.boma.org/research/Documents/Zurich%20Futures%20Forum%20Report%20FINAL.pdf>

- HM Government. (2012). *UK Climate Change Risk Assessment: Government Report*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69487/pb13698-climate-risk-assessment.pdf.
- HM Government. (2013). *Construction 2025*.
- Hodges, C. (2005). A facility manager's approach to sustainability. *Journal of Facilities Management*, 3(4), 312-324. doi: 10.1108/14725960510630498
- IFMA. (2013). *BIM for facility managers*. Hoboken, New Jersey: John Wiley & sons.
- IFMA. (n.d.). *What is FM?* Retrieved from <http://www.ifma.org/knowledge/browse/what-is-fm->
- Ikediashi, D., Ogunlana, S., & Ujene, A. (2014). An investigation on policy direction and drivers for sustainable facilities management practice in Nigeria. *Journal of Facilities Management*, 12(3), 303-322. doi: doi:10.1108/JFM-02-2013-0013
- Ikediashi, D. I., Ogunlana, S. O., Oladokun, M. G., & Adewuyi, T. (2012). Assessing the level of commitment and barriers to sustainable facilities management practice: A case of Nigeria. *International Journal of Sustainable Built Environment*, 1(2), 167-176. doi: <https://doi.org/10.1016/j.ijbsbe.2013.06.002>
- International Organization for Standardization. (2010). ISO 29481-1:2010 Building information models -- Information delivery manual -- Part 1: Methodology and format.
- IPCC. (2007a). *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: C. University & Press.
- IPCC. (2007b). *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland.
- IPCC. (2007c). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: C. U. Press.
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA: C. U. Press.
- IPCC. (2014). *Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change. Contribution of*

Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: C. U. Press.

Irizarry, J., Karan, E. P., & Jalaei, F. (2013). Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. *Automation in Construction*, 31(Supplement C), 241-254. doi: <https://doi.org/10.1016/j.autcon.2012.12.005>

Jensen, P. A., J. M. van der Voordt, T., Coenen, C., & Sarasoja, A.-L. (2014). Reflecting on future research concerning the added value of FM. *Facilities*, 32(13/14), 856-870. doi: 10.1108/F-09-2012-0070

Juan, D., & Z heng, Q. (2014). Cloud and Open BIM-Based Building Information Interoperability Research. *Journal of Service Science and Management*, 7

Jung, J., Hong, S., Jeong, S., Kim, S., Cho, H., Hong, S., & Heo, J. (2014). Productive modeling for development of as-built BIM of existing indoor structures. *Automation in Construction*, 42, 68-77

Jung, J., Stachniss, C., & Kim, C. (2017). Automatic Room Segmentation of 3D Laser Data Using Morphological Processing. *ISPRS International Journal of Geo-Information*, 6(7). doi: 10.3390/ijgi6070206

Jung, Y., & Joo, M. (2011). Building information modelling (BIM) framework for practical implementation. *Automation in Construction*, 20(2), 126-133. doi: <https://doi.org/10.1016/j.autcon.2010.09.010>

Kang, T. W., & Hong, C. H. (2015). A study on software architecture for effective BIM/GIS-based facility management data integration. *Automation in Construction*, 54, 25-38. doi: <http://dx.doi.org/10.1016/j.autcon.2015.03.019>

Kaplan, R., & Norton, D. (2001). *Transforming The Balanced Scorecard from Performance Measurement to Strategic Management: Part II* (Vol. 15).

Kaplan, R. S., & Norton, D. P. (2004). *Strategy Maps: Converting Intangible Assets Into Tangible Outcomes*: Harvard Business School Press.

Kassem, M., Kelly, G., Dawood, N., Serginson, M., & Lockley, S. (2015). BIM in facilities management applications: a case study of a large university complex. *Built Environment Project and Asset Management*, 5(3), 261-277. doi:10.1108/BEPAM-02-2014-0011

Kenneth, F. H. (2000). Recognising deductive processes in qualitative research. *Qualitative Market Research: An International Journal*, 3(2), 82-90. doi: 10.1108/13522750010322089

Kivits, R. A., & Furneaun, C. (2013). BIM: Enabling Sustainability and Asset Management through Knowledge Management. *The Scientific World Journal*, 2013

Koukiasa, M. (2011). Sustainable facilities management within event venues. *Worldwide Hospitality and Tourism Themes*, 3(3), 217-228. doi: 10.1108/175542111111142185

- Kreider, R. G., & Messner, J. I. (2013). *The Uses of BIM: Classifying and Selecting BIM Uses*. University Park, PA, USA: T. P. S. University.
- Krueger, R. A., & Casey, M. A. (2009). *Focus groups : a practical guide for applied research* (4th ed. ed.). London: SAGE.
- Kumar, R. (2011). *Research methodology : a step-by-step guide for beginners* (3rd ed. ed.). Los Angeles, [Calif.] ; London: Los Angeles, Calif. ; London : SAGE.
- Kvale, S., & Brinkmann, S. (2009). *InterViews : learning the craft of qualitative research interviewing* (2nd ed. ed.). Thousand Oaks ; London.: Sage Publications.
- Kwok Wai Wong, J., Ge, J. & Xiangjian He, S. (2018). *Digitisation in facilities management: A literature review and future research directions*. *Automation in Construction*, Volume 92, 312-326
- Kymmell, W. (2008). *Building information modeling : planning and managing construction projects with 4D CAD and simulations*. New York ; London: McGraw-Hill.
- Laakso, M., & Kiviniemi, A. (2012). The IFC Standard - A review of history, development, and standardization. *ITcon*, 17, 134-161
- Lacey, A., & Luff, D. (2007). *Qualitative Data Analysis*. T. N. R. f. t. E. Midlands.
- Lee, G., Park, H. K., & Won, J. (2012). D3 City project — Economic impact of BIM-assisted design validation. *Automation in Construction*, 22(Supplement C), 577-586. doi: <https://doi.org/10.1016/j.autcon.2011.12.003>
- Lee, S. Y., & Kang, M. (2013). Innovation characteristics and intention to adopt sustainable facilities management practices. *Ergonomics*, 56(3), 480-491. doi: 10.1080/00140139.2012.752110
- Lee, W. L., & Burnett, J. (2008). Benchmarking energy use assessment of HK-BEAM, BREEAM and LEED. *Building and Environment*, 43(11), 1882-1891. doi: <https://doi.org/10.1016/j.buildenv.2007.11.007>
- Lee, W. L., & Yik, F. W. H. (2004). Regulatory and voluntary approaches for enhancing building energy efficiency. *Progress in Energy and Combustion Science*, 30(5), 477-499. doi: <https://doi.org/10.1016/j.pecs.2004.03.002>
- Light, D. (2011). *BIM Implementation*. Retrieved from http://www.thenbs.com/topics/bim/articles/BIM-Implementation_HOK-buildingSMART.asp
- Lijing, B., & Zhengpeng, Z. (2008). Application of point clouds from terrestrial 3D laser scanner for deformation measurements *International Society for Photogrammetry and Remote Sensing* (Vol. 37, pp. 458-454): The International Society for Photogrammetry and Remote Sensing.

- Lin, Y.-H., Liu, Y.-S., Gao, G., Han, X.-G., Lai, C.-Y., & Gu, M. (2013). The IFC-based path planning for 3D indoor spaces. *Advanced Engineering Informatics*, 27(2), 189-205. doi: <https://doi.org/10.1016/j.aei.2012.10.001>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, Calif.: Sage Publications.
- Lucas, J. B., T.Thabet, W. (2013). An object-oriented model to support healthcare facility information management. *Automation in Construction*, 31, 281 - 291. doi: <http://dx.doi.org/10.1016/j.autcon.2012.12.014>
- Lynch, A. J., & Mosbah, S. M. (2017). Improving local measures of sustainability: A study of built-environment indicators in the United States. *Cities*, 60(Part A), 301-313. doi: <https://doi.org/10.1016/j.cities.2016.09.011>
- Male, D. (n.d.). *The Dreadnought Seamen's Hospital/Library*. Retrieved from <http://www.greenwich-guide.org.uk/dreadnought.htm>
- Martin, C. S., & Guerin, D. A. (2006). Using research to inform design solutions. *Journal of Facilities Management*, 4(3), 167-180. doi: [10.1108/14725960610673751](https://doi.org/10.1108/14725960610673751)
- May, M., & Williams, G. (Eds.). (2012). *The Facility Manager's Guide to Information Technology*: International Facility Management Association.
- Mei, H., Ma, Y., Wei, Y. & Chen, W. (2018), *The design space of construction tools for information visualization: A survey*, *Journal of Visual Languages & Computing*. Volume 44, 120-132
- Miettinen, R., & Paavola, S. (2014). Beyond the BIM utopia: Approaches to the development and implementation of building information modeling. *Automation in Construction*, 43(Supplement C), 84-91. doi: <https://doi.org/10.1016/j.autcon.2014.03.009>
- Miller, A. (1998). *Strategic management*: Irwin/McGraw Hill.
- Miller, N. G., Pogue, D., Saville, J., & Tu, C. (2010). The operation and management of green buildings in the United States. *Journal of Sustainable Real Estate*, 2(1)
- Min, Z., Morgenstern, P., & Marjanovic-Halburd, L. (2016). Facilities management added value in closing the energy performance gap. *International Journal of Sustainable Built Environment*, 5(2), 197-209. doi: <https://doi.org/10.1016/j.ijjsbe.2016.06.004>
- Mingers, J. (2003). A classification of the philosophical assumptions of management science methods. *Journal of the Operational Research Society*, 54(6), 559-570. doi: [10.1057/palgrave.jors.2601436](https://doi.org/10.1057/palgrave.jors.2601436)
- Mitchell, J., & Schevers, H. (n.d.). *Building Information Modelling for FM using IFC*.
- Mitropoulos, P., & Tatum, C. (2000). Forces driving adoption of new information technologies. *Construction Engineering & Management*, 126(5), 340-348

- Morgan, D. L., & Scannell, A. U. (1998). *Focus group kit. 2, Planning focus groups*. Thousand Oaks, Calif.: SAGE Publications.
- Moriarty, C. (2014). Operating on the edges of compliance. *Facilities Management*, 22(1)
- Motamed, A., Hammad, A., & Asen, Y. (2014). Knowledge-assisted BIM-based visual analytics for failure root cause detection in facilities management. *Automation in Construction*, 43, 73-83
- Myers, M. D. (1997). Qualitative Research in Information Systems. *MIS Quarterly*, 21(2), 241-242. doi: 10.2307/249422
- Myers, M. D., & Avison, D. E. (2002). *Qualitative research in information systems : a reader*. London: SAGE.
- Naoum, S. G. (2013). *Dissertation research & writing for construction students* (3rd ed.). New York: Routledge.
- National Research Council. (2005). *Key Performance Indicators for Federal Facilities Portfolios: Federal Facilities Council Technical Report Number 147*. Washington, DC: The National Academies Press.
- NBS. (2012). *The IFC/COBie Report 2012*.
- NBS. (2013). *What does 'Government Soft Landings' mean?* Retrieved from <https://www.thenbs.com/knowledge/what-does-government-soft-landings-mean>
- NBS. (2016a). *National BIM Report 2016*.
- NBS. (2016b). *Working towards a unified approach to BIM in Europe*. Retrieved from <https://www.thenbs.com/knowledge/working-towards-a-unified-approach-to-bim-in-europe>
- NBS. (2017a). *BIM Levels explained*. Retrieved from <https://www.thenbs.com/knowledge/bim-levels-explained>
- NBS. (2017b). *National BIM Report 2017*.
- Neef, D., Siesfeld, G. A., & Cefola, J. (1998). *The Economic Impact of Knowledge*: Butterworth-Heinemann.
- Nielsen, S. B., Jensen, J. O., & Jensen, P. A. (2009). Delivering Sustainable Facilities Management in Danish Housing Estates *CIMNE 2009 international conference on Sustainability Measurement and Modelling*. Barcelona.
- Nielsen, S. B., Sarasoja, A.-L., & Galamba, K. R. (2016). Sustainability in facilities management: an overview of current research. *Facilities*, 34(9/10), 535-563. doi: 10.1108/F-07-2014-0060
- O'Connor, A. C., Dettbarn, J. L., & Gilday, L. T. (2004). Cost analysis of inadequate interoperability in the U.D. capital facilities industry.

- Oakland, J. S. (2004). *Oakland on Quality Management*. Elsevier/Butterworth-Heinemann.
- Olatunji, O. A. (2011). A preliminary review on the legal implications of BIM and model ownership. *Special issue Innovation in Construction e-Business*, 16
- Oman, H. S., & Dulaimi, M. F. (2015). Using BIM to automate construction site activities *Building Information Modelling (BIM) in Design, Construction and Operations*. Southampton: WIT Press.
- Oppenheim, A. N. (2000). *Questionnaire Design, Interviewing and Attitude Measurement*. Bloomsbury Academic.
- Parker, L. D. (1979). Divisional Performance Measurement: Beyond an Exclusive Profit Test. *Accounting and Business Research*, 9(36), 309-319. doi: 10.1080/00014788.1979.9729172
- Pärn, E.A., Edwards, D.J. & Sing, M.C.P. (2017). *The building information modelling trajectory in facilities management: A review*, Automation in Construction, Volume 75, Pages 45-55
- Patterson, R. E., Blaha, L. M., Grinstein, G. G., Liggett, K. K., Kaveney, D. E., Sheldon K. C., Havig, P. R. & Moore, J. A. (2014), A human cognition framework for information visualization. *Computers & Graphics*, Volume 42, 42-58
- Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed. ed.). Thousand Oaks, Calif. ; London: Sage.
- Pettersen, T. D. (2000). *Ecoprofile for Commercial Buildings*.
- Pishdad-Bozorgi, P., Gao, X., Eastman, C. & Self, A. P. (2018), *Planning and developing facility management-enabled building information model (FM-enabled BIM)*, Automation in Construction, Volume 87, 22-38
- Pitt, M., & Hinks, J. (2001). Barriers to the operation of the facilities management: property management interface. *Facilities*, 19(7/8), 304-308. doi: 10.1108/02632770110390784
- Pope, C., & Mays, N. (2006). *Qualitative research in health care* (3rd ed. ed.). Oxford: Blackwell ; London : BMJ Books.
- Potter, S. (2006). *Doing postgraduate research* (2nd ed.. ed.). London: London : The Open University in associaton with SAGE Publications.
- Price, I., Beard, C., Ellison, I., & Matzdorf, F. (2011). Triple bottom line space: productivity paradoxes in FM *10th EuroFM Research Symposium, EFMC2011*. Vienna.
- Price, S., Pitt, M., & Tucker, M. (2011). Implications of a sustainability policy for facilities management organisations. *Facilities*, 29(9/10), 391-410. doi: 10.1108/02632771111146314

- Pärn, E. A., Edwards, D. J., & Sing, M. C. P. (2017). The building information modelling trajectory in facilities management: A review. *Automation in Construction*, 75, 45-55. doi: <https://doi.org/10.1016/j.autcon.2016.12.003>
- Pătrăucean, V., Armeni, I., Nahangi, M., Yeung, J., Brilakis, I., & Haas, C. (2015). State of research in automatic as-built modelling. *Advanced Engineering Informatics*, 29(2), 162-171. doi: <https://doi.org/10.1016/j.aei.2015.01.001>
- Ramskov, G. K., & Balslev, N. S. (2016). Towards sustainable public FM: collective building of capabilities. *Facilities*, 34(3/4), 177-195. doi: doi:10.1108/F-05-2013-0039
- Ravetz, J. (2008). State of the Stock' What do we know about existing buildings and their future prospects? *Energy Policy*, 36, 4462-4470
- Reineck, M., Poltermann, J., May, M., & Pelzeter, A. (2011). Measuring Corporate Sustainable Development in Facilities Management with Key Performance Indicators. / *OIDA International Journal of Sustainable Development*, 02(10)
- RIBA. (2013). Plan of Work 2013.
- RICS. (2012). *Raising the bar: Enhancing the strategic role of facilities management*. London.
- RICS. (2015). *International BIM implementation guide*. London: R. I. o. C. Surveyors. Retrieved from RICS guidance note, global.
- Roper, K., & Beard, J. (2006). Justifying sustainable buildings – championing green operations. *Journal of Corporate Real Estate*, 8(2), 91-103. doi: 10.1108/14630010610679899
- Sacks, R., & Barak, R. (2010). Teaching Building Information Modeling as an Integral Part of Freshman Year Civil Engineering Education. *Journal of Professional Issues in Engineering Education and Practice*, 136(1), 30-38. doi: 10.1061/(ASCE)EI.1943-5541.0000003
- Saidi, K. S., Choek, G., Franaszek, M., Brown, C., Swerdlow, J., Lipman, R., . . . Goodrum, P. (2011). *Development and use of the NIST intelligent and automated construction job site testbed*
- Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research methods for business students* (4th ed.). Harlow, England ; New York: Financial Times/Prentice Hall.
- Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students* (6th ed. ed.). Harlow, England ; New York: Pearson.
- Service Works Group. (n.d.). *How FMs use Technology will be the Biggest Challenge in 2016 and Beyond*. Retrieved from <https://www.swg.com/how-fms-use-technology-will-be-the-biggest-challenge-in-2016-and-beyond/>
- Shah, S., Davies, G., & Brogan, P. (2016). *BIFM Sustainability Survey 2016*. B. I. o. F. Management.

- Shah, S. S. (2007). *Sustainable practice for the facilities manager*. Oxford: Blackwell.
- SmartMarket Report. (2014). *The Business Value of BIM for Construction in Major Global Markets: How Contractors Around the World Are Driving Innovation With Building Information Modeling*. Bedford.
- Spens, K. M., & Kovács, G. (2006). A content analysis of research approaches in logistics research. *International Journal of Physical Distribution & Logistics Management*, 36(5), 374-390. doi: 10.1108/09600030610676259
- Stafford, A., Gorse, C., & Shao, L. (2011). *The retrofit challenge: delivering low carbon buildings*. T. C. f. L. C. F. 2011.
- Stern, N. (2008). The Economics of Climate Change. *American Economic Review*, 98(2), 1-37
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research : techniques and procedures for developing grounded theory* (2nd ed. ed.). Thousand Oaks, Calif.: Sage Publications.
- Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders. *Automation in Construction*, 18(3), 357-375. doi: <https://doi.org/10.1016/j.autcon.2008.10.003>
- Suddaby, R. (2006). From the Editors: What Grounded Theory is Not. *Academy of Management Journal*, 49(4), 633-642. doi: 10.5465/AMJ.2006.22083020
- Sun, J., Liu, Y.-S., Gao, G., & Han, X.-G. (2015). IFCCompressor: A content-based compression algorithm for optimizing Industry Foundation Classes files. *Automation in Construction*, 50, 1-15. doi: <http://dx.doi.org/10.1016/j.autcon.2014.10.015>
- Tashakkori, A., & Teddlie, C. (1998). *Mixed methodology : combining qualitative and quantitative approaches*. Thousand Oaks, Calif. ; London: Sage.
- The American Institute of Architects. (2007). *Integrated Project Delivery: A Guide Version 1: AIA*.
- Thiétart, R.-A. (2001). *Doing management research : a comprehensive guide*. London: SAGE.
- Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, Vol 27, Issue 2, 237-246.
- Todd, J. A., Crawley, D., Geissler, S., & Lindsey, G. (2001). Comparative assessment of environmental performance tools and the role of the Green Building Challenge. *Building Research & Information*, 29(5), 324-335. doi: 10.1080/09613210110064268
- Tol, R. S. J. (2014). Quantifying the consensus on anthropogenic global warming in the literature: A re-analysis. *Energy Policy*, 73, 701-705. doi: <https://doi.org/10.1016/j.enpol.2014.04.045>

- Turk, Ž. (2016). Ten questions concerning building information modelling. *Building and Environment*, 107(Supplement C), 274-284. doi: <https://doi.org/10.1016/j.buildenv.2016.08.001>
- U.S. Green Building Council. (2009). *LEED 2009 for existing buildings operations and maintenance*.
- UK Green Building Council. (2011). *Carbon Reductions in Existing Non-Domestic Buildings*. London: U. G. B. Council.
- Underwood, J., & Isikdag, U. (2010). *Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies*: Information Science Reference.
- United Nations Environment Programme. (2009). *UNEP 2008 Annual Report*. http://www.iri.edu.ar/publicaciones_iri/Anuario/Anuario%202009/Mayd/Naciones%20Unidas%20-%20United%20Nations%20Environment%20Programme%20-%20ANNUAL%20REPORT%202008.pdf.
- University of Greenwich. (n.d.). *Leadership in Sustainability*. Retrieved from <https://blogs.gre.ac.uk/greengreenwich/>
- Valero, E., Adan, A., & Cerrada, C. (2015). Automatic Construction of 3D Basic-Semantic Models of Inhabited Interiors Using Laser Scanners and RFID Sensors. *Sensors*, 12(5), 5705-5724
- Van Maanen, J. (1979). Reclaiming Qualitative Methods for Organizational Research: A Preface. *Administrative Science Quarterly*, 24(4), 520-526. doi: 10.2307/2392358
- Vanlande, R., Nicolle, C., & Cruz, C. (2008). IFC and building lifecycle management. *Automation in Construction*, 18(1), 70-78. doi: <http://dx.doi.org/10.1016/j.autcon.2008.05.001>
- Vaughn, S. R. a., Schumm, J. S. a., & Sinagub, J. M. a. (1996). *Focus Group Interviews in Education and Psychology*.
- Volk, R., Stengel, J., & Schultmann, F. (2014). Building Information Modeling (BIM) for existing buildings — Literature review and future needs. *Automation in Construction*, 38, 109-127
- Walasek, D., & Barszcz, A. (2017). Analysis of the Adoption Rate of Building Information Modeling [BIM] and its Return on Investment [ROI]. *Procedia Engineering*, 172(Supplement C), 1227-1234. doi: <https://doi.org/10.1016/j.proeng.2017.02.144>
- Wang, N., Wei, K., & Sun, H. (2014). Whole Life Project Management Approach to Sustainability. *Journal of Management in Engineering*, 30(2), 246-255. doi: 10.1061/(ASCE)ME.1943-5479.0000185
- Ware, C. (2012), *Information Visualization: Perception for Design*, Morgan Kaufmann

- Wetzel, E.M. & Thabet, W.Y. (2015). *The use of a BIM-based framework to support safe facility management processes*. *Automation in Construction*, Volume 60, 12-24
- Wilsey, D., Rohm, H., Perry, G. S., & Montgomery, D. (2013). *The Institute Way: Simplify Strategic Planning and Management with the Balanced Scorecard*: Institute Press.
- Wongrassamee, S., Simmons, J. E. L., & Gardiner, P. D. (2003). Performance measurement tools: the Balanced Scorecard and the EFQM Excellence Model. *Measuring Business Excellence*, 7(1), 14-29. doi: 10.1108/13683040310466690
- Wood, B. (2006). The role of existing buildings in the sustainability agenda. *Facilities*, 24(1/2), 61-67. doi: 10.1108/02632770610639206
- Xiong, X., Adan, A., Akinci, B., & Huber, D. (2013). Automatic creation of semantically rich 3D building models from laser scanner data. *Automation in Construction*, 31, 325-337
- Yau, Y. H., & Hasbi, S. (2013). A review of climate change impacts on commercial buildings and their technical services in the tropics. *Renewable and Sustainable Energy Reviews*, 18, 430-441. doi: <https://doi.org/10.1016/j.rser.2012.10.035>
- Yin, R. K. (2013). *Case Study Research: Design and Methods*: SAGE Publications.
- Yousefzadeh, S., Spillane, J. P., Lamont, L., McFadden, J., & Lim, J. (2015). Building Information Modelling (BIM) Software Interoperability: A Review of the Construction Sector *Proceedings of the 31st Annual ARCOM Conference* (pp. 711-720): ARCOM.

Appendices

Appendix 1	Sustainability in facilities management interviews transcription	pg. 231
Appendix 2	BIM and FM focus group transcription	pg. 361
Appendix 3	Questionnaire survey	pg. 387
Appendix 4	IFC mapping	pg. 402
Appendix 5	Sustainability policies case studies	pg. 424
Appendix 6	Publications	pg. 429

Appendix 1 – Sustainability in facilities management interviews transcription

Interviewer: First of all, could you please tell me your experience in FM.?

Interviewee: My experience in FM, I have been working for ... since 2014, October 2014. Before that I worked for a medical school in the infrastructure and buildings department for a year. I am not-- here's my experience with FM. Before that I was a fitness instructor.

Interviewer: How did you ended up in FM? It's not related to this but...

Interviewee: Yes, so what happened was I got passed up for a promotion in the gym, me and another internal colleague, we were promised that one of us will get it, so we both ended up leaving. And it just so happened this job came up for this chap in the medical school that I knew, and I went forward for it and I had a lot of transferrable skills that are... you know, and I found a passion for it.

Interviewer: Okay, you are probably one-- if you talk with FM people, they always say, "oh I come like architecture or I was the handyman before I ended up in FM. You are probably the only one in the world to do what you are doing. That's amazing. That's really good. Could you describe the facilities you are managing, or facility?

Interviewee: Yes, at the moment we manage three large PFI secondary schools in West Sussex and they have approximately 1200 to 1400 children per school. There's multi-site operation obviously and I am based on one site with the ability to move to the satellite sites and they are approximately 10 to 12 years old. One was built in 2004, and operational in 2004 and the other was 2005, 2006. There are no renewables up on the site at all, anything like, it's a box standard kind of setup if that's the right phrase, and that's about it. We manage the total facilities management for that project because we are an outsourced company. The client have given pretty much everything to us.

Interviewer: [00:02:14 **inaudible**] have fun [laughs]

Interviewee: Yeah, pretty much, so they can focus on teaching I think.

Interviewer: That's good, that's what we want. Does your company have a sustainability policy?

Interviewee: Yes.

Interviewer: Okay. How do you align with it?

Interviewee: We have objectives within that sustainability policy and sort of environmental and sustainable objectives and we have to-- we have free very into kind of try and achieve those if that makes sense. We don't-- personally I don't think we have enough involvement with our sustainability team because we've got sustainability team. They are based at one location, which is the head office and I have never met-- apart from one of course, I have never met and they have never come to site to see what's going on operationally. My personal opinion is that they write these policies on these pieces of paper and they don't actually align with anything that we do operationally.

Interviewer: Do you have within-- so the policies is just kind of a guideline, you don't have any formal goal that you need to meet or anything like that?

Interviewee: No, we never have any formal goal. I mean the objective is if we hit them. Happy days, people just go, "hey" of course a pat in back if we don't hit them and there's no discipline against, so there's no investigation as to why, it's just what it is.

Interviewer: Okay, that's fine. How do you... okay, in what you do, how do you behave related to this policy and things? Is it something that drives you? Is it something that is just a matter of trying to achieve those objectives that you were talking about?

Interviewee: I wouldn't say it drives us as a project. We have-- so apart from here, we have an operations manager who oversees more projects and I don't think she has ever mentioned sustainability to me. What happens is that we've got an HSEQ manager, health safely, environment quality and we also have the sustainability team and occasionally one of them would send an email out saying, "look at this new sustainability initiative that's come on board and please relay it to your team and we'll hold a toolbox talks and with the greatest of respect to the people that make up the majority of our workforce, they are sort of cleaners, caretakers, and while they have

their use and they are very skilled at what they do, they are not really interested in the wider picture, so we deliver the toolbox talks and the feedback you get is just a tick in the box.

Interviewer: And so this is basically the other thing that I was asking you, how about staff in supply chain? How do you get them involved in the talk that you were just talking about?

Interviewee: Yeah, in terms of procurement and in terms of--

Interviewer: Oh so in terms of procurement, yes.

Interviewee: Yes. The way we procure contracts with people is literally just the case of them filling supplier evaluation questionnaire. It mentions about management systems and environmental management systems and things, certified ones and non-certified. We have the ability to visit their sites to see how they achieve things but we don't-- the focus for our company is health and safety because we are BSI accredited for that as well. It goes in the background if I am honest and it's not really talked about anywhere.

Interviewer: So you don't have formal requirements for-- you kind of ask the question but then again you don't really check whether they do or not and then at contract level, you don't put anything in writing about, do they need to-- for example cleaning, do they need to use anything?

Interviewee: No. All of our cleaning apart from external building cleaning, that's outsourced but all the internal cleaning is done by us. The only thing is we write about disposal of-- you know, and this doesn't really come into it if I am honest. It's just kind of-- it just happens. We have all of our hazardous waste stuff and all of that and things like that, all of our environmental things from that point of view but no, it doesn't. It's not requirements to work with us.

Interviewer: Okay, no, no absolutely. That's fine. That's the other side that I was looking for.

Interviewee: Yeah that's the honest side.

Interviewer: I would say, the other one were pretty convincing. So yeah it sounds like they are doing something.

Interviewee: The trouble is because we have-- it's all based in different regions. We have a south region and north region, and the person you've spoken to is probably based in the south region as well but they are a couple of hundred miles from here. And then we are based in the south region as well but we have different operations manager. So it all depends on the individual. The thing is there for us to refer to and it all depends on how much we want to invest time into it.

Interviewer: No, absolutely it make sense. We don't talk about targets because you don't have ready targets, right?

Interviewee: No.

Interviewer: On your day to day job, do you think sustainability is part of it or not?

Interviewee: I would like to make it more of a part of it but I don't think it is a great part of it at the moment. I don't think. Day to day, the most-- we're actually quite reactive in our job and that is, the helpdesk that we've got with the three projects with the three schools on the project are very demanding. The actual problems that we have with the schools and I think that stems back to construction phase. They are quite demanding, the projects, the problems we are encountering. My main priority is resolving those reactive issues by any means necessary in some case. And also we got slaughtered by the BSI before I started for our health and safety performance. We had a contractor on site and then the BSI goes, walking around, doing this little audit and he's like, "I am going to see that contractor and everything that you could possibly think of was wrong with their health and safety, with their meter statements, their risk assessment, their PPA, they had a scaffolding and it was intact and things like that and he literally tore the project apart. So, my main focus since coming on board is to try and resolve our health and safety issues and then once I've done that I also want to focus on our quality management next. So, sustainability has fallen further and further down the list because at the moment we've tendered out all these contracts and we never meet with the suppliers. We never meet with them to say, "Your performance is

good or bad, can you do this, can you do that, can you improve this?" and that's something that I want to...

Interviewer: to put in place, yeah. As an overall thing, how do you think-- so you kind of answer just in general, for the FM industry, do you think sustainability is important?

Interviewee: I think it's very important myself. I think that companies, bigger companies, certainly our company is kind of just a tick box exercise form at the minute. It's like, yes we take sustainability seriously, yes we employ sustainability advisor and sustainability manager, I don't know what they actually do if I am 100% honest and that to me is difficult to understand why sort of put ourselves out there and it's for bidding purposes as well. so, because we're [0:10:00 **inaudible**] business against people like where we are now [laughs], and to win contracts, we have to demonstrate how we're going to be sustainable and how we're going to be good on health and safety and how with BIM we're going to start. We were one of the fore runners in getting BIM, and we never used it and it will never be used across any of our existing portfolio. So, to me it's kind of just like we blow all these [00:10:26 **inaudible**] and win this contract and we don't have the resources to actually deliver what we're saying we're going to deliver and that's happened on the project I came from. In fact we have a lot of renewables on site, rain water harvesting pumps, CHP things, biomass things, PV, everything you can think of, because it's only three years old [00:10:45 **inaudible**] one or two from the cloud and we can see trends and we can do this and do that, none of it works. None of it works, it has not worked from day one. People have held off invoices to pay us for these utilities, hundreds of thousands of pounds and it has come to the top of our business and still not resolved and that's where we're doing a lot in the bid stage to win the contracts when really we didn't have the resources to deliver it. Sustainability, yeah. I personally think we should invest more in it because you can save money, plus the planet isn't going to be here forever, and while it might not affect us, our contracts and maybe PFI and then 20 to 30 year contracts over that sort of period, it's quite important, it's more like it's a yearlong contract.

Interviewer: What are the challenges of implementing sustainability for you and industry wise?

Interviewee: The challenges for me with my project is getting people to buy in and even down to-- we've got a deputy FM and she freaks about everything but she is just not interested in that. She is just interested in smooth running of the contract. She's not interested in initiatives we might take on savings, we might make by doing things differently. It's getting buy-in and because we've got a lot of I don't want to say unskilled labor, we've got about 60 cleaners across the project. That is the bulk of our workforce and yeah they're not professional labor, that's probably a better way. They just don't care. And they are the people that we need to really buy into it from the ground and the top down and the ground about in the middle, hopefully me in the middle, but it's not. So the top aren't buying in, I don't think, and the bottom aren't buying and then we've just got a couple of individuals within the business who have taken quite seriously, and we're fighting a losing battle. I think that's probably industry wide as well because I would imagine the bulk of FM workers are-- certainly in soft services are cleaners and or are unskilled or less skilled labor, caretakers and people that don't really understand or want to appreciate the wider concept of it all, and because we only have me as the FM on the project and then say 60 cleaners, 10 caretakers and that's about it. We've got a few helpdesk staff but again they don't really care.

Interviewer: Have you ever thought about putting something in contracts or you don't have the opportunity to do that?

Interviewee: In the person's employment contract or in...?

Interviewer: In the supply chain or the cleaners or the caretaker when you-- okay now probably the contract is in place and there's no way to turn it back but couldn't that be a solution for implementing something more sustainable?

Interviewee: It could, yeah. We could do that when we tender out contracts and things but because we've got the day job to do and all the tender is done by operations team apart from some things commercial. Our commercial department is quite interesting. They're not really a support function. They think they are in everything

and they should just be a support function to support us but they tender. They pick and choose what they want to tender and the rest of it is tendered by us basically. And we don't really have the time to put a decent tender together if I am pretty honest. For example we had window cleaning. Our deputy decided to, I gave her the opportunity to tender our window cleaning contract and it's now come back to ... in the backside because it's been sent to our commercial department and they have come back with a list of about 20 points in that room and I have got to retender all myself and put a tender back together myself when I should have trusted her, so things like frequency of cleans wasn't in her layer and we don't specify products or anything like that, even just a scope of works, those one on there and I am just like, that's the difficulty that we're facing. She says it's because she didn't have time. To then add sustainability objectives into that, it wouldn't happen in operational terms, if commercial were involved, possibly, but again they don't really do that. We don't put any kind of targets in any of our tenders.

Interviewer: Do you-- going back to something you said before, and do you also feel that there's a gap between the people that do the policy for your company and then actually what you can achieve and do on the field?

Interviewee: Yeah, there's a huge gap. In fact I don't think they ever even venture out of their office other than to audit sites and from the audit nothing happens. It's an internal audit, if we don't achieve what they've told us to achieve, nothing happens to us. It just rolls on to the next audit and it would just keep appearing year after year after year. No one will ever say, "hang on over there, you need to be disciplined or we need to sit down and discuss how we're going to achieve this" They set unrealistic targets to achieve it sort of ASAP and things like that and it's like, "well, what does that mean?" They are getting a bit better certainly from the health and safety perspective and things like that on the health and safety audit but on any other kind of audit, no, people just chuffed it to the back of the key and like I said I think they just sit in their office behind a computer typing up policies, looking up figures, loving, they love figures--

Interviewer: Yeah [00:16:42 **inaudible**]

Interviewee: Yeah exactly, so they'll put a nice little table or a nice little pie chart and they'll send that figure out to secretary who will then send it out companywide and people don't even read it. Some people just go, because the tagline in the subject, obviously they put sustainability or environmental or whatever and update and then that's it. And we get ... world magazine and again we have things in there, and again that's because we're a Dutch company, that would come from Holland and no one really reads it. I've got one in my bag and I haven't read it.

Interviewer: [laughs] you just bring it around.

Interviewee: It's just there, just in case.

Interviewer: If someone ask you, "yeah but they'll need to stop it"

Interviewee: Yeah exactly. So there's a huge gap and it's where they don't connect with us. Like I said I've met our senior sustainability advisor I think is his title, and I met him on an effective manager's course and I have never seen him since and that was over a year ago. And I've met the sustainability manager once and he came to my old project to discuss how the utilities that we've got in those renewable technology should work and after that he was like a phantom, after he explained it, and facing difficult questions from the clients and kind of shied away and then he's now a phantom, not involved at all. And they did undergo a big restructure. So they're only about four of them across the whole business. We've got-- I don't know how many projects we've got. We've got a lot of projects. We've got a lot of hard services projects as well and that's where I think sustainability should come in **[00:18:17 inaudible]** certainly. with the commercial clients, we've got like I said it's a bit more free wherein on that with the PFI we're a bit more tied into what the client has specified at the contract stage and we can't deviate from that but with commercial clients there's a bit more freedom for us.

Interviewer: And going to the client, do they have any requirements for you? So it's all related to what is in the contract.

Interviewee: Yeah, we made a PFI contract where there's something called the project agreement. You probably really know one of these kind of thing. There's a

project agreement between our special purpose vehicle and the council on most of the occasion and then there's an agreement between us and the special purpose vehicle and within that or within the project agreement there's things called the authority requirements and that's all it will specify. Whether there'll be a KPI or there will be a point or an output specification and as long as we're achieving that, that's it. We won't ever go beyond that because it costs us money.

Interviewer: Is there anything related to sustainability in this kind of specification?

Interviewee: Not in the contract I work on now. If you interview my colleague, then there probably will be on the project. His name on the list. So they are on that contract but quite vague, kind of quite grey, it can be open to an interpretation.

Interviewer: That's good and bad.

Interviewee: A good and bad yeah because it's caused a lot of arguments and then yeah, so there is in that contract but there's not in my contract.

Interviewer: So there's nothing in there-- so there's no reason for you?

Interviewee: Yeah, and I think maybe that's because the contract I came from, it was 2012, the school has been operational, so it's only four years ago, the contract I am on now, the school is in operation in 2004, so the contracts would have been done 2002 maybe and 2010 [0:20:14 **inaudible**] times have changed and the industry has changed since then, and even government sort of-- the government has changed since then. Yeah, there's been different things for us to build into these contracts and the more we do of PFI, the better we get, so we build that in...

Interviewer: Do you think it could be a solution for you to work out-- okay ideally, so, don't consider you're a part of a big company and stuff like that, if you want to buy into sustainability, do you think-- would you be able to kind of create a list of things that you would like to achieve and what was that?

Interviewee: I think I would-- you could, yeah. I think that we would face challenges to achieve that in the business that I work in at the moment and the fact that there are a lot of people who object to doing things. They like things done their way and if you

deviate from that with your own ideas, you get questioned and you won't achieve what you want to achieve. And there's a lot of people who have been in the business since [00:21:21 **inaudible**] since before we've moved on and they haven't moved on with the times and they are just stuck in their own ways and if you present a different idea to them, it's kind of it's their way or the highway.

Interviewer: Because that's-- I know it's one of those struggle because the same thing is happening with BIM. Obviously it's fun [00:21:40 **inaudible**] with every single presentation with BIM about FM, there's this guy trying to create a fire and there's a guy beneath him with a lighter and the first guy said, "oh that's the way it was done" So I do understand the feeling. What I am trying to understand from my point of view, for my research is to see-- because I do really realize a gap between people that do policies and the reality of operations especially in big companies, the people that are up there, they don't really understand how business is done on the ground and why you mentioned staff. I am thinking about trying to develop something more tangible and doable but obviously I am aware that there are some other barriers that will come into place at that stage that would be probably people in the first place, then again it's a matter of time, resources and buying in from supply chain and personnel itself.

Interviewee: Yeah. The trouble with our supply chain is that we don't have like a-- we do have national contracts with certain providers. We have a national symmetry kind of wear contract and pest control contract which is led by our commercial department. There's no any involvement from operational teams in anything on that side of it, on any of the national contracts. So whether it is this, "can you tell me what you have got on your side" and you're like, "XYZ" and then they go, "thanks" and then they do with any kind of tender. So we've got about four or five of those. the rest of the contracts all depend on the individual service area and we use a lot of small, not necessarily one man band kind of companies but small, really small local companies because in our contracts with the clients, I said, we we'll try and use local resource where possible, so we don't have national companies such as... who's national? Kone, that do lifts?

Interviewer: Yeah, on your lift.

Interviewee: We have got Kone actually but that's a bad example but somebody, a big one that can do national. So we don't have that. So, window cleaning for example, we don't bid, mostly done by local two-man band or something like that. In Bristol, there would be Bristol based company doing it, in Crawley, there'll be Crawley based company doing it. And so that's why it's difficult for us because they are so small and the smaller companies don't necessarily have the resources to achieve what we would like them to achieve as well. I think there's a problem with the supply chain that we use.

Interviewer: Do you now think that kind of from my-- from the research I've done so far, you will see in the email that I'll send you, is there... in terms of sustainability, when you're thinking of sustainability in FM, there are two different areas, one of them is sustainability in terms of chemicals that you use, or energy used to build things, stuff like that, so everything that is actually related to the building but then there's all the management bit of sustainability that goes back to what you just said. There is a big focus for example on communities and how you give back. There's discrete line between area between sustainability and corpo-social responsibility. Some companies call it sustainability, some companies call it CSR, that's fine, it's always there, but using local resources or companies, that's still part of sustainability even though it's not strictly to sustainability only in FM because it can be applied to everything. I think it's more of a management thing. So they are at these two, I've identified or kind of seen that they at these two big areas and obviously when I will link it back to BIM, because I would need to do that at one point, I think my point would be that for the management area obviously there's not much you can do with BIM, so involving communities well. I do have a lovely model of my building. I don't really know how I am going to use with the community. I don't think I am going to use it but you would use it with everything that involves the building itself, energy use, cleaning services...

Interviewee: The CSR for our sort of business isn't really nonexistent. We do work experience, I guess you could class that as CS, but that's because we work at schools. Most of our contracts are schools and schools will ask us if their students can come and spend the day with us and we're just like, "yeah, fine" We do have nice bulletins

that come out again, sort of bulletins, all jazzed up with green and orange and all fancy colors of that...

Interviewer: And pie charts because we love that.

Interviewee: Yeah, exactly. We have those come out saying how we've done this and this and we have a communications manager within the business who sends out nice fancy emails about what individuals have done. Trouble is she doesn't know what individuals have done unless they tell her, and how many tells? Anyway there's no real network and there's no real communication in our business at all. For example like I said the supply we've got, we've got a national-- so we've got parachuting system that's been developed in Holland and is shocking. I think it's called SharePoint and it's shocking. It's awful. It does a job but it's awful because all the suppliers are just listed in alphabetical order. That's it. They are not categorized and there's not mechanical or electrical or I don't know, pest control. However they want to categorize it, it's fine. I have been demanding since day one that needs to be categorized because the difficulty we are facing is we need **[to request it 00:27:25]**, it's in our contracts to get **[the request]** to demonstrate value for money to the client. So she cannot **[00:27:30 inaudible]** corpo-social responsibility in some sort of way. We have to do that but we don't know any contractors and we don't want to go a contractor that's not on the books. in case our commercial department says that's the one you're using and then we have to get them set up which takes about four or five weeks and then by then the job we needed done for example is like a reactive job, take...I don't know, I must have a good example, fire door, if someone has smashed a fire door and it's just like cleaners or and one, we're not compliant with our fire strategy then, you know if we have a fire spread blah, blah, blah, but two, we'll get a financial penalty because this building is under contractor if we don't achieve the ratification and we don't have any contractors because we don't know of any-- because it has not happened before, so we don't know of any. We got to the purchasing system and unless we think or well, let's look for fire...

Interviewer: Fire, yeah that's an easy one, otherwise it's just like names.

Interviewee: Yeah, exactly and then it's literally Google search local companies that do that, get them in, can't use them because they are not in the system and that's-- ... is

investing a lot of resource and investing a lot of money in BIM and people are forefront in that but the things that will make our life easier operationally I think is like being able to search our purchasing system and nobody is doing anything. We invested a lot of money into system called CONCEPT as well which is a CAFM system. We invested lots of money into that and training. We've trained all of our people to use but it doesn't-- we're not using it to its full capability. We're trained into place about five months before the actual change came in, so everyone has forgotten. I haven't even had the training because I missed it. I was off sick, so I missed it. And they said, "well, you can just read the presentation" And I was like there's no context then" and that's the kind of difficult. ... start always different projects, projects, sign paper and all these weird and wonderful projects and they don't finish them.

Interviewer: Since you're talking about this, first of all what I think about ... is that I do see that from the BIM perspective, they are at the front end they are keen in anything. They always wanted to buy in and stuff and it make sense a lot for a company like ... for a new construction. They old process go through and then you handed over to someone who was managing the building, is called lovely mode, the only information that's ready, the problem comes in place with places where you are working because how do you do that? That's what all my research is coming from basically. But the other thing is that how do you work-- this is not related to sustainability but, how do you work for the information? You have a CAFM system or you are supposed to have a CAFM system and do you get all the information out of it? Do you still have something paper based or do you have information that you absolutely no idea and you just trying to come up with the information?

Interviewee: We have-- we still use paper a lot. We still use fax machines.

Interviewer: That's brilliant. I was wondering about fax machine the other day because I called someone from ... and I missed-- I don't know why I took the fax number and he ended up-- so fax, and I was like, "that's a fax number, so exciting"

Interviewee: Yeah ... as a company still use fax machine and it came up in a regional meeting and we said, "why are we still using fax machines?" to the interim managing director at the time, and he said, "I don't know", "you are the managing director"

Interviewer: Is there anyone actually sending faxes.

Interviewee: What happens is the CAFM system we fax those jobs to our guys on site from our help desks. Certainly on the help desk that we use on my old project and the help desk I use now, we fax the jobs. Jobs are getting lost for example because aren't the most reliable thing in the world, and not to mention the ink, not to mention the paper, both ends, because you have to feed one end and then another page comes out the other end and we fax everything. We fax a lot of things. So that's not very sustainable.

Interviewer: No that's true but I can give you another example if you want. I used to work for help desk of my university, FM of [00:31:58 **inaudible**] University of Greenwich, and basically we did have some kind of system that we were using to raise tickets for maintenance team, cleaning team and stuff like that. It was always chronicle, some crash every two days and stay offline from five, that was fine but while it was working, as soon as you create the ticket, the ticket goes straight to the team and the team print it out and basically they are based on the next group. If I shout out and say, sorry could you please take in those of it, it would be easier and if I sign and everything like that, but it's kind of to say obviously [00:32:33 University of Greenwich] is not ... but still you're not the only one.

Interviewee: We are very well behind the times like it's either-- yeah they fill in on paper-- this is-- because our business is split in hard and soft services. The hard services director is leaving the end of this month because we acquired a company called Sutton maintenance in 2013, maybe 2012. The acquisition went really well but the merging of the two didn't. They were two separate systems, contractors that Suttons or hard services use weren't on our systems, so we couldn't use them, vice versa and it was a shambles, real shambles. This is where the Concept, where all these Concept trainers come in. They now use FSI goals, handhelds PDAs and things, and all their jobs are allocated. It's all electronics and it's great. We use to use paper in soft services. We use to fax the job, the guy gets and it goes all well and go, go clean up some sick, so he comes back, he gets his pen and he writes down, clean up the sick at XYZ time, signs it, faxes it back and then it gets logged onto to the help desk and the job is closed and then that paper copy gets put into a file and it's half as big as this

room probably, half height, and cabinet with files from [00:33:53 **inaudible**] A4 files of help desk paper. And we have-- to put that into perspective at the moment we have almost a thousand jobs outstanding across our Camden project and Crawley project. You imagine when they would have done these a thousand pieces of paper. So that's not very sustainable and I have no-- the only thing that I can do, I say we email our jobs but then one person still needs to print it to sign it. Personally I mean you can invest money and get a [00:34:23 **inaudible**] or whatever it is but our guys aren't skilled enough to even know how to use that. They just about get by with emails, so there's a training issue as well on the IT. But it's more sustainable not to print those pieces of paper and the CAFM system kind of offer the jobs electronically, so there's no need for us to print them but nobody knew that until very recently. So they have just been printing them and printing them all the time. From that point of view, we're not very sustainable. From the utilities point of view, because none of the risks on the project I am sits with us and it will get really charged to the client, we kind of wash our hands off it. so there's [00:35:05 **inaudible**] one dish washer but there's three dish washers in there because the school have brought their own and there's failing on whoever is in charge before bringing things on site but we don't mind about the additional utility use, the fact that every room has now got a cartoon and every has now got attached to and they are overloading circles and things but they are using a lot more electrics for example, we don't mind because we pass all that to the client and that's the way we look at gas use, that kind of thing. We pay at first, we have pocket but we just recharge it back and back. Same with water as well. Obviously the projects, the newer projects do have those rain water harvesting pumps, so there's less water usage from the main things and that's great. The project we're on now is just box standard.

Interviewer: But that's the thing because you have such a long still even though it's not 20 years, 30 year project, the whole operation for a building, if it's ten years old and ready, it's kind of historical. It's just like it's been ages ago, it's probably different now the way we do staff and what we think about...

Interviewee: And the other difficulty which Tracy has got, obviously our asset management woman, asset manager, I think that's her title. She is really good, really good, a lot of time for her [00:36:30 **inaudible**] pieces but lifecycle, so, where we

might have-- we've got very affluent funding on the project and at the minute we can get like 700,000 a year. We could do a lot with that, we could better the building. We aren't allowed to better-- we are not allowed to change the building. The building in 20 years' time has to be virtually exactly the same as it was at the beginning to hand back to the client. So if I said, hang on, we can install LED lights, I can't, under lifecycle unless I get the client to agree to a change request. That's the difficulty. Our hands are tied from that point of view. We are getting away certainly with LED lights. Taking that as an example, we're getting away with that a bit now because the cost is so negligible. Now the LED has come down in price, we can get away with doing that and basically not telling anyone [laughter] but other things like if we wanted to install smart meters and things and all kinds of different things like that, we couldn't.

Interviewer: That's really... but I think it's the nature of the contract you are in.

Interviewee: Yeah it's because it's that PFI, you're locked in and that's it and we don't own the building obviously.

Interviewer: Yeah I understand that but I would-- when you put in place a contract like that, instead of saying I want you to give me the building as it was 10, 30 years, I would say simply, "I want you to give me back the building as it was or better" something like that. We just change a tiny bit and then if you have funds or where you can put into money to invest and making it something different, then it would be something more for the building itself.

Interviewee: I agree with you but--

Interviewer: No, I know, it's just for the sake of saying.

Interviewer: And the other difficult thing is because lifecycle-- the lifecycle funds, the client pay them including their unitary charges which is about a million pounds per school, is it per year? Yeah, per year, roughly. So just over it's probably 3 to 4 million is what we get just for being there, "did you go?" [laughs] and including that is there a lifecycle when it goes into a nice little pop and then we draw from the pop. If at the end of the third year is there's-- there could be millions in there by that time and we haven't spent it, where we have sweated assets and we've gone where we don't

need to replace that carpet or clean it or we'll not do those lights, we'll do something else. If there's a million pounds left, we can go, "hang on a minute, we're having that" equally if there's a deficit and we're saying "oh god, we do need to replace that carpet and there's zero left, we take that risk. The business looks at it from-- it kind of looks at it or was looking at it like it's a guaranteed income revenue for us, we just leave little things and then have to take that money at the end and run off. So that's difficult because obviously sustainable initiatives and things do cost money sometimes.

Interviewer: I have run off questions I think, yeah nothing else to ask. Is there anything [laughs] else you would like to add?

Interviewee: No, not really. I mean Yeah CSR is taken-- if you class that system but that's taken more seriously in ... and we have-- we support charity.

Interviewer: Yeah I know, okay, fair enough.

Interviewee: So in this charity and we're trying to do things with book sale-- not book sales, cake sales and things like that.

Interviewer: Oh you're running 200 kilometers for...

Interviewee: That's just a personal thing.

Interviewer: All right. It's not by a company.

Interviewee: Yeah, we wouldn't go through we tried to go through really three picks last year for our chosen charity which was the outside in society that year, audition, I think it's two years, and we asked ... plant because we've got plant [00:40:19 **inaudible**] that's cranes and mini buses and you name it. We said, "Can we have a mini bus for free to take us round because we're doing it for ..., for ...'s charity"? "No you can't" and it's CSR. It was CSR. We were promoting it all over Facebook and everything like that, and we couldn't. So in the end actually one of the schools I work in at the moment gave us a mini bus for free. So if they can give us a mini bus for free--

Interviewer: Why is [00:40:42 **inaudible**]

Interviewee: And that was CSR. So that's taken fairly seriously but sustainability as a whole and if you call it lack energy initiatives and things like that, and the chemicals even to the degree of disposal of items because it's all done at a local level. I don't think anyone...

Interviewer: What about recycling? In general recycling.

Interviewee: So we do have, we have a recycling collections. We subcontract our waste collections to the big boys, like Biffa, SITA or again that differs from project to project. My honest experience of all the waste contractors we've had are awful apart from and I won't drop names but apart from Kier. They were quite good and they are on the project that we've got with my colleague. SITA who we've got at the moment are awful on my project. As in they say they'll come on a Monday, they come on a Wednesday, they don't come at all, or they say they've broken down. You ask the driver if he's not in office and he says there's nothing wrong with it in the first place and they spin you, spin you and spin you. They don't give you waste transfer tickets and things and you have to demand them and it's a battle, a real battle. But yeah, we do have recycling and we do have the recycling bins in the school, however the cleaners I think to save themselves on bags and things like that and on trips to the bins, they just pile everything into one bag, and that's where it comes down to a management thing, of managing those cleaners and educating those cleaners but because with the greatest of respect to the ones we've got here in this demographic, they are not all naturally English speakers as their first language.

Interviewer: And that I think is always one of the biggest struggle with the cleaning industry.

Interviewee: Yeah, that's difficult to get the message across because sometimes they don't understand it and then you really have to invest a lot of time in that. Whether we need to think of putting notices in their cleaning convos in their chosen first languages as well because we've got a lot of Mauritians on our project. They all go away at once. Actually they all try and go on holiday at the same time and things, and religious festivals and all kinds of things. We've got a lot of Asians as well and English isn't their first language. So when you meet with them, you can see that they are just blank.

Interviewer: But then again is a kind of a loop because obviously you don't have requirements for your supply chain. So they don't need to comply with anything, because you don't need to comply with anything from the client side and your company side, so there's no-- it is not cascaded because obviously there's no need.

Interviewee: There's no driver behind it at the moment and that's what it needs and whether that personally, I think the driver should come from our sustainability team in the same way our health and safety team drive health and safety initiatives, they should be driving those. They should have more proactive presence on sites. You can't expect them to go round every site every week but in a year you'll expect to see one of them at least once and sit down and chat and he can sit down and chat so the guys on the ground can see he's got more expertise on that as well. Yeah, there is a lack of a driver across sustainability and I'd imagine I think-- certainly if you class it as environmental, that's getting becoming a lot more important across the trade as a whole because people realize they can save a lot of money as well. And obviously if you do build things into contracts and they are not achieving that, then you can withhold payments and things or you can terminate contracts early.

Interviewer: That's such a great fun, and they you need to go through tender again and then you need those specifications.

Interviewee: Yeah, exactly, but yeah, there is just a lack of a driver certainly from my point of view and I do think that that's the same across the whole of my company. I know others would say different but...

Interviewer: That's fine. That's what I am looking for. I am looking for different perspectives.

Interviewee: I mean as I said because some of it can be led by the operations managers and to put you into perspective we've got projects in Camden and the HAC have been there, fire brigade, everyone that you can think of has tried to tear that project apart because not the client, it's the schools are unhappy with us basically. They want the contract terminated. Our operations manager that manages that and my project, obviously our main concern is making sure we're as quick and clean on there.

Then everything else just goes out the window until that's done. So it's something that we don't really...

Interviewee: That's fine. I think that's where my whole research started from [00:45:27 **inaudible**] to do. There's a problem with sustainability in FM and BIM system [00:45:35 **inaudible**] so maybe it's going solve all the problems in the world.

Interviewee: I think BIM is great from new buildings and things like that and I am just not sure how it can be applied to what we've got at the moment but that's what other people are there to tell me..

Interviewer: I would like you to tell me a little bit about your experience in FM.

Interviewee: Okay. I have worked with ... FM for the last 13 years, as from everything from catering manager right through to facilities manager responsible for soft services in the midlands. Before that, I was actually the general manager at a football stadium, doing all the FM and the stuff there as well for that three years, and that included building the stadium.

Interviewer: All right, that's a good task.

Interviewee: Before that I actually worked at hotels and conference and buying cuisines and things like that. I've been in and around field of FM for the past 29 years.

Interviewer: Okay, so you have a good experience in the field.

Interviewee: Yes.

Interviewer: Okay, right now, what kind of facility do you manage? Could you give me any of the description of the buildings and...?

Interviewee: Basically at the moment I look after 10 schools which is on 7 different sites across the midlands and that is under, they are under PFI. I look after one school which is just a general FM contract and that is in Hillsborough and I also look after an office block for FM as well.

Interviewer: Okay, I do know the answer for this, but still, but does your company have a sustainability policy and how do you align to it?

Interviewee: Yes it does have a policy and basically, we basically just do everything that we can to sort of when we're buying stuff, when we're getting rid of stuff, to see what we can want to get rid of stuff, what we can recycle, what we can pass on to other places, even through our CSR scheme, recycle it at the charities and different things. And also obviously when we're buying stuff, looking at how we buy what we buy and the promise of where it comes from.

Interviewer: Okay, what you're saying mainly is about getting rid of stuff for recycling path and how you supply your new stuff to the site.

Interviewee: That's right, yes.

Interviewer: And do you have people working for you or with you?

Interviewee: Yes, I have colleagues who work within things like the cleaning department who report to me. I have people in kitchens, kitchen managers and things who report to me.

Interviewer: And the reason why I ask you is because I just wanted to know how do you pass all these information about your policy and the way you should be doing sustainability to them?

Interviewee: Basically, we obviously make them aware of the policy, and what we try and do as far as possible is to have suppliers that they use. So, we nominate the suppliers. For example we even do sustainability in the catering department because we use sustainable food stocks of fish and things like that. So, we have actually nominated the products that they can buy and use, and we stick with our suppliers. For example even within the catering, we use MSE fish. So, we make sustainable fish stocks. I've already spoken with our supplier. We have gone through our menus, we have nominated a list of products and then basically those are the only products that appear on the buying list for the kitchen managers so they can only buy those products.

Interviewer: Okay, that's a really good way of doing it.

Interviewee: Yeah, basically they've still got a choice of different products for different things but they can't buy outside the buying list unless it comes as they ask the supplier, the supplier will then actually contact me and say, "Is it alright?" and I'll say yes or no. If it's no they don't get the product, they'll get the one that is on the sustainable list. If it's it might be for special occasion that's the client has actually requested something. So I'll say, "yeah go ahead" it's a special one-off, we'll go with what they ask for but it's actually a fixed nominated supplier list, and we do that with

as much of our stuff as possible, especially within the food department we do that. Within things like the cleaning department and other things, it's-- we do the same with the chemicals. We go through, we nominate certain chemicals for certain jobs because obviously we have looked at the sort of environmental impact, all of that, and again we produce a buy-list for them and they can buy of that list and then we...

Interviewer: So, it's mainly your way of working with your supply chain and obviously put some limits on what your staff can do, what they can buy, but it's you who work with the supply chain to identify what products and food that are more sustainable.

Interviewee: Exactly, yes.

Interviewer: Okay, that's really good.

Interviewee: And when it comes to bigger items, for example I also replace things like the ovens in the kitchens. So, I will go over it and I will I will know what I need the piece of equipment to do, so I will, knowing our policy on sustainability, being ecofriendly, everything else, I will then start looking at... the recent one was combination ovens for the kitchens. I looked at power usage, water usage, things like that. We ended up going for ovens that use a lot less water and a lot less power but actually achieve the same result.

Interviewer: Okay yeah. That's really good. I am aware that ... is a really sustainability company, so I am really happy about the kind of information I am getting out of-- because you are not the only one from ... that I am interviewing but you all kind of aligned with the policy. About your work, do you deal with sustainability on a day to day basis? Is it always in the back of your head?

Interviewee: It is, because it's always the one because in this area, I tend to do most of the buying in terms of even things like furniture, white goods. I also look after all of the waste. In this area, I introduce the supplier that actually has a total [00:06:58 inaudible] to landfill. We were the first units in the company that had an office into landfill and now we've extended that the whole way across the midlands so that everyone uses the same waste disposal. So, we basically have a 100% diversion from

landfill. It goes off to their plant and then it actually goes back into-- it goes and accumulated somewhere or they do something with it and it actually is made into aggregate for concrete. So, it goes back into the supply chain. We actually have-- we recycle cupboard, we recycle paper, and everything else is diverted from landfill.

Interviewer: In your experience right now, do you think the people, I'd say the clients, the users of the building, is it easy for them or do they do it easily all these recycling paths or is it just a matter of you manage...?

Interviewee: The younger kids love it because we have the mixture of schools here from nursery right through to 18 year olds. Up to about 12, up to about 11-12, they are maniacal about it. They really are. They want to recycle everything. There is an age between about 12 and 13 where they really couldn't care less.

Interviewer: Okay, that's fine. I think it's normal for everything.

Interviewee: Exactly, and then as they get a little bit older to the 15, 16, they become more aware of it and they are actually back asking questions about, do we recycle? Do we do different things? There is a trend that has appeared and we are aware of that now. So, we work with them to try and bridge the gap.

Interviewer: Okay, that's really good. Do you have formal targets that you need to meet?

Interviewee: Do you know, I honestly don't know...

Interviewer: Okay that's fine.

Interviewee: ...because it's very, very difficult because a lot of the things like the waste generation is totally out of our control.

Interviewer: Yes, I know that.

Interviewee: So, basically by making sure that we dispose it correctly and it's diverted from landfill, we basically know that we will-- I mean last year I think this site alone diverted something like 85 to 90% of waste to landfill.

Interviewer: That's brilliant.

Interviewee: Again I think the previous year with about 65% are against the company average. We were 85 against the company average of 65 and we've gone up even, so there's more. So, basically our target is just to achieve as much as we can [laughs].

Interviewer: Okay, no, that's-- and still you are doing a great job even though you don't really have a formal target, you are doing a really great job. As a general thing, do you think sustainability is important for FM?

Interviewer: Sorry, do I think?

Interviewer: Sustainability is an important method for FM.

Interviewee: Well, yeah because we are here for the long-term in these contracts and we have to be able to match like for like and try and keep things going. Obviously the longer we can keep things going and the better it is for the environment, the better all-round really.

Interviewer: Okay, do you think there are-- what are the challenges and the problem of implementing sustainability in FM for you in what you're doing and in general as an industry for the overall the FM, since you have so much experience.

Interviewee: The big one is cost, because obviously sustainable products tend to be a bit more expensive, but it's whether or not you can get clients and things to understand that actually maybe what's costly upfront but actually in the long term, it's more cost effective and obviously depending on what it is, when you are buying it, what time of the school year, everything else, depending on the school budget as to what they can afford as a budget.

Interviewer: So, mainly cost.

Interviewee: Yeah.

Interviewer: One thing, in your contract with the schools, is there anything regarding sustainability that they ask you?

Interviewee: Is there anything in the contract?...

Interviewer: Or any requirements from the school itself.

Interviewee: Not particularly but we push it and even when we do, going forward and tender for new contracts and things, we always push things like sustainability and proper sourcing of materials and things like that. We're just tendering at the moment for other services at another school, totally independent of this within catering and a big thing is things like Food For Life retroactive programs sustainability. so it actually knowing that we have all that information to hand and if somebody asked a question within that, we can say, "yeah we do this, this, this and this" It's another string to bow that actually says yes, you are thinking about it and it's not just a-- oh yeah that's an answer to the question that you asked me.

Interviewer: First of all I would like to know a little bit more about your experience in FM, if you could just tell me a little bit.

Interviewee: What would you like to know?

Interviewer: All right, so how long have you been working in the FM industry and your background basically.

Interviewee: I have worked for this FM Company, this is my first FM employment and I have been here since 2002. I just started with the company in front of house as a helpdesk operative. I then progressed to facilities coordinator and assistant manager and now I am manager.

Interviewer: Okay.

Interviewee: I enjoy the role. It's very different from day to day. That's it really, yeah, I think.

Interviewer: All right, perfect, thank you, and a little bit more about the building that you are managing. What kind of building it is and how big it is.

Interviewee: Right. I currently look after three sites, which are three office buildings which are occupied by the local authority. They have approximately 300 people in, apart from one which is the business center which is a small enterprise that leases out offices and workshop space for local businesses. I am also involved in provide-- help to provide FM services to another one of our clients which is a blue chip company and they have five or six sites across England which we deliver hard and soft services. I am involved with three of those sites. They have approximately a thousand people and York has about 300.

Interviewer: Okay, fine thank you. The next question is does your company have a sustainability policy and how does FM align with it?

Interviewee: Did you say sustainability?

Interviewer: Yes.

Interviewee: Yes we do. We have an energy and sustainability manager who the board would state out the aims and objectives and targets for the whole of the ... company not just FM, whether it's targets and objectives for the coming year. That would be then filtered down to the different FM and for our construction and ... proxies etc., and they would be set down to site level and we would try to incorporate some of those targets into site specific targets and mainly energy reduction and sustainable energy and things like that.

Interviewer: Okay, so you do have some goals that you need to meet every year?

Interviewee: Yeah, but they would be set at the board level and then they would be filtered down to see whether you know that was supposed... if we were able to meet those targets or if it was something that each site could incorporate, things like that.

Interviewer: Okay, so basically when the board make the policy, then it's up to the site itself to say if it's doable or...?

Interviewee: Yeah, the board would make the policy, then that would be filtered down to FM because total ... is a massive company and FM is sort of like a smaller part of ... Construct UK. Those relevant targets and objectives would be filtered down to FM. They would check it out with sustainability manager and he would then filter them down to the individual sites to see whether those would be relevant.

Interviewer: Okay, fine. In your role to manage, how do you deal with-- do you have any staff working for you?

Interviewee: Yes.

Interviewer: And how do you deal with the staff in the supply chain? I guess you get some cut targets or something and how do you pass it on to whoever works below you or for you?

Interviewee: Again if they were target that things that was set at the-- we've got health and safety targets, we have... what else would we do? All of our-- we have like environmental health and safety quality, those parts of our services would all have targets and objectives which we would need to meet as a business. They would be

filtered down to the staff as part of the toolbox talks or appraisals that we would try to bring those targets in there.

Interviewer: Okay fine. When you're working normally, how do you deal with sustainability in terms of, is it something that you have the time and the resources to think of or is it something just to meet these targets that the board is giving you or how do you they work for you?

Interviewee: We try to be consciously aware of it but in all honesty it's just another little task that we have to do. At the moment, on site, our client is really looking if to save money and introduce better ways of working as a business for them. So we've sort of work-- we're working with them quite closely now and looking at improvements that we can make within the site which is passed down to our staff on site but realistically in a day to day running of the site, it isn't something that I am conscious of every day. I think because it's part of an FM role. You've got so many different things that you manage-- that you are juggling at the time, that sometimes sustainability isn't one that's at the front of your mind.

Interviewer: Yeah, no, no, it perfectly makes sense. You mentioned your client and do they ask you for-- do you have any requirements in terms of sustainability from the contract or it's just a matter of plan is in between the two roles so you can work together.

Interviewee: Yeah it's just that they don't have any-- well, they haven't shared with us any targets that they have had in the past. It's just something that they're looking at now and this has only really came about in the last 3 months. Now we have a workshop and meetings planned and things like that. But before I have never heard that bit of information shared with myself.

Interviewer: Do you know what they are looking for?

Interviewee: We're looking at renewable energy. We're looking at that for the solar panels on the roofs. We're looking at changing the internal and external lighting to LEDs. We're also looking at changing the BMS system to improve as far as the

contract and also the cost of running the heating and stuff. We're trying to zone out certain areas and put better machines in.

Interviewer: When you look at these kinds of options, how do you evaluate them in terms of if you think about replacing of lights to ELD or put up the solar panel, do you do some research? Is there a process for doing that?

Interviewee: Well, there has been a taskforce put together and that is our energy manager and our M\$E engineers, we have consultants that have been involved, suppliers, so it is a massive groups that are working collectively to come up with the solutions. It isn't just one person saying, "I want that and I want that"

Interviewer: All right. It sounds like you have a really good plan in place right now.

Interviewee: Yeah, I mean it's-- but it's only just been last few months but it seems to be working and everybody is working for the same end goal. So hopefully, some of the things that are coming out, changes that we could possibly make should meet at the end and we can bring these things because unfortunately when we've tried to raise these issues before because of the costs and the cost, the constraints on other departments, we seem to do a lot of the ground work and put this proposal forth to the client and then it doesn't really go anywhere. Hopefully this time it works because there seems to be more momentum growing quickly.

Interviewer: No, it does sound like-- I have been studying the topic for a while now and I am kind of surprised that obviously probably you have a client that is inclined and he wants to develop further, so that's the reason why he is pushing, but I am really surprised, I am really happy about it.

Interviewee: Yeah, yeah.

Interviewer: And in general, do you think sustainability is an important area for the FM?

Interviewee: I think so, yeah, I think so. I think we should and I think as an FM company, we should be doing more to develop it and share our experiences and things across the sites, but I think with a lot of FM companies, it is not always about doing

the best thing or being the greener company or saving, it's always about costing, how much it costs to implement this project and that's what I find a little bit frustrating as an FM. It's always about the cost.

Interviewer: Yes. If I ask you what you think are the challenges of implementing sustainability in FM, so first of all I would say it's cost because that's...

Interviewee: Yeah, that's always there, they always look at the cost before they look at the benefits and the money that they are going to save and how quickly they can get the money back, yeah.

Interviewer: So that's the first one, can you think about anything else that you believe is a challenge of implementing sustainability in FM?

Interviewee: No, I was just thinking it all comes down to money, that unfortunately I find that is the most frustrating.

Interviewer: First of all could you please tell me about your experience in FM.

Interviewee: My experience, yeah I've been-- I was a service manager [00:00:20 **inaudible**] so I was in building services side for probably 20 years, and then I went to education as a facilities manager 10 years ago. So I have gone from social facilities manager through to space director which is where I am currently and I look after commercial appliances as well. So I have had 10 years in through social facilities and space management, but prior to that, I am electrical engineer, so that's my background, which might be relevant later if you ask me the right question. [laughs]

Interviewee: [laughs] Let's see what happens.

Interviewer: I think in kilowatts as you see, so when we talk about carbon, I probably think to differently to some people.

Interviewer: Let's see what comes out. Right now what kind of facilities are you managing?

Interviewee: Quite diverse. I have got some general further education campuses, a number of those, one we share with the university but I've got [00:01:29 **inaudible**] campus, that's where I am now at, quite diverse. It's over 64 buildings. I've got a free school on the side of our zoo, I have got a client, I have got a fish farm which is I think internal. It uses a lot of energy. I have also got winter, the manager has been erected, on site. It's probably like a mini village.

Interviewer: Yeah, that's a really interesting portfolio.

Interviewee: It's 450 acre a stay. If you want to come and have a look at anytime, let me know if you are in the area, if you want at all.

Interviewer: It sounds really interesting, a really diverse portfolio.

Interviewee: Yeah, so I've got general college campuses, yeah need time centers but then obviously this one is a bit different [00:02:18 **inaudible**], most of the activities on site.

Interviewer: Okay, does your company have a sustainability policy?

Interviewee: Yes, we, the company I am with now, the organization was formed in 2009. It was three separate colleges were merged and the actual first policy was sustainability but even though it was like a model policy. So, from the board, there was this board-driven agenda on environment sustainability from day one really to the when it was formed, if that makes sense.

Interviewer: Yeah, absolutely.

Interviewee: The policies and procedures, it was the first one for what was approved, even before health and safety I think, probably just before but it was like a model policy.

Interviewer: Okay, and within this policy, do you have any goal that you need to achieve?

Interviewee: Any set goals?

Interviewer: Yeah.

Interviewee: I think that's outside the policy-- I mean our policies tend to be more policy statements. There are sort of plans that have come-- strategies that came out of that. So, going back a few years, we did have sort of targets at department level. So even crucial mannerism, that type of things. So it was quite a strategy that came out of that at the time and then we did go on to have an environmental management system ISO for 2001. And then we went on to eco-campus as well and on the eco-campus campus probably gone.

Interviewer: So, you said that this was back a couple of years ago, you had goals?

Interviewee: It was end of 2000, January 2001 was the official when the organization was formed. So it's seven years ago.

Interviewer: Okay, and nowadays, how do you translate this policy, this statement policy that you have into your operation?

Interviewee: What we did at the time, because obviously it's a journey, what we first did was having much of key areas for each department or you'd have things like carbon, and we did have a carbon management plan. So we came up with seven projects we've identified and we've delivered those. so we've sort of [registered] that now, some of that through savings grants, some of it through capital projects where we've demolished buildings and replacing with more efficient buildings, but you know, there are different departments having sort of things, things around printing, reprographics, that type of thing, you know and IT and then with the [00:04:53 **inaudible**] with things like campaigning to the students and those types of things.

Interviewer: Okay that's really collectively--

Interviewee: It's almost like a structure that permeated and then overtime I would say once we have the environmental management system, we sort of do it through that. We had a sustainable build policy as well, although the way we're funded from the FFI, but we might have held the capital power strings. a lot of the projects had to be BREEAM, excellent for new Build or BREEAM very good for refurb, some of the projects we've done like the free school which is a different, it comes direct the EFA, they are not interested in environmental. So you've got one government departments or different government departments where they just want it cheapest possible, so you categorize in free school program. It's a different cost model, that was not in BREEAM under climate but what we had for refurbs and the small projects, we got the sustainable build policy but we apply, so where it might be a small project like a nursery or something that's different from this trend, there's no-- we haven't achieved it with BREEAM writing and because of the cost model we couldn't achieve it. We apply our own sustainable build policy which is about... I can send it to you. It's quite...

Interviewer: Okay, yes it will be great. Thank you.

Interviewee: It's about robust materials, it's about property controls, lighting controls, it's being sensible, I suppose. It's not having showers and bike spans and things. It's probably more about things in the building, you know the quick wins and things like that and the approach to the building, if that makes sense.

Interviewer: No, no, absolutely.

Interviewee: I can send you a copy of the issue.

Interviewer: Yes, if you could send that, I would just remind you.

Interviewee: So, yeah having a carbon management plan, and actually, it certainly helps me with the to help and know what we could have done, having the plan and absolutely going to deliver it really, and then taking opportunities [with needles], so that's the big stuff from the state point of view and FM's point of view.

Interviewer: Everything that you do in terms of sustainability, how do you pass it on to the staff in supply chain?

Interviewee: As far as-- At the point, I can't remember the date but we went prior, so again we've been looking at that as prior as when we were tendering, so even down to insurance whether our board would ask, so we definitely look at environmental credentials of our supply chain, so it could be through tender process, obviously looking at local suppliers where possible. It's not always looking at the cheapest. It's looking at best value. So if it's a product or something that wears out, it's looking at how, you know the lifecycle, so it's something small. It's not buying the cheapest, you might buy something that can be repaired or at least got a small robust if that makes sense.

Interviewer: Yeah absolutely.

Interviewee: Passing it up to our supply chain, I think it is part of the tender process, some on big contracts, who are all the ISO, if we're not-- we'd insist on the site waste management plans and we consider a constructor getting high writing on that, you know, it's sort of our due diligence at tender stage and then if we engage somebody, making sure-- should we consider to construct a report from that type of thing.

Interviewer: Okay. But--

Interviewee: [00:08:32 inaudible] if that makes sense. It's making sure they comply and they got [00:08:38 inaudible] from a waste point of view. [00:08:41 inaudible].

Interviewer: Yeah, no, no absolutely.

Interviewee: And then they're even on like your [00:08:45 **inaudible**] services, those companies are ISO, when you unpick it, sometimes that they are at one address, you know big company like THS, when you look at them, they'll have a badge that says ISO but it's one address, normally it's one office. But I think that's how we did it, we have one campus so far and then we rolled out to other sites.

Interviewer: Okay, what about the people that actually work for you?

Interviewee: People who work for me, obviously training. What we did-- because in our organization it was one of the sort of the first candid policy, everyone had to do online sustainability module. [00:09:27 **inaudible**] given us and all students. It has dropped off a bit now where it's still mandatory for staff, it's an option for students, we don't sort of force them to do it. It's like a multiple choice online course that we've done in house. What else did you ask, I am sorry, I lost my statement?

Interviewer: How do you move the requirements that you have in terms of sustainability to your staff? The people that work for you in general, is it subcontractor or it's all directly linked with you?

Interviewee: Yeah, it is just training. So again on the sort of waste side and even down to dealing with spillages, and it is training, so we do some enhanced training. So, that's clear one, everyone does that. because even now it's on our intranet, anybody, any new starter that's sees somewhere there, when we have health and safety, some were there, mandatory, things they have to complete, and it's part of the [00:10:25 **inaudible**] process, so down to actual core values. As an organization we have critical success factors and we obviously have our mission statement but in the core values, it is part of the annual performance reviews, it's sort of linked to that as questions in there, and resource management sustainability. Every year when somebody has their annual review, it is part of that sort of paper work and discussion as well, if that makes sense.

Interviewer: Yeah absolutely. And so you mentioned some of the projects you involved with in terms of sustainability and there seems to be more, as you said it's more of a journey, so you have a plan and then you develop something overtime.

Interviewee: Yeah, I think nobody is perfect and things change and we are under financial pressures now. We've actually deregistered from ISO because we can't afford to pay the audit at the moment. But we still do is the supplying. We've still got the management system still are there, annual environmental review. We do some clear sort of auditing. So we linked with retails and if any retails that do photocopiers. They've got their own environmental champion that's in Telford, that's not too far from here. So we'll go do an audit like a-- and literary sort of this typical management where our environmental manager will go and audit their site, they'll come here and audit our site, and pick things sort of up, if that makes sense.

Interviewer: Yeah, absolutely.

Interviewee: They have quite-- the industry they are in although it doesn't sound very environment from what they do, sort of recycling machines and they do-- from Japan, and it's quite a drive to be...

Interviewer: Well, yes.

Interviewee: Even on the transport side, they were eventually sort of if some things are transported, they will transport other things the other way, so they have arrangements with other company as well, and even their waste space if they find alternative to use this route for their different waste trends as well. So our copiers are, although we have got copiers, they are recycled, sort of rebuilt copiers. Again we had targets on that on paper, so it's I want to be in practice, which we've reduced 30% I think on the streets.

Interviewer: Okay, that's good.

Interviewee: And obviously controlling copying, so actually it's-- that's one way to roll it out to all the staff, but we have to-- they have credits and release stations and things, not that poppy one if you implement it and then they are not used to it. We are

used to having our own printer. So, yeah, at some point we took all our printers out, because [00:13:12 inaudible] some of the colleges that had lost printers, the individual printer. So that was part of the plan. And obviously transport as well, business transport, we've reduced that over the years.

Interviewer: Okay, are the campuses linked to each other or they are just...?

Interviewee: It's 25 miles from one end to the other. So we do have a public transport-- well, we have our own transport for students and that we're looking at transport system. We go on to sort of google and the clouds and then having virtual meetings. Again if you look at say the IT team, part of their strategy would be look at those virtual meetings to reduce business mileage, and so people driving from one end of the office to the other, like in google hangout, and you know, it's like driving over. So we have an impact on our mileage. That's probably an example. But a small organization, we're in FM, so drifting off into it. I think [00:14:13 inaudible] to our area...

Interviewer: That's the thing. That's what I have discovered so far is that yes there are two different aspects of sustainability in the FM world, so there's the one related to the buildings, so it's the energy, waste usage so on and so forth and then there's the management part that's more related--

Interviewee: We've driven it though, it wouldn't have happened if our department hadn't sort of-- because the environment manager sits in our department and obviously we control the energy use and procurement and obviously reprographics come to us, it's not with us now but it did come to us for a while maybe because of the paper, printing, we wanted to address that, so we did cut that all and it's gone over to our IT now, but we've cut it on for a couple of years to try and address it and I think we are like catalyst and driving it really for the college. Because you know, you'd come, you know, with the capital projects and everything that we-- not everyone looks after that, you know you might have as a separate FM and the states team and you know, and bigger organizations where there's a bit of a disconnect to that if it's outsourced, otherwise it's insourced.

Interviewer: Well it seems to be working since you achieved reductions and everything.

Interviewee: Yeah, we got Eco-campus platinum. So we were the first college who got that and the first college in England to get ISO, at the time, I think it's 2012 or 2013, we got it.

Interviewer: So it proved that the way you're working, it's working.

Interviewee: Yeah, it's working. I think now we're struggling on resources to-- it's more about financial sustainability. That's where we are at now. So we're looking at our floor area and looking at our sites. If we want to be here as an organization, you know we better cut in now from the government, that was a quarter over the last five years.

Interviewer: All right, that's...

Interviewee: It's more focus on financial sustainability.

Interviewer: That's going to be a question about barrier. We're going to talk about that later on. On a day to day basis, how do you deal with sustainability? Is it something that you deal with or it's just again as you said something that you just plan ahead and develop over time?

Interviewee: I think we breathe it really, we think about it all the time, well, I do. I think it's there every... it's there, it is like you do your [00:16:48 inaudible] whatever you do, if you're buying something, you're looking at energy. Yeah, I'd say it's certainly for us, I am not saying everybody, this can be, from the way I'll look at it, it's there all the time, consideration...

Interviewer: Okay, and we touched briefly about it earlier, do you have any formal targets that you need to achieve in terms of sustainability.

Interviewee: We did on the carbon. We had 25%, and the other day when we had to but we hit it early.

Interviewer: Okay, that was great.

Interviewee: And then obviously we had the carbon management plan. We had it for other projects, that's to hit that target. We delivered those projects. I think now we are struggling on projects. Because I think you got the law hanging free early on the big wins and now it's harder, each department harder.

Interviewer: Basically the main target you had was the carbon reduction.

Interviewee: Carbon reduction, I think because we've changed, we're not the same organization. So if on this site we've got free school now, so it's fairly hard. I think the easiest way, we're talking in terms of recently is looking at cost, per meter, that kind of thing or kilowatts per meter or carbon per meter. Because all relative teams and the students as far as like we know the measure. I think most organizations change, so you can't sort of-- it's very hard to compare. You know when you've taken additional sites and things or we've got rid of sites, so that's crazy. It's not benchmarking, maybe per student or per meter, usually when we do that, we benchmark externally and between sites and that type of thing.

Interviewer: Okay. And as an overall, do you think sustainability is an important method for FM?

Interviewee: sorry, I beg your pardon, it's important?

Interviewer: Yes

Interviewee: Yeah definitely, yeah. It goes hand in hand with sort of optimizing and value for money really as well. So it doesn't mean you have to have the cheapest but I think it is about, you know, if you're managing your resources effectively, then obviously the [00:19:17 the terms] look after themselves, if that makes sense. Yeah, I think it goes hand in hand, but I think it's a sensible approach, I think there's a lot of tokenism, you know some things have very long payback. so you could invest a lot of money in some things, you know, like rain water harvesting but if it takes 53 years to pay back, is it really reduced to that fund? So I think it's certainly around BREEAM, there are some things in there and I understand why they are there, it must be a system

but some of the I think people are ticking the boxes and I think it's not relevant enough to each situation.

Interviewer: It's more a general approach, it's that over...

Interviewee: I think we'll obviously be able to control, you know the [00:19:56 **inaudible**] regulations are a lot stricter now. You know a lot of prep in your buildings just to make building control are very efficient these days and obviously lightings moved on to LED lighting controls and the biomass with LED is in theory you haven't got the bulb replacement [00:20:15 **inaudible**] after you haven't got the cost of maintenance however, so especially when you've got high level lights and things where you got to get access...

Interviewer: Yes, you need to have a certificate or something.

Interviewee: I mean obviously they do get wrong but generally, and that's very hard to factor that costing of your maintenance time, changing bulbs and lamps and things.

Interviewer: All right, now the question, so, what are the challenges of implementing sustainability in FM for your company, for what you're doing and what do you think maybe the challenging overall?

Interviewee: What might be the...? Sorry.

Interviewer: The challenges for implementing.

Interviewee: The challenges?

Interviewer: Yes, or the problems.

Interviewee: I think the challenge is... what are other challenges? I think where we are in our journey, is we've done the big wins, it's getting harder. You get some people, I think with the culture, we've run campaigns where certainly can have effect on people but that [00:21:29 **inaudible**], so it tells off after a few months. We run other campaigns on [00:21:30 **inaudible**] and that type of thing and that will have-- it might have a reduction of 7% or 10%, up to 10% of your energy. Where we've done

sort of pilots like that and it won't be sustained though. I think that's the thing like culture and certainly campaigns with people that you need keep, sort of refreshing them and reinforcing them, every year, maybe more frequently and have different campaigns. I can't think of any other challenges really, I suppose it's culture.

Interviewer: You also mentioned that it's more of a barrier than a challenge.

Interviewee: I suppose you could have a barrier if you-- I think you'll need the top level buy-in, if you haven't got top level buy-in, you can't sort of permeate it through the organization. So it needs to come from the top, through your governors or chief exec. If you haven't got the buy-in for it then from that level it's not going to work.

Interviewer: You mentioned earlier the problem with the fund.

Interviewee: Funding, yeah, obviously the way we're funded, although we have the CFO run money, we're maybe building, now it's not the CFO who hold the money, it's the LEP, the Local Enterprise Partnership. If we're doing a capital project now, again they are not interested in environment. They are interested in the cheapest possible really. That's [00:22:56 inaudible] so you can see some schools and some projects going ahead on that basis. As an organization, we'd apply our sustainable build policy to it. But yeah I suppose that is a challenge where the funders, you know if it's grant funded, the funders aren't interested, but you still can incorporate it within the cost model. What you couldn't do it probably is the BREEAM, you know to your BREAM very good or BREEAM excellent, because they'll look at very tight cost model per meter. [00:23:36 inaudible] one of the funds really, plus it's not a requirement. They are not interested. You know, and have descriptions with people at EFA about it and all they want to do is get as many academies and schools as cheap as possible, and that's the truth.

Interviewer: You kind of work with two type of clients, they are the one that wants the cheapest option available.

Interviewee: That's the funders, yes, that's the government departments who are providing the grant for me and offer capital. So you've got schools fund in [00:24:06 inaudible] that was that used to hold the social colleges by I want BREEAM

excellent and BREAM very good, and they'd like you to spend more per meter to achieve that but you got the academies and schools funding which is the EFI funding and they are not interested, they just need the cheapest possible.

Interviewer: And then I that's where the problems come because obviously you...

Interviewee: Really, you've got a government, it's not consistent across government departments, so that was inconsistency. So we're funded from BIZ which is the business, BIZ government department and then the EFI which is the schools' department. There's no requirement for any, it's not a consideration.

Interviewer: Okay, that's the list of question I have. Is there anything else you would like to add?

Interviewee: I just wouldn't do, [there you've got number of all] people. Is there any theme or anything coming out or...?

Interviewer: Sorry, say that again.

Interviewee: Any themes or anything?

Interviewer: Well, the small survey that I am going to send you will have 1, 2, 3, 4, 5, 6, 7, 7 different themes that I have identified working in for all sustainability policies and I just want to know-- I am just asking every single company that I am interviewing, or every single person that I am interviewing, if these themes that cover the NEP policies, if they have targets to meet related to this [00:25:40 inaudible] and so on and so forth. The weird part is that obviously there is a grey area between the sustainability policy and the corpo-social responsibility. Some companies call it either, so, in a sustainability policy see you can find things about employees, about communities and a lot about health and safety for example, and then when you go into environment, that's the big bit about buildings itself. So it goes into obviously the CO2, energy use, waste, water, recycling. These are the main areas that I found are related with sustainability in FM.

Interviewee: For me that's very interesting discussion with people about waste, because what we-- obviously going back eight years we put a lot of segregation,

different waste streams. So we separate cupboard, paper, everything really, and obviously we've got to segregate a lot now because of what is hazardous. There's a lot more I think that needs to go. So to be compliant, you're doing a lot of that with your re-waste and [00:27:00 inaudible] although with other items you can't put in your general waste. Now, there's a lot of different views on this. My environmental manager, he use to write in for the AUC, there's a column in there, we came to a point where we look to say our cupboard sort of we were compacted and we [00:27:23 inaudible] all day to compress cupboard and bail it up and things like that. Sometimes you get paid for this and then it's a bit like a stock market, sometimes you don't get anything for your cupboard. It's just taken away, and when we looked to all our waste streams, a lot of the students were contaminating, sort of mixing the waste streams and we went and talked to our contractors about-- you know, without these targets not to send any waste to the landfill, and we went to look at their facilities. A lot of the contractors now have MAFs which are these-- I think it comes from multiple recycling facilities. [00:28:06 inaudible] there's no point. You don't need to separate your waste because we've this equipment that does it for us. Basically nothings to landfill, landfill is left, it goes to CHP, so none of these are going to landfill anyway, obviously apart from sort of your soil and building gravel and that type of thing. So you generalize office waste, you're just wasting your time [laughs] [00:28:26 inaudible] separate it if you want but it doesn't make any difference to us. A couple of years ago we made the choice just to separate food and free waste and then general office, we'd want to separate it, and they do it automatically, I think just all of our contractors across all their sites, have got MAFs.

Interviewer: Oh that's interesting.

Interviewee: Anything they can't separate, it goes to CHP, so it's [00:28:49 inaudible] CHP plan. But we were paying a chap, for actually, one person to be there and ripping up cupboard and [00:29:02 inaudible]. So we save some money, it sounds a bit nursery on staffing cost.

Interviewer: No, no, that's interesting.

Interviewee: It wasn't going to landfill. Now it makes me laugh when I go around to different places and see lots of recycling, but we've still got some here and a lot of

people are not comfortable with it but to me I think the technology has moved on and I think the people know we've been through that separating things and obviously we had to do our skips for certain types of wastes with our workshops and everything but it does make me laugh a bit when you see people separating every single thing when really there's this machine that does it. The people don't like-- there's a perception that certainly from students who expect to see it. But I think there's a perception there I think, technology and the world has moved on, and you know we can follow our waste and I've seen it myself. You know I've been down there myself and seen it working. It's in their interest not to send it to landfill anyway but so far efficient is important, [00:30:12 **inaudible**] from the waste operator.

Interviewer: Well, we do have-- at the university where I am going, we have-- obviously we have recycling point everywhere but the bins they provided are so small that you cannot put stuff into them.

Interviewee: It is interesting to see whether all these goes in one—when they take it way, it just goes in one lorry.

Interviewer: Maybe.

Interviewee: They've got one for the other. Now everybody-- I am not saying that every area has got enough but certainly here in the midlands, it's all separated by private facility, so there's no-- we're just wasting time but they-- and if they can terminate it at the streams anyway, there's no point.

Interviewer: Yeah, no, no, absolutely.

Interviewee: I think people's mentality, the general public as well, if you're saying your environment to be good and everything you'll expect to see it. There are things you can recycle locally, you know, I suppose going to bin to start with, so it's that. Looking at less packaging and reusing things. We should probably maybe looking at [00:31:27 **inaudible**] less at the end but I think the segregation apart from what you have to do for law, I think it's a waste of time. That's where I am at. It's probably not what you expected to hear but... [laughs]

Interviewer: No, no, no, it's interesting to find out because the whole purpose of my research is not just related to sustainability, my research is about building information modelling. So, finding out--

Interviewee: The financial sustainability is [00:31:55 inaudible]. You know, we had to find savings and we're looking-- last time we lost that post but we probably halved that post of that waste [00:32:05 inaudible] it was sorting the cupboard. You know, it wasn't hurting environment because it's been sorted anyway.

Interviewer: And it was just a cost?

Interviewee: It's just a cost of this-- you know he's wasting time really, so he was spending half his time doing that, sort of doing a little pickings whatever else he does. So I think we reduced [00:32:25 inaudible] save money. So I think the financial sustainability is important because if we're not here in a years' time or two years' time, we can't do what our core mission is, you know. So I think for organizations that if you talked about true sustainability, it's about that, you know, being here for your purpose especially if you're like a charitable body like we are, we want to be here to serve our communities but if we're not financially sustainable then we won't be here, you know, it's a big thing.

Interviewer: By the way you spoke so far, you look like you-- okay, I don't know about your finance in general but you got the chance to implement initiatives and create new sustainability buildings and anything like that. It sounds quite amazing because obviously most of the time you just hear, "oh sustainability is not on my agenda because I don't have the money to do so"

Interviewee: I think it's space because I work as spaces manager. What we're looking at now is our floor area and space as an organization. And you know, a lot of universities have probably got a lot more space than they need, and a lot of colleges, so that space cost money to run, you know. That's what our focus is on now. You might not think of your sustainability but it is being more efficient, it's about efficiencies as well and you know, and making sure we haven't-- where we have got some space, we're either renting it or selling it. Because it's not-- I mean a private

building that's cost-- you know it's low cost per meter and low carbon per meter, but you got twice as much as you need. There's no point in that, if that makes sense.

Interviewer: Yeah, no, no absolutely.

Interviewee: So I think that's how FM, true FM can help, you know, more space utilization, and we have-- that's where we are at the moment. We've got a lot of space that we're looking at, rationalizing that space, although it's with low carbon and low kilowatts per meter, but to me square meter.

Interviewer: Well, the rationalizational space, it's really interesting because obviously it links back with my actual, the other base of my research that is about building information modeling because it's key bit of information about that specific thing, and obviously--

Interviewee: So, as an example, ours, most of our sites are good apart from one that is very old, below benchmarks for the sector, per kilowatts, per meter and everything but if you look at per meter per student, we're not getting a good place with our too many too much space. Although I suppose having the right measure you know, to say "Oh yeah, our running cost per meter are very good, you know we're well under the sector norms, very efficient" but we're not that efficient because we've got too much space [laughs]. The space per student is double what the sector is or whatever it is, you know. It's just about making sure we got the right measures, it's not just about the carbon. It's about the probably carbon per student or per widget or whatever is it that you produce.

Interviewer: It makes absolutely sense. All right that's the end of my questions.

Interviewee: Okay. [00:35:35 inaudible] [laughs]

Interviewer: No, it was really interesting, especially the part of where you actually measure everything based-- the part that you ask cost per square meter and initials per squares meter is used for, but...

Interviewee: We have to keep complete returns for our funders. So we have to gather our data anyway. It's not just gathering it, it's analyzing it and applying it and using

the reports that come back out. It's not just sending out information off to our funders, it's actually using it to see if it's [00:36:08 inaudible], and then if same doesn't look quite right, you can drill down to-- you know "that site, it doesn't look quite right, what's going on?" You know, is there heat in our old site, is it a control issue or that type of thing. I think benchmarking between your sites is good, and obviously your older sites probably do. Our works, you know, we've got sort of single glaze windows, old heating systems or... but you know sometimes there's other things you uncover, you think, "well, that shouldn't be, what's going on there?" and you might find some meter issue, it might be something else, you know, something is left on whole night, or whatever. Our environment manager does walk-arounds early morning, walk-arounds that are quite useful. Before even he get to see when the cleaners are interesting, what goes on, [00:36:59 inaudible] leave the lights on, you know, it's simple things like that or it was not just things that are run or should that be on, [00:37:06 inaudible] what's that on? [inaudible]? Did you know this was happening? Did you know the cleaners are coming in putting on-- yes, doing this, putting these things on or...?

Interviewer: Yeah, that's a good way to find out what's going on especially when the building is not supposed to be on.

Interviewee: Yeah, and then aligning with our health and safety team, we've got a small couple of paperwork to look after our health and safety and now we are doing fine, so whatever they do in our health and safety audits, that they are looking for environmental things as well. So we should know it's the two together actually. This is we are at presently. It was almost forced all the way through less resources and less people.

Interviewer: Well that's again, it links back to finance sustainability.

Interviewee: Finance, it's, what's going [00:37:58 inaudible] sounds more efficient and we're expecting as far as...

Interviewer: Yeah, you're just one team, so it's not a problem between, communication problems or anything like that as well. All right.

Interviewer: Could you please tell me your experience in FM.

Interviewee: In FM?

Interviewer: Yes.

Interviewee: Yes, I fell into it from another career. I had an interest in architecture previously, and found it was a way to kind of get into building works that way. It's been an interesting six years, lots of ups and downs and it's not the most persecuting industries. It's always very demanding and there are lots of moans and groans but generally there are some rewards to seeking solutions to prove that to people. It's so much in FM, it's really hard to-- you can never describe it to someone.

Interviewer: Yes I know.

Interviewee: Our role particularly in in-house magazines covers so many different areas. It is forgotten internally how much we do for [00:01:08 inaudible] team, but we do... we have got copies of some of the work we do, so it's quite nasty when you leave and people happy.

Interviewer: And within the role-- sorry, within the team, what is your role specifically?

Interviewee: I am the facilities manager. I know I have a director above me. A lot of responsibility falls on me for most of our contracts about maintenance, cleaning, security, management at front house. We do a lot of project works, like building works, ensuring the health and safety side of things in businesses. [00:01:52 inaudible] We have-- there is another person in the office who he's been assisting FM to support in the financial side of things and then we have AMs junior roles who do a lot of the admin and stuff like that.

Interviewer: Okay, so you cover both the hard services and soft services in your role.

Interviewee: Yeah.

Interviewer: Okay, that's really-- and what kind of buildings do you manage? How big they are and they are mainly offices or?

Interviewee: We've got three that we manage specifically in London. We have about a thousand-- or I have the 60 fulltime staff about the three premises. One of them is an old 70s building that has [00:02:42 inaudible] basement and then four office floors, and then we've got a flats above us. The other property, a new office block which is just office space and a basement. And then the third property is a small 5000 sq. ft. area that has a testing facility for good housekeeping. So we have beauty testing, wet testing, sound proofing and then above that area we have an event space and a cookery store.

Interviewer: Okay, I guess the third building is the more different to manage compared to the other two obviously.

Interviewee: Yeah. My director who had particularly spent a lot of time running that project get it built, and then running it since, so it's quite a time consuming area even though he's got 12 people down there.

Interviewer: Yeah no, no, I can imagine that. And so the main focus area of my research is sustainability. I would like to know if you have a sustainability policy, if you have any requirements related with sustainability or anything like that.

Interviewee: We don't specifically have a policy or anything. My director and a colleague of hers who used to work in a [00:04:02 Continuity] magazine have been probably a few of the FM have [00:04:11 inaudible] really trying to push green initiatives, so trying to [00:04:20 inaudible] I think they worked with the senior management at the time to say that they will be carbon neutral within five years. So we've worked with [00:04:33 inaudible] or something like that. So we worked with this company who helps us reduce a lot of our carbon down from something like 5000 to 1000 carbon tons per year and that was-- it was just premises, so it was not operations or anything. It pretty much got down to let us utilize our utilities in general FA or air travel that was cooling issue and then in the last year we [00:05:14 inaudible] thousand 1500 carbon tons to be carbon neutral. So what we found from that project is that we were struggling to sustain that if we want to do that every year,

it was going to cost us a lot of money and so what we've since [00:05:30 inaudible] and we are trying to work with people who are like cleaner, cleaner air. I think we are doing initiative at the moment to try and encourage people to decide who to work with to take alternative route there aren't as polluted.

Interviewer: Okay, so mainly the main focus has been becoming carbon neutral over time even though you don't have a specific policy that was your goal over a period of time. And right now, do you have any initiative to involve actually your staff or it's just mainly based on subcontractors right now?

Interviewee: In the last probably 18 months, it's probably pulling off the radar a little bit. So we don't have any initiatives with our staff and that are specifically green. We have a few initiatives that came off the back of some of the previous ones. We have a big [00:06:31 inaudible] or a big to-be-hireds and we also worked with Oxfam. So all of our samples [00:06:37 inaudible], we give to Oxfam and we've raised over 25 grand in the last three years. So we have those types of things but there's nothing specific with staff, or within our recycling bins and we mainly have projects such as putting motion sensors on our lighting. We put multi-spin invertors to reduce the energy on our fans for the air conditioning and wherever possible we tried to put in improvements to reduce the energy that we use.

Interviewer: Okay, absolutely. As you said this thing is falling a little bit out of your radar right now and do you consider sustainability during your day to day operation? So while you work daily, is it in your head or it's just something that you don't have the time or the opportunity to think about?

Interviewee: Me personally, a lot of things I will look at the best options for something, so we're always looking at our recycling, I think in I think it's early last year that I helped institute [00:07:54 inaudible] paper recycling. So it cost us a little bit more money to find the paper initially but all of our paper wastes goes off site for free, and then it comes back in as black and white recycled paper. So, that was the little initiative. It cost a little bit more money but it was actually a nice thing to have and it took some of the waste out of our other streams which has reduced the cost on that contract as well. So, there are little things like that I'll look at and look at the options to see whether it's sustainable as a green initiative and also sustainable as a

money initiative. But there isn't anything-- there isn't like a procurement thing that we have that you have to look at sustainable thing.

Interviewer: Okay, and when you look at this kind of initiative, do you need to present it or make a case to your director or anyone else? So where is the chain of command if you want to do something like the initiative you've just mentioned with the recycling paper?

Interviewee: The paper one as an example, if something came my way I would present it to my director and then it goes to the CFO who tell our manager but it's the exact same way as if we're doing any initiative, so whether it was a sustainable one or just a [00:09:26 inaudible] that we were looking at or service change that we were looking at, it would go via my director to the CFO.

Interviewer: Okay, you were saying before that you don't have anything in the contract, so even when you do contract [00:09:44 inaudible] any kind of services that you do that you outsource, you don't have any requirements or anything else that you ask them in terms of sustainability to your supply chain?

Interviewee: No, it's a strange one. We don't have the sustainable policy or anything but we have at least environmental policy that we try and follow but we don't have a procurement department. Most procurement is done individually each department, but in the facilities team we do try and whenever we send out a tender, we do ask for what a green initiatives people do, so whether it's an ISO or they have a green fleet, things like that. So I think car taxi company, generally we use a green car over executive car. So there are little things that we put in but it's more an individual thing to our department and also it generally happens if the core work is achieved anyway, because we--

Interviewer: Okay so...sorry go ahead.

Interviewee: So we have the typical comment which you might find from other people is that if it doesn't save money, they won't do it. If something costs more money they are not interested really.

Interviewer: Okay, no, no, I understand that. So there is no formal KPI or anything like that related to sustainability for your contract or anything like that.

Interviewee: Nothing formal but it's in there at some point.

Interviewer: Okay, as a general thing, so you kind of mentioned it right now, what do you think are the challenges of implementing sustainability in facilities management both in your company right now and as an industry as a whole if you have any knowledge in that field?

Interviewee: The difficulties we find and have found is it affects the way the business works. If it's affecting the core part of our business, they don't like it. Like the paper, we can only go as far as buying black and white recycle paper. The departments wouldn't accept it as the color paper. So we still-- like in most offices you have black and white in color but we also have the color proofing paper which we use for our... our editorial departments would do that before they print the actual magazines, although there is actually a digital option for doing that. So we have a digital option but we still print paper. So there's some difficulties in that sense trying to get people to break the norm in how they work and we've sometimes come across things like with the PIs and motion sensors to lighting, people don't understand that it is affected by the light. So we have our departments who have to have their lights either permanently high or permanently low. So there are sometimes areas that you kind of get a little change in whether the energy is going up or down depending on someone's preference.

Interviewee: Okay, all right. It's really interesting because obviously the company you're working for is really particular. Generally the people I have been talking to so far have waste managing offices because your office although it's so technical, a kind of office environment, they do have requirements, so I can imagine it's challenging to make everyone happy especially with this I understand they're having something printed out. It's something that they will require no matter what even though it's not technically a sustainable solution but they probably want it beforehand in the printed version.

Interviewee: Yeah, I mean to sum up our staff, we've got 10 floors across 2 of our buildings and we've got 2 departments who are luxury departments, like luxury magazines, and one of them, I was speaking to my person earlier, one of them is run perfectly, it works really well and across the hall the other one is the complete opposite, it's a nightmare, things get lost but it's the type of person that works in there. It's- they have kind of really high maintenance. So, across the floors, we have a difference in personnel but across the building [00:14:42 inaudible] as well. We're trying to run a one-way initiative never works, you always have to have some sort of adjustment per department but they still need to follow a policy that goes up our senior management. So, it is very difficult for us.

Interviewer: You to tell me a little bit about your experience in FM.

Interviewee: Okay, let's go way back to begin, I work for Dorset police and I've been with them for about 22 years, man and boy. I've been working in States Department for most of that time. In the last-- this is I think 12 years, I do few [00:00:54 biz and busy] jobs within this police but not actually states related but the last 12, 13 years I've been in the States Department.

Initially for the first, I forget it was about five years, I was working on major projects on capital projects, mainly building large police stations and doing refurb works within them. Basically what happened is around about 2010 the, I was completing [00:01:34 **inaudible**] project. The bubble burst if you like as if we had major financial crash and it affected considerably the public sector and that is where a lot of the cuts as a result were made.

As a result of that we lost a fair chunk of staff which means obviously the state wasn't growing at the shrink quite considerably. So at that point is two part radius, one was the shrink in the state, may not going to be able to build. And obviously as a result of shrink in the state we had to make a release site. I went from being the capital projects manager to being the facilities and asset planning manager. That was about 2010, 2011.

I did that up until I think March this year and what happened then is my, one of my colleagues, the building services manager retired and they merged his job which is [00:02:46 **inaudible**] the hard FM side of it, the building maintenance side of it. They merged that and the soft FM part, which always was my part, the cleaning, the grounds maintenance side. They merged all those parts together.

Now I've got the asset planning and the whole FM discipline if you like. So I'm managing the whole lot now [00:02:46 **inaudible**]. I've now been doing that for the last three, four months, and trying to get my head around mainly around making the hard FM side of it, give program maintenance, response maintenance sort of it.

I've got some background in that where I did it for my old job mainly more on kind of the administration, on the account side it, so that has been quite handy and then how

their generality that all works and the other point in the contract is this is more of a technical job and being a responsible person, person who run as best as control and at least control as well.

That is kind of part my remit as well. So, say I've got a team of I think about 18 people. Some of those are kind of caretaking based staff, building surveyors, the kind of electrical engineers, we've got one or two mechanical-electrical engineers, two building surveyors, one of them deals mainly with projects.

Within the estates as well, under my control is public-private finance and its chief of state, but about a third of our state is probably due to increased, there's a way [inaudible 00:04:03] state is PFI, which is procured by public finance but obviously run by the public sector with us controlling the performance is now put via the PFI provider.

I've got a PFI contract manager who manages that under my guidance and the rest of the job is kind of asset planning and release of sites and sale of sites. That's basically my job in a nut shell really.

Interviewer: Okay. That's really interesting. It's been a really interesting journey, I can say that.

Interviewee: Yeah, it's actually quite an interesting one basically from building and then going on to selling them and really trying to make efficiency of actually running them really now.

Interviewer: Just a little bit about the facilities you're managing, what kind of buildings they are and do you have a rough idea about how big they are as an overall?

Interviewee: Yes. We have, that's a good point actually because we-- we've got I think it's 60,000 meter squared of internal office space for the force and it's a mixture of operational police station space. Some of it is we have three dedicated to custody suites in the county which are specialized suites for detainees detention and processing and that is kind of in terms of security level and provision level it's

somewhat beyond what you get in the prison service because of the vulnerability of people when they come into custody so they can afford quite specialist units.

We've got three of those in the county, the free 24 hours ones and we have some other non-designated, non-24 hour ones in the county as well. We have... it's I think one, two, three... currently five help sites around the county. We have one over at Weymouth, one at Poole, one at Bournemouth and currently one [00:06:21 **inaudible**] which is currently being in the process of being vacated and sold and we have our headquarters at open field site in South Dorset. We have-- yeah it's four main help sites and plus our headquarter site.

Most of response side of the county is set from Weymouth, Poole, Bournemouth areas and [00:06:47 **inaudible**] down Leicester now and our headquarters is maybe at the administration center at Winfrith. There's generally on a reason of, each site is on a reason between 600 and a 1000 net in meter squared area. We have another probably about 15 or so police stations sites around the county which are smaller. The site is generally made up of parade rooms, rehab rooms, some of them have-- the bigger ones will have [**inaudible** 00:07:25] and some of them have got specialist rooms as well.

The peculiarity-- It is slight peculiarity with police station environment is because they generally 24 hours sites rather than being nine to five sites where you have 10 hour sites, headquarters can be more of a 10 hour sites but mainly most of them are 24 hours sites doing much of the policing role. Provision wide they are, most of all the help sites have got a call of resilience to them.

Most of them have generator back up, most of them have uninterrupted power supply back up as well and particularly the Bournemouth and Poole sites have heavy reliance upon cooling and the like, quite a heavy usage of plant to support the EPS and have business critical functions.

At headquarters, we have a [**inaudible** 00:08:27] building which takes the emergency and non-emergency calls to the county and that is quite a reasonable size slightly above the headquarter, criticality-wise, [00:08:41 **inaudible**] critical functions of our

headquarter site and that's the 24 hour 999 calls at the call center to headquarters. That's what you thought of as I mentioned planned association with it as well.

So generally wide age profile of the sites, we've got a real mismatch really, we got... it's actually most of my sites are really quite modern estates really, the PFI estates, the one that weigh most of PFI estates and that's got four buildings within it, four police sites within it and that was built on the 1999, 2000, so it's about 15 years old. Poole was completed 2009, so that's actually about six or so years old. Bournemouth site was-- is in two parts. First part was 93 and the second part, the custody block was 2010 and we have other sites. Headquarters was a mixture of 1950s through to 1990. I think the oldest site we have probably Gillingham, I think it will be. Most of the sites is probably 1950, almost is what we're doing. I don't think any sort of any site of any major significances, historical significance really fortunately for us.

Interviewer: Well, it sounds like you're managing a really differentiated portfolio and obviously it's because the kind of obviously the kind of office that you're managing is so different from any other officers or normal things and you need to go to so many other things that sounds like-- it's so interesting. It does sound really interesting for me and why I say this, I do know that it sounds hard because every single time I talk about facility management with people that are not involved in facility management, I just look like the weirdo they found it interesting about funny stuff.

Interviewee: You and me both then.

Interviewer: It's just fine, that's fascinating, that's great.

Interviewee: We're a strange breed of [inaudible 00:10:59]?

Interviewer: That's fine, that's great. Do you have a sustainability policy?

Interviewee: Facility policy?

Interviewer: A sustainability policy.

Interviewee: Sustainability policy, oh no. We do actually. We have what I call is, but we refer it to as an environmental policy which the sustainability side of it will kind of we tend to wrap up within the environmental curve.

Interviewer: I'm sorry, give me one second, I just did a mess and I completely lost you.

Interviewee: That's fine but you are there?

Interviewer: Say that again, if you had...

Interviewee: We basically have an environmental policy which I think in terms of sustainability that we kind of consolidate the sustainability within our environmental kind of policy, which kind of takes into account obviously the various kind of sustainability, environmental, and that's for both the estate and non-estates elements of our business. That includes transport and buildings and other kind of non-FM kind of issues we do.

We kind of wrap that up in the environmental policy generally. So we put-- individually we then kind of look at sustainability on each individual project level as well but generally I think we wrap it up in our environmental policy.

Interviewer: As an FM team how do you align with this environmental policy that you have?

Interviewee: As an FM team we obviously do it on a discipline by discipline basis. It's fair to say that, I'm going to talk candidly here on this one which you probably appreciate. The environmental and sustainability approach of the force has always been not schizophrenic, schizophrenic is the wrong word. It's always been difficult to kind of manage and difficult to nail because obviously fundamentally our business is in public protection and policing.

The way we've done sustainability up until more recent years is we try to maximize sustainability and the run environmental profile but was not actually kind of making up part of our reason for being here, that sounds awful to say it but...

Interviewer: Yeah, no, no, it perfectly makes sense, absolutely it's not your call...

Interviewee: If we work on it as a byproduct we would do so but it needs to be cost effective alongside the location functions and particularly where we're being kind of sort of strapped for finances. What we tend to do is when we're doing like office refurb, the refurb side of it, we try to maximize our sustainability as part of any kind of planning and delivery of a building. I'll use one example when we did the Poole PFI project and we put in as part our client human power unit and we put a CSP in to maximize the environmental protection of the site and also to get our BREEAM certification as well. Now, how well that's being post implementation is in itself conjecture really, because it basically have-- it doesn't run that often frankly because there's too much power generation outside we've got to heat the entire Poole harbor..

But we've implemented it through that way through that few projects and we've done like a number of things where we've done refurb, for example we did a refurb for a police station, which is part that. We put it down, install PV cells, showers and solar heating, solar power.

We've done those kind of things as part of our individual projects to be kind of, A to kind of because we if I kind of get good paybacks but also to as a... I wanted to say kicking the box is one word for it but as to improve the kind of the forces credential resources to introduce obviously to carbon reduction as well, as part of our carbon reduction measures.

On an ongoing basis as well we've done a lot with our cleaning maintenance contracts and ground maintenance contracts. We took a building sustainability where we can, when we got those contract as well, a lot with the catering side of it, obviously use of sustainability materials, obviously that goes with new built roles particularly the cleaning side of it. The cleaning products we use now are actually environmentally friendly.

The products that we use are environmentally friendly and going for contractors that are ISO14001 accredited as well. We go for contractors that have got those accreditations as well, checking, making sure that we can demonstrate those, we're

getting the contractors or the supplier's stream is kind of environmentally sustainable as well.

Interviewer: That was kind of following question as well. You mentioned you have an environmental policy. How do you translate that into operation and also how do you pass it onto your staff and supply chain? You have kind of a guideline I guess, something you're supposed to follow.

Interviewee: Yes. I think what we do generally and we kind of interpret it into actuality, into practicality is when we obviously let individual contracts is one of the key documents we're looking at when we let individual contracts and just keen on that as well. Most contracts we let now are let through our South coast regional procurement team.

What that basically is, is Dorset police are part of one of four forces that is us which Devon and Cornwall is collective force and Avon and Somerset, that's our four kind of forces. We basically collectively have, I should scrub Avon and Somerset, it's not them. Sorry Avon and Somerset did their own thing. I said Gloucestershire, Dorset, down the Cornwall basically the South West England really. We all have our procurement team that basically procure on our behalf. They're all police staff but they're procurement specialists.

The team is split up into two, basically it's got hard FM side of it, the building side of it and then there's the soft FM side of it who do a lot of the cleaning on the grounds and like. They clean-- the soft FM can be more kind of to CRPS members, here they're talking through policy members whereas the other side of it tend to be more of RCS kind of oriented, they always [inaudible 00:18:54].

But we do it both equally [inaudible 00:18:57] as a result of that they kind of link into our kind of environmental policy and our sustainability, to pick up any, where we needed to maximize or kind of incorporate our environmental policy into our procurement because most of the big jobs we ever do whether it's on the maintenance, engagement contractors, suppliers, is going to be procured through the South Coast region procurement team.

We very much rely upon them to kind of pick up those kind of issues. They generally pick up those issues, they can pick up also the procurement issues as well and basically we're kind of [00:19:43 **inaudible**] general compliant as well. That's kind of how we do it on the kind of the supply chain. I think what I have seen the last couple of years I have been involved in some of the evaluation exercises, yeah they kind of, they are incorporated and quite a lot with 14001 accreditation as we were working on, when we did on a few-- about a year or so ago and we did the grounds maintenance where the 14001 was an important consideration.

It was for cleaning one as well, there's not much we did though, what's that we did? [**inaudible** 00:20:22] three or four of them now. Oh waste, got it, of course the waste contractor, how can I forget that one? We recently did the waste one and obviously that was a big part of the evaluation there. It was the sustainability on the policies of the various suppliers and how they kind of run their, I'll talk about that point in a moment but how they actually kind of deliver their service was obviously scrutinized very heavily in terms of what their procedures were, processes were with process in waste and whether they and how-- yeah what are process, procedures, how do they bring it in line with their processes as well, it was quite an interesting one. One that we're still teasing that out at the moment frankly. We're still kind of rolling out part of that stuff as a result of that contract. In terms of the users as well and that's a big issue for us is yeah, we've got the... our side of it, our own internal team, the procurement team, then we've got obviously on the flip side the end users and the education of them, is being quite interesting.

Day to day, the environmental sustainability is not necessarily kind of their main reason they come to work but we're trying get into the society that you need that, think about this, so we kind of do a lot the things on our internet and kind of remind them about that. Our environmental policy and the need to kind of carbon reduction and the need to turn off lights and generally what we're doing is kind of rather than going on about policies because most of colleagues have kind of policy to death, these day [laughs] he's going to break you down into [00:22:15 **inaudible**], things like why don't heat to 90 degrees, why we heat to our 19 degrees, why we have our lights turned off at certain times, why we're doing these upgrade measures and how they can help as well. It's funny a lot of staff are [**inaudible** 00:22:35] as well, on the waste

side of it, why they need to separate out their waste, sort it well and how it can reduce our cost and our kind carbon as well.

What's quite interesting is anecdotally, what's happened is, and pretty Dorset, because across a lot of the counties on the waste side of it, they're going towards separation of waste, follow build on their domestic side of it, we see they're going to transpose into the work side of it and a lot of the times the work side of it is actually slightly behind where we they are domestically.

We've seen a correlation between where some parts of the county [inaudible 00:23:14] separation, you can see that can transpose into the work side where staff really go to separation and you've got maybe the [inaudible 00:23:23] where the local councils are really not as key at that point as they do in a lot less separation. The staff aren't kind of switched on to it as much.

Interviewer: That's really ingesting.

Interviewee: It is.

Interviewer: Yes I know sort of a link about how your regulations at home and how that has reflected to your behavior when you're at work obviously there is a straight link into that.

Interviewee: Yeah, it is... say the food separation cans sometimes lead to high cost now we doing food separation. It'd be very interesting to see because we've have the headquarters and this bill comes it from the Southwest. I'm pretty sure the people in the rest of the county do approve separation are probably switched on it, they're not [inaudible 00:24:05] for about 12 years now. [Inaudible 00:24:07] we get something in the East of the county where they're not doing food separation domestically at home and therefore not switched onto it as much but there's certainty now it's start to come in but some, one start to affect things in Vienna.

Interviewer: That's very interesting. It's kind of, I will ask you that later on. I still have a couple of questions to ask you. You don't, do you have, obviously you've kind

of mentioned but do you have any formal targets relation which sustainability that you need to meet?

Interviewee: Any formal targets we don't, I'll be honest we don't have formal target in the force but we have what we've referred to as a benchmark in return. We do a benchmark in return which we were actually, our benchmarking of our energy usage. Our journey on cost per meter square, cost per number of staff basis is measured, cost [00:25:15 **inaudible**] elements like waste, energy usage, building maintenance, refurbishment elements, building maintenance, all kind of-- the whole FM side really was collected locally and we can benchmark our buildings together, and compare buildings. But we also kind of submit it to a National body called the National Police Estates Group, NPEG. Basically they kind of procure the national benchmarking facility which we pay a [00:25:54 **inaudible**] amount of money for. And they basically collect all information again and they produce an annual report which benchmarks us against other or other forces who are involved in... out of 43 police forces I think 34 of them are signed up for benchmarking there. We are benchmarked against other forces. To be honest how much data is actually, I've got some my own views about how accurate some of data with other forces put into it. We're a bit kind of careful how we compare ourselves against other forces, because some of the way that they collect the data [**inaudible** 00:26:37] too sure about. And sometimes our collection methods, internally collecting the data gave us a hell of a few concerns about. But it is actually quite interesting exercise to see how they are comparing internally and externally with other forces, and telling you how much we were spending on each site. A lot of waste issues and picking on energy as well, on which side we're doing well, on which side you're not doing well, but we don't have any formal targets. It does though... it is worrying they kind of practice but what we actually do is look at the site and say, "well, okay, this site didn't do especially well for energy usage, this site, I use pool for example, pool is our site, is a brand new site, much modern site in the county. It puts still one of the highest energy uses if not a cost per square basis which indicates points us to some issues there which we kind of dig down into and work out where they are. We tend to use [**inaudible** 00:27:39] more to actually indicate where there are areas for improvement rather than saying we must have a reduction of ... That being said, our chief of finance, God bless his soul, just tend to kind of quite often give us [**inaudible** 00:28:00] average target year on

year to hit. And [inaudible 00:28:03] on what you take, a 500,000 off the energy or the FM budget for next year and it's going to [inaudible 00:28:13].

Interviewer: So it's technically not to tie your ability to sustainability but it's more about, "Oh you don't have the money, so we'll need to cut the like ... Use the resources and costs and everything

Interviewee: Yes, exactly.

Interviewer: It's another way to see that.

Interviewee: Exactly. I think that's probably you put hitting them in the head there, If I was to be truthful I think, they need to reduce cost across the board has driven the sustainability to a greater extent. [00:28:48.07 inaudible] but the sustainability side of it is by [00:28:49 inaudible] because we need to reduce cost. Yeah, and I don't think anybody can frankly argue with how the things [inaudible 00:28:58]. If sustainability is kind of being driven out of the floor and necessity there, yeah because we can't ... we got to reduce cost because as our ex [inaudible 00:29:05] said, it breaks me to go before people.

Interviewer: And related to this, the next session is about what are the critical factors and the challenges of implementing sustainability in FM? Obviously, you just mentioned one. Is there anything else do you think is a big challenge? Obviously one is the cost of implementing sustainability in FM. Can you think about anything else that you believe is a challenge of being more sustainable?

Interviewee: Certainly, I think what one thing is, and then it works, and it's-- and a very interesting one is that we procure our energy supplies [inaudible 00:29:46] basically for a central government agency. And like they change their name every year to keep us on our toes. As a result of that what we do is we get very, very competitive rates to [inaudible 00:30:01] and what of course I doubt is in terms of the payback on picking things like PVs on various different renewables, is that It makes the payback on those individual schemes quite long because we're getting such good

rates on domestics where you can get payback say 2 or 3 years, or payback, [inaudible 00:30:28] 11 and 12, 13 years. And when you look at in the accounting side of it, they, "mm-hmm we've done our payback, there's reason of doing it" because it goes with the energy, individual kilo-hour rate we get is quite competitive, so it's like buying across the whole public sector. It means it's paradoxically... It means [inaudible 00:30:48] actually go down the sustainability line. So what I think what they have started doing with their line is rather doing an individual kind of scheme basis is that, "okay when we do the procurement of energy, we procure energy essentially from sustainable sources, So we use it to get on government framework you have to have an excellent percentage of your energy generation from a sustainable source. Yeah, basically they slip it in his head a bit, so Realizing if individually is more difficult to generate, they'll just divide the cost that they've been doing to individual schemes. So that's kind of, if you have had one difficulty, it would be voice from the head. Yeah, the cost side of it as you know is always going to be a difficult one verses obviously [inaudible 00:31:49] budget. To certain extent, the make up our [inaudible 00:31:52] as well, makes it sometimes difficult to actually-- because sometimes we have physical infrastructure side makes it difficult to actually have [00:32:12 inaudible] wind farm and the like. Because especially a lot of sites kind of have their own [00:32:18 inaudible] town center sites, there is obviously a lot of [inaudible] issue and the like. We have a lot to think of solar farms. [00:32:28 inaudible]. We have kind of explored those kinds of things. The building age, building infrastructures causes difficulties. [00:32:43 inaudible] side of it if you like and the new built side of it. Availability of government grants as well, that's kind of [00:32:52 inaudible] over the last couple of years, so if a lot of money is spent from the government hasn't been out there as much as it needs to be really to kind of incentivize it. I think because we've kind of [00:33:12 inaudible] on new build projects. Yeah, where we can maybe let it run, regenerate our state free run for new build and that has kind of been taken way now as well, we've then merged on the lines of improving, making doing them what we've already got. I'd say probably everything is, yes sometimes the government's policy on it and the government guidance on this matters is being a bit kind of mix matches on where they wants to go. With our sustainability it's been a bit kind of the partite parts. So I think now, individually the waste side of it. There's been ... I think they've tighten up on the generation of waste and separation of waste which I think is a good thing now. So we [inaudible

00:34:21]. Which is a ... Again [inaudible 00:34:21] been interesting one to kind of roll out in the county. A lot of these is a fragile behavior of the staff as well as getting the staff to the standard, everything in the building has a cost and they need to kind of have that in mind, and act accordingly as well where it's kind of treatment of the state and obviously things like the small measures like turning the lights off, not using cooling and the like and even things like the small breathing fan, heaters and the stuff because don't see the discrepancy, the bottom-line of it.

We've been trying to use a lot more management information to show so that, you got to use that, we went for the big, the one for million pound mark on energy usage cost. So we said like, yeah, we use a one million pound a year energy that equates to X amount of I think it's about 40 police officers. So you're sure to say that across county that permits that we can, it's always quite useful one to use when we say before we equate the cost of anything back to the cost per police officer. And that always makes it quite handy for the public and the staff as well. if you save this amount of money, there is a police officer on the bay or there is another patrol car that we can put on the bay and to get that message through, it has always been because it's almost change in organization, that's pulling everything as well, we said something has been changed over the last couple of years or last three or four years, because we are try and get the message through to the staff, with everything changing I think there is got to be almost a change myopia, or a bit a change doubt.

So, it's almost getting me the buying for some of our implementation measures is being quite difficult as well. Yeah, there's a quite a bit of challenges there, and clearly the building, a number of us now, because when [00:36:13 inaudible] we haven't got a big team, we are quite a lean team, we don't really have at the moment enough people ready to champion the environmental side of it as much as I would like to do really. But I would like to kind of get on top of more in the coming years or so.

Interviewer: I have found it really useful, more understandable and I believe for people to see the actual expenditure in something that are close to, make it sound like, "Okay if we save enough money, we will pay for X amount of new stuff" it's just making it more easier to understand." Otherwise a number is just simply a number and it could be, "Oh well, I don't know if one million, it's more, it's a lot, it's not a lot

yes it's a lot but compared to everything else we do, I don't know how much is that." No, no it's a good way of doing that absolutely.

Interviewee: Because a lot of people, I mean, as we, in this state we keep saying that, as a police force of our budget, 80% of their budget is on personnel. We talked about our expenditures to all our personnel but after that the next biggest cost is on the estate. That surprise most people, when you ask people, most people think, "Oh after that it will be IT, it will be the transport [inaudible 00:37:42], I think it could pinned on the idea of like the line cost, the business rates of the sites, it can run into a hundred of thousands a year to not just for being on the site. And then it kind of hit them after that, they can say, "what the hell! If the states cost a lot of money, so where there's one person in it or X amount of thousands in it, it's all us cost the same money, so education side of the staff is quite interesting really.

Interviewer: Just one thing that I would like to ask you, the final question from me. You mentioned you do have a procurement team that takes care of procurement and you did mention the [inaudible 00:38:38] that is a key element when you select subcontractors but do you have KPIs related with sustainability when you check your subcontractors or it's more during the tender process that you try to go for the most sustainable or you tend to look at these kind of things when you actually get them on site, it's not a key element for you or is a key element for you?

Interviewee: Yes we do. What we do is, I've been official to KPIs, what we often do, [00:39:03 inaudible] when it comes to any procurement procedure, what they tend to do is, they do... there's a split between the cost and the submission [00:39:21 inaudible], if you like. Generally, it's fair to say that the cost is weighed slightly heavier than the quality side of it. However, within the quality side of it then there will be a series of response questions that will then be graded, and each one will be weighted depending on how important it is. I think the [inaudible 00:39:41] side of it and the quality of response is weighted quite highly within that percentage. So the percentage use is quite high but the actual kind of the way is, the way it's actually done is it's done a more of a qualitative than quantitative response from the tender list.

We will look at what the submission is, what evidence they've given for where they can use the grants, clearing the waste replies for example, [inaudible 00:40:31] they say yes or no, but then there's kind of how they actually process the waste, what kind of percentages of waste processing they've got, are they using dirty or clean waste recycling facilities, do they take everything in or do they need to pre-sort it and also what kind of ... what their recycling means are like as well, what their carbon proponent is as well, so yes, there is a lot of those kind of things that built into this process.

I haven't got on top of my head actually what the percentages are, but I do remember going through that and that's when, I think that's the way they kind of grade it out, so at the end of the day I think it's about 40 percent total evaluation quite a key part that was the kind of the sustainability and to the point I think where my colleague wrote it down and went to their various recycling plants as part of the evaluation process, okay, let's see how you actually do your... to make sure that you [00:41:39 inaudible] in the UK is that there is only certain amount of recycling plants around and when you actually look at it, actually [00:41:50 inaudible] use the same recycling plants as [00:41:52 inaudible] different, they all use the same recycling plants [inaudible 00:42:03] you actually find that they are actually all referring to the same recycling plant [inaudible 00:42:17]. So the best kind of thing they do-- Although actually, I don't think it's cheeky, I will give you various details as well because it's quite easy for [inaudible 00:42:28] you may have, you may be the supplier at the time have a [inaudible 00:42:36 have a chat with you about more a bit from the suppliers' side of it.

Interviewer: Okay, I know, it will be great.

Interviewee: [inaudible 00:42:44] you answer a few questions, this is quite user friendly as well.

Interviewer: Alright. Thank you.

Interviewee: Yes, so [inaudible 00:42:45] side of it, what is not directly sustainability related we do use KPIs quite heavily with PFI state.

Interviewer: Okay.

Interviewee: Now, have they got on the full sustainability? I think they have actually. They have got a KPI sustainability I can't maybe think what it is but it was an element of KPI, yes actually the best one they have, the western one is all encompassed in FM contract. So it includes all cleaning, all glass maintenance, all waste is within that, so I think the one of the KPIs within that is for waste recycling and waste generation and they recycle in what rates. I [inaudible 00:43:30] me what the KPIs is, the pool ...

Interviewer: No, no fine.

Interviewee: ...the pool PFI on the other hand is been slimmed down PFI, very much more but it's on the hard FM side of it, on the building maintenance side of it. Decision was taken a few years back I think about 10 years ago now that public finance [inaudible 00:43:50] out of FM, soft FM particularly in them and they take a lot of soft FM parts back in house. So yeah, the modern recent PFI's. Are you familiar of PFI's? Sorry.

Interviewer: A little bit yes. It is not one of my key areas of expertise but I've been interviewing people from different schools and they also are part of the PFI projects and I have a little bit of knowledge, not much.

Interviewee: [inaudible 00:44:22] Yeah, the pool PFI and there is I think decision quite a while ago to kind of take a lot more of control of the soft FM procurement and delivery in-house. But it's causing the same problems because then you've got this continuous conflict between soft FM provider and hard FM provider and he is responsible for cleaning the carpets and [00:44:48 inaudible] under that one but, yeah.

Interviewer: A little bit about your experience in facilities management.

Interviewee: I worked for a facilities management company, ..., for over 10 years. I started in the office administration, it's just tenth and actually my background is plumbing and engineering. So I ended up getting involved in hard services side. It is my seventh job with I have always worked on PFI and yeah, I am now responsible for running the Bristol area and all of our mixed facilities management services here. That's much to it really.

Interviewer: Okay. What kind of facilities do you manage right now? What kind of buildings and how big they are?

Interviewee: I have five buildings as part of my PFI contract, four schools, secondary schools each home to a thousand pupils. I also have a leisure center with a swimming pool for access to the public. Within these buildings I operate a full PFI, IFM FM service and that includes premises, mechanical-electrical building compliance, cleaning and catering. I have 120 staff reporting to me across these five sites. And yeah, we are on year 10 of a 25-year contract.

Interviewer: Okay, all right. I do know that your company have a sustainability policy. I just would like to know if and how do you align with this policy and if you have any formal goal that you need to meet within every year or in a given period of time.

Interviewee: Okay. I don't know a lot or anything about the sustainability policy. I didn't know we have one. I am not aware of any sort of targets or objectives based on sustainability which I need to adhere to or align to. I am afraid-- It's not really been well communicated to us.

Interviewer: Okay, are you aware that you have sustainability policy as ... business.

Interviewee: No, not really. I'd probably guess that we had one. I can't say I have ever seen it.

Interviewer: Okay, yeah I know. I can tell you you are not the only.

Interviewee: Okay, that's good.

Interviewer: Don't worry about that. In terms of sustainability in your work, do you think about sustainability when you make decisions, how do you deal with sustainability in a day to day basis in operations side?

Interviewee: We look at sort of business sustainability and how we operate and the methods and techniques of that, so yeah, we do have it considered, we look at certainly in procurement, I know it comes off a lot in our procurement procedures.

Interviewer: Okay, so you said that you have a thousand staff, like a big staff that work for you?

Interviewee: Yeah, we have 120 in Bristol.

Interviewer: Is there anything you ask them to do and also is there anything that you ask your supply chain or your subcontractor? So you mentioned procurement, do you develop that further or is it just a requirement for you during the tender process?

Interviewee: Yeah, a lot of it is during the tender process and we're looking at-- I mean particularly on catering side which is quite high risk, high priority for us, we look at sustainability through procurement and make sure that there's no gaps in what we are buying or for the supply.

Interviewer: Okay and do you have KPIs that you ask your supply chain to comply with related with sustainability?

Interviewee: We do, yeah, just lean on catering as example, yeah, there are KPIs. We insist that a lot of the procurement is sourced locally for internal sources. It needs to undergo certain purchasing criteria. So all the meat we purchase is here farm assured. A certain percentage of what we purchase by spend needs to be organic. So yeah, we do have KPIs and our contractors need to adhere to that and price accordingly.

Interviewer: Okay. What about your staff and also the people working in the buildings that you are managing, the actual people in the schools and the leisure

center, do you have anything to do with them like in terms of for example recycling or resource usage or anything like that?

Interviewee: We do, yeah. We are completely responsible for all waste management, waste produced by our staff and the building usage. We have lots of control in place on the waste management. We encourage recycling quite actively. We talk to our supply chain, our waste contractors about what new office were in auction, to kind of encourage recycling. We try and promote this within the building by sort of putting bulletins posters up, stuff like that to encourage recycling. On this contract, we don't actually have any...contractor, signed off in 2004. There are no waste management targets. That said, we do kind of publish our diverted from landfill percentage, so it's just to raise awareness of how well we're doing and how well we're performing with regards to waste management.

Interviewer: In general, within the contract you're working with, do you-- does the client have anything on the requirement in terms of sustainability? So, yes you mentioned that you do provide percentages of diverted from landfill, but do you have anything formal act from the clients perspective in terms of what you have to do?

Interviewee: No, we don't have any energy or waste targets which I think is quite unusual.

Interviewer: Yes, true.

Interviewee: But what commitment we do have to them is to-- is like complete clarity on our performance. So they need to know with regards to waste, energy, utilities is always a hot topic. So we're quite open about our utilities usage. What we think we do need to do actually is on our PFI process, because we are responsible for life cycle in certain elements of the building. We do have a requirement to make sure that when we are changing license over, they should generally be like for like, however if there is an option with lighting, I look at a lot of lighting as well, they are 10 years old. When we change this we should be considering energy consumption and making sure that we put in the best possible solution for the building.

Interviewer: When you make this kind of decision, obviously I was aware that you had to replace like for like, and it sounds quite silly on one end but if I know that.

Interviewee: Yeah

Interviewer: But when you for example you mentioned lighting, for example you suggested the replacement of the lighting from something a little bit more--

Interviewee: Totally different, we're putting LED lighting in place of old lamps. I would go to my client as I have done, I would say, "Say, we need to change these lamps because they are a bit older, they are at the end of their life. I can change in like for like or we can agree on a new standard, I might just replace the [00:07:48 inaudible] for some LED lighting and I needed to formally capture that in a variational contract. So that's how we do actually. There's a bit of discussion with the client. It's on the agenda when we meet with them quarterly to talk about that type of thing, energy, utilities consumption, and that's the platform where I'll be sitting with them to talk about any work planned and all changes in that type of area.

Interviewer: What do you think is the client-- I am just-- this is not part of the question I generally ask but I am just interested from my research. What is the client's point of view? When you present this kind of option, what does the client want to know?

Interviewee: They generally want to know the cost implication and if it's going to cost them any more money, and it just comes to that end. Generally [00:08:42 inaudible] that lifecycle is going to give to us a saving over an X amount of years and they are not really objective to it. They're quite happy for us to let us go on with it. We have a very forgiving client in Bristol, and quite fortunate at that. If I say something needs to get done, they do generally have an issue with it, they're quite happy-- they are confident in us and let us just go on with it really, which is good.

Interviewer: That's really, really good. In general, how much do you think sustainability is important for facilities management?

Interviewee: Yeah, absolutely. It's going to be important-- I just think-- unfortunately I do think for my company, they cannot raise awareness and pinpoint what elements of my work are linked to sustainability and what areas are not.

Interviewer: What do you think are the major challenges and critical factor about implementing sustainability in your company?

Interviewee: Probably raise awareness to operational staff because I am sort of part of the operational team, and when you talk about sustainability in all honesty I am not really sure what the company want. I think they need to raise awareness of it.

Interviewer: And in general as an FM, not related to your company, what do you think the challenges are, since FM can be like an industry they can have a really good impact on the sustainability side. Why do you think it's not really working right now?

Interviewee: I don't think-- it's a tricky one, but I don't think they are sharing enough information about it. I think that's the challenge. I think the challenge would be to raise awareness and get people talking about it at all levels, not just operational work throughout the ranks.

Interviewer: Okay, well, the other thing that I was told also is that there's obviously a gap between what people-- again it's about communication from high end level to actual operational staff, so it's just as in your company have a big group and it goes really cascaded down to you and then you are not able to move it on to whoever work for you.

Interviewee: Yeah of course yeah.

Interviewee: My experience in FM, I have been in FM now for probably 23 years. I worked for the ... doing FM worldwide for a number of years which was everywhere from Kenya, United States, Canada. Since then as a [00:00:28 inaudible], did that for quite some time looking after ... states, then went on to doing-- I went to university [00:00:37 inaudible] Cambridge. I spent a couple of years at the United States and since then I was then contacted by the current company I work for who asked me to pop up for a chat, I came up and they offered me a role up here. I have been here for last two and half years.

Interviewer: Okay, and right now, what kind of facilities are you managing? What kind of buildings and how big they are roughly? I don't need a specific number.

Interviewee: Currently I am managing a 846 acre site, with 72 buildings...

Interviewer: That's a lot.

Interviewee: ...ranging from climatic wind tunnels through to... which is probably 65,000 sq. ft. We are a technology park, so we're automotive research and development. We have all the sort of equipment that wind tunnels climatic chain does, but buildings average anything up to I think around about 100,000 sq. ft. and we've got [00:01:48 inaudible] for 2 million sq. ft.

Interviewer: Okay, that's a lot. And do you have anything-- so you were saying that obviously you do kind of research in automotive, do you have anything particular that you manage? Any kind of strange building I would say, just for curiosity.

Interviewee: Strange building?

Interviewer: Yeah in terms of, you can like wind testing or stuff like that, I don't know.

Interviewee: Yes, we have two climatic wind tunnels, basically they do winds up to 80 miles an hour and they do from -40 to +50 degrees. So we do snow testing in them, we do like say we do desert sort of testing.

Interviewer: [laughs] That is-- it is always-- because I am doing a lot of-- obviously I am doing interviews, interviewing people that are working from different companies and I found really funny, it's interesting each person I interview to find out different buildings that they are managing. So that is not just a communal phase, it's something a little bit more specific and in your case it sounds like the weather things got quite interesting.

Interviewee: I mean we have electro-magnetic complains testing facilities where we file electro-magnetic poses at, vehicles, everything from your standard car through to ... vehicles which-- so we have a high energy outdoor crash test facility, we also have an indoor crash test facility.

Interviewer: [laughs] all right, I think your job is fascinating and interesting.

Interviewee: Every day it's different.

Interviewer: Yeah it sounds like, it does sound like-- do you have a company sustainability policy that you need to align with as an FM function?

Interviewee: We have an environmental policy that's, I won't say-- we try and as vigorous as we stick to it as possible obviously there's cost factor which obviously restricts some of the things we would like to do but it's not always affordable. And unfortunately some of the technologies we use are quite energy hungry.

Interviewer: Oh well, I would say that if you need to recreate minus 20 and plus 40 degrees it's not really easy.

Interviewee: Well especially in the middle of a summer when it's like 30 degrees outside and you're trying to get a change down to minus 40 to do a snow test, it's-- we do require a bit of energy.

Interviewer: Yeah, I can say that. Within your environmental policy, I guess it's just kind of a guidelines that you need to follow when you can, right? You don't have any formal goals that you need to meet.

Interviewee: We have formal goals, yes. Obviously we've got energy reduction goals. We also-- any new facilities we put in, we insist that they have some sort of energy recovery. So when we have dynamometers in, dynamometers turn the wheels of a vehicle as it-- it's basically a rolling rod, so it turn wheels of a vehicle but there's a lot of heat energy comes off that, so we're looking, one of the systems we use is recovering the heat energy off that to then heat the rest of the building rather than waste it.

Interviewer: Okay, that's a really good...

Interviewee: There are policies around that. All of our new build, we build to BREAM very good. We looked at excellent and we couldn't really afford it.

Interviewer: Well, the excellent is a quite expensive I guess.

Interviewee: Well, to be honest the very good is quite hard to achieve with building sort of buildings we have which tend to be sort of large workshop areas.

Interviewer: Yeah, true. I can see that. In terms of operation, so you mentioned obviously new building, you do have goals for energy consumption but do you translate your policy into your day to day operation?

Interviewee: Yes, we do. A lot of our larger customers require us to give them a carbon return every year. So the likes of Jaguar Land rover, Aston Martin, all want a carbon return after some days. This is part of their policies that we can show that we are almost a green supplier that we've been as green as possible, I know we have-- so yes, driven by our customers, what they need off us or what they are asking for, of course we have to do a lot of green elements. We do tend to stick as close as we can to our policy. Obviously finance is other big one that restricts that occasionally.

Interviewer: And I guess with 70 buildings you do have a team of people working, managing these facilities.

Interviewee: Yes we have. Every building has an individual facility guys who usually are technician within the area. Part of his role is also to do the facility sides for the area as well.

Interviewer: And how do you pass to them and to the supply chain, the kind of sustainability requirements that you have?

Interviewee: We have a CAFM system and we also have a building management system that feeds the data into a central system that everybody can-- a lot of people have gouged this but a lot of don't want to get rid of this access obviously. So they can pull the data off the system of-- you know--it'll tell them when our wind tunnels are pit-loading, if we got three wind tunnels running were drawing five and half meg on those wind tunnels, so it show our [00:07:41 inaudible] give them a baseline for year on year, so we can pull up-- you know we can overlay off the years and say, "oh certainly we were picking around this time, why?"

Interviewer: Okay, and what about in terms of the actual users of the building? Do you engage with...?

Interviewee: The actual users?

Interviewer: ...yes, do you engage with the people that are working there as well or you don't have any kind of initiative?

Interviewee: No, no, we have-- we engage with every group. We have an environmental working group which basically all of the building sort of facility managers come along to and we then look at what their consumptions are, we work on projects to see how we can reduce energy. We've just converted a lot of our-- as one of the ideas brought up, we had a lot of oil-fired rigs that we've now changed to gas-fired rigs. This environmental working group gets together, I also chair the environmental working group, on top of that then we have the environment committee which I sit under the directors. So I take everything from the environmental working group, speak to everybody else, I then take that to the environmental committee with the directors and we would engage through what we need to fund and what can wait till next year.

Interviewer: Okay, so whenever you want to implement something new, it's about discussing with directors and decide whether to go ahead or wait for next year or another time.

Interviewee: Obviously I mean as everywhere everything is budget driven. So we sort of like as an environmental working group, we come up with our priority list, which then now goes to the directors for financial backing, which to be honest they are very good at. As long I've got a reasonable business case, then nobody will sign it off.

Interviewer: Okay, that's good, but I guess it's also driven by the fact that your... the clients are asking for more sustainability numbers and everything. So it's kind of--

Interviewee: However we have a-- we've got a large area where the wind farm would be ideal, however, we've got a CEO that hates wind turbines.

Interviewer: Okay, so it's not really-- they are not really easy to hide.

Interviewee: No, no. We have a lot of restrictions, obviously we produce a lot of noise, about 100 kilometers test track.

Interviewer: Okay, oh yeah, that's something else.

Interviewee: When you've got a few Aston Martins or Lamborghinis going round, they tend to make a lot of noise. So yeah, a lot of noise complaints which doesn't help.

Interviewer: Oh, yes, that's true. I haven't thought about that.

Interviewee: I think if we would propose to-- we've done a lot to mitigate it but if we were to propose that's 20 wind turbines as well, as the populous would resolve.

Interviewer: Obviously you mentioned the fact that one of the biggest challenge is the financial aspect of implementing your sustainable project or whatever we would like to call. Is there anything else that you think is a challenge in terms of implementing sustainability in FM?

Interviewee: Yes, I mean we have-- the company has been on this site since 1946. So, as well as a lot of new buildings stock, we have a lot of old building stock.

Interviewer: Yes, true.

Interviewee: Trying to bring a 1950s building up to current sort of build standard is very, very expensive.

Interviewer: And how do you work with that? How do you deal with the old buildings?

Interviewee: We do [00:11:40 inaudible] so if we refurbish any area, all the lightings change to LED, if necessary, I mean a couple of buildings we've over-insulated, so over-clad insulation on it. What the-- we've got a demolition plan for the old stock and replacement, however again it's investment driven. I have got a low building, it should have been demolished two and half years ago and it's still standing there. And again all budget driven.

Interviewer: So, the main issues are obviously the budget driven part of the business and...

Interviewee: Yeah, like I said the old building stock just cause us-- if you were just looking under the buildings, I mean the building I am stood outside of now, it's got sealed glass critical windows, you know, things like that, but to replace all the windows in the building, that's probably about 4 million pounds.

Interviewer: So that's why you've probably gone and go ahead and whenever it's going to happen it's a better option to demolish it instead of going in and do smaller things to make it more sustainable and more whatever we want to call it.

Interviewee: Yes.

Interviewer: Okay, more functional.

Interviewee: What we do do though as part of our environmental is we reuse a lot of the waste we produce on site as in construction. So if I demolish a building, we then crush that on site and then that gets used for the foundation to the new building.

Interviewer: Okay, that's a good initiative. In terms of the resources use, so obviously as you just said you reuse construction site resources, but what about for example waste or water usage or anything like that? Do you cover it or it's...

Interviewee: We do. Our water usage surprisingly isn't massive. We do have a 7 1/2 kilometer wet drips truck. Basically we spray with water to reach a certain coefficient friction. So that then when the vehicle is going round-- it is basically [00:13:52 inaudible] but 7 kilometers long. But what we've done there is we built a reservoir, so we basically dug a reservoir that holds all our water and we have a borehole pump that obviously is controlled by the water authority. We have a discharge consent to that. So we draw off a certain from the borehole to top up in the summer but everything else as it comes of the truck, it then goes into drains through a filter system and then back into the reservoir. So we're just recycling the whole same water.

Interviewer: Okay, that's a really good initiative obviously. So you said that obviously your clients are demanding in terms of sustainability and green as your behavior. Do you have a formal requirements in the contracts that you do with them?

Interviewee: Yes, we do. I mean part of the contract is that we do their sustainability return and to remain on the contractor's list, you have to enter the sustain-- and you've got to reach a certain score on the sustainability return.

Interviewer: What about your role as a contractor? Do you subcontract any of the services that you do?

Interviewee: No, everything-- all my maintenance team, states team are all in-house because we do a lot of military works, so it's all... everybody basically needs to be cleared to come on site.

Interviewer: Okay, it makes sense. So you don't have any-- you don't do any procurement from your side?

Interviewee: Yes, we do, yes we do... we procure from a lot of major construction. So, for a new build, we'll go out to contract for new build.

Interviewer: Okay, and do you have requirements in terms of sustainability for your subcontractors?

Interviewee: Yes, we do a full-- before we put out any major works, then we vet anyone that's on the tender list, so it's site visit, go through all their paper work or

their ISO probably [00:16:04 inaudible] side of it. We go through all that. We just appointed a new waste contractor for example that is, and part of the audit works have to go across to Belgium, so we have to look at the plant that's in Belgium that they are using to dispose off [00:16:21 inaudible] batteries.

Interviewer: Okay, oh yeah of course because obviously we have some specific things that you need to dispose I guess that are not really environmental friendly-- nothing that you just generally dispose as environmental friendly but still...

Interviewee: No, we dispose off a lot of obviously oil spin and automotive test sites, dispose a lot of oils, a lot of different specialists field [00:16:45 inaudible] but again they'll go to power stations basically.

Interviewer: And just final thing, do you think the reason why-- because by the way you sound, you really sound driven towards sustainability, obviously everything can be done in a better way, there's always room for improvement but you do some that's someone who could put effort and energies and resources into sustainability, do you think that is driven mainly by your client requirements or is it from an in-house willingness?

Interviewee: I doubt. It's-- as we work in research and development, it's almost driven by-- you know, we do research and developments, we do need an automotive, therefore everybody looks at automotive as killing the planet, so we need to look at-- example is, we've got 55 electric vehicle transport on the site that are free. So we're encouraging staff to buy electric vehicles. We have a bus route that comes on to site now that we've sort of paid towards. So we're looking at sustainable-- we've got electric bikes on site, people can get away on site on electric-- basically they can catch a train in London to the technologies who manage the technology park, get off the train at the train station, jump on to one of our shuttle vehicles, one of the buses that will drop them off on site, then they can jump on electric bike at the other end of site.

Interviewer: Okay, that's really interesting.

Interviewee: [00:18:23 inaudible]

Interviewer: Is company-wise, that's what I was asking you has driven this.

Interviewee: Yeah, We're trying to get the image of more certainly within a hell lot of our research is into hybrid vehicles, electric vehicles, we're doing some work, a lot of work at the moment on hydrogen powered vehicles. It's all that sort of things. We have to be seen to be as part of what of we do, we're trying to reflect the automotive industry as actually, "we're not all trying to kill the planet" We are trying to save a bit as well.

Interviewer: Yeah, no, no, it perfectly makes sense. All right, these are all the questions that I wanted to ask you. And thank you again for taking part in this, in my research. It is really, honestly, you are one of the most interesting one I've interviewed so far because obviously the kind of the facility you manage is so unique, that it just makes it-- it's a different point of view and you need to think of so many other problems that are not normally dealt with in office environment or any other-- not domestic environment.

Interviewee: Yeah, well, exactly, I mean, we have to worry about noise pollution as well as our standard pollutions and you know obviously we don't want to be upsetting the neighbors as such.

Interviewer: Yeah I know true.

Interviewee: But we work closely with council on things like that. Of course every bit of government funding we get for infrastructure upgrade, obviously that all go into our environmental ticket with it that we've got to achieve.

Interviewee: I was FM for the back in South Africa for SFI process. I had a title of under 50 thousand square meters but I left after. Then here I was the FM for the Royal college of general practitioners for six years. They are based [inaudible] from Euston station. It is great two [inaudible] building. It is about 8 ½ thousand square meters.

Interviewer: What about your job right now?

Interviewee: Currently I am with JCD Clark and the buildings is about 2 ½ thousand square meters, that is net space, not gross.

Interviewer: What kind of building is it? Is it just office spaces?

Interviewee: It is recently refurbished, the company is new building for 18 months. So we are just building [inaudible] and all sorts of things.

Interviewer: In terms of sustainability policy, does your company have a sustainability policy?

Interviewee: Yes, we do.

Interviewer: How do you align within the FM?

Interviewee: Obviously it says sustainability, the second it will occur is reduce energy consumption by having [inaudible] LED, as opposed to fluorescent lighting, so it is predominantly LED. The company has signed up to all the ISO accreditation, so what happens is although our research is for this particular building. The organization has new research throughout the country. Also it forms the part and parcel of the bigger picture as a company which is based in France. They have offices in France. So any manufacturers process and all supplies that we use are from the manufacturers side or the [inaudible] side they all are accredited to this as well. They are expected to comply with ISO14001. So they have to fill in forms to say that they are the, they are at [inaudible] to the printers of carton, [inaudible] and so and so forth. So all companies have signed up to do business with the JCD'Clarke. They have to understand that this is one of our priorities.

Interviewer: So you mentioned the sub contractor at the national or international level as you are an international business. In terms of your specific building, are there any tender that you do just for the building itself or it is all part of the bigger tender for the company?

Interviewee: It is part of the bigger picture but obviously, different sites have different requirements. They also tailor make to them to whatever their requirements are.

Interviewer: Do you have any involvement with the procurement?

Interviewee: No.

Interviewer: Okay, so it is done centrally or regionally.

Interviewee: Correct, so what happens is that, any new supplier that wishes to start up. They will given a set of documents, they need to complete. It says sustainability that is one of the document they need to complete. It is based on the level of their involvement in terms of sustainability that also determines the organization takes them on as a sub contractor or as a supplier.

Interviewer: When they come alongside to whatever job they need to do as contractor, do you have any, keep eye or any thing other, where sustainability you can check, or it is mainly during the tender process that you assess the sustainability of your sub contractors.

Interviewee: It is mainly during the stage when they signed up to be, they will have to do business with the organization, that is when the questionnaire is given to them. We ask for every time. They are actually involved in there. [inaudible] when tick the boxes, yes we did that, yes we did that. It is more case of prove it.

Interviewer: Do you have people working with you, or it is just you managing the building?

Interviewee: At this building I am just myself.

Interviewer: What about the involvement with the staff? Do you have anything within your sustainability goals or ideas that need involvement with the staff, for example?

Interviewee: Yes, there are notices at the all notice boards on the floors. It is on the building too. It is to let people know we are monitoring is being edited. It is size thing, that uses less uses space. Make sure, for example when it comes to energy consumption, which is all part of this. It is all part of the sustainability, make sure your computers are switched off. Make sure your monitors are switched off. The lights in the buildings all works on the IR, it is subject to movement, in terms of the lighting coming on. Even our windows, there is an interface, when it is sunny outside, then the lights in the office space actually dim. We got to that sort of levels.

Interviewer: You mentioned you have a sustainability policy and you do align with it, do you have any formal goal that you need to meet annually or six monthly anything like that?

Interviewee: Our reviews have been throughout been done during the course of the year and it is really depends on when these reviews are taken place. But they are on target.

Interviewer: Into your day to day operations of the building, how do you do sustainability, do you have a chance to implement sustainability features or projects?

Interviewee: Certainly, the company certainly open to suggestions, reviews and recommendations, for example, when it comes to sustainability the majority of the materials being used by the organization and I am persuaded your [inaudible] and so for, lot of, they are pushed into recycled materials instead of virgin. Sort of [inaudible] back on our labels. Have you been our website?

Interviewer: I haven't looked at the website yet. I do know the company because of say, I am Italian and I also spend a lot of time. You are well known.

Interviewee: If you go to our company's website, you will find some information on there as well, in terms of the effort the organization takes towards sustainability and the environment.

Interviewer: : I am definitely going to look at that because that is also part of the research I am doing, so it is comparing what is the company saying to actual work on the field from the FM side of the building. One of the thing I like to ask you is the, obviously you are part of a sustainable company, I would say and how much do you think sustainability is important for FM in managing buildings?

Interviewee: I think it is important, anybody can do it. It is not just the favorite of [inaudible] what happens is we as individuals are judged on what we do. So it is pointless saying, yes, the company has a policy but we don't worry about it, because they do. They do regulatory checks, they do the audit. They have independent auditors coming in. They get reports from the various waste things removal organization and so on. So you know everything is fine or not. We have to report in here , we have to report in there. Those sort of things are active at the point from a corporate level.

Interviewer: You mentioned obviously the company is open to suggestion for improvement, is there anything that you like to implement. Does it go through a suggestion, then it is taken on board by someone or can you put them to formerly to regional director or anything like that?

Interviewee: It depends, if there is some, that is in house, for example, the [inaudible] building that are taking care of which is based Westminster. Anything here, I can present it to the directors, if they have two words, then I may have to change some methods, irrespective of what is implemented elsewhere because again each site is a lesson. We are not talking about six or seven office blocks throughout the country, we have manufacturing if you take for example, Great west road which is out in Greenford. That is called the way house, they do repairs, they carry out repairs there. They are implementing changes from there in terms of advertisement, that you see the advertising boards. But also you may have noticed that, a lot of design today is digital, which again reduces the carbon foot prints in terms of paper printing, as transportation of posters from place to place and distribution and so on.

The company is now very much focusing on the digital side of things, which again will reduce waste streams, in terms of your actual green ratings.

Interviewer: Yes, I can definitely see that. Your company is driving this town to all levels, even for city's management that is not obviously their core business is driven by the corporate vision on sustainability terms. You do have a target related sustainability and they are audited by third parties and the companies.

Interviewee: That is right, what happens is we have internal audits, and then we have external audits.

Interviewer: In order to achieve the targets that you have, what do you do, do you create projects or do you set milestones that you going to achieve over time or something like that?

Interviewee: There will be targets and they will set by, probably generated by France, and rolled out on an international basis. But obviously again it is different courses for different horses, you cannot compare to what happens in Africa to what happens in Europe.

Interviewer: Absolutely, so mainly it is set out from central from France and then you need to comply to what they say or try your best to comply to what they say because obviously every building is different and every country and place is different.

Interviewee: Yes. Obviously how can I speak for this particular building. I didn't have a particular target that I need to work towards, I have to at least maintain, where we are currently and if I am able to improve on it, then that is great. But if a new manager comes up and say you have to do X, Y and Z to reduce by five percent whatever the case may be. It depends on each situation whether it is viable or not.

Interviewer: Just last question, in terms of sustainability in FM, what do you think are the challenges of implementing it? so what are the biggest of obstacles?

Interviewee: Education all the way through.

Interviewer: Education at what level?

Interviewee: All levels.

Interviewer: So from CEO, CFO down to everyone.

Interviewee: Right down to the [inaudible] operators, absolutely. Everybody needs to understand the crisis and everybody needs to learn the crisis and the thing is education perfect, it is a really a case of, I thinking overcoming a certain level of laziness. It is easy to dump these thing in a den. If a person is thinking about it and saying what do I really need to dump this or do you have to [inaudible], which are sustainable right now, which say...

Interviewee: Yes, I am... as operations manager, in civil engineering, part of that required me to train sorties managers on base, hundreds of them across the base. Make sure they essentially follow the guidelines and reporting problems to our customer service centre. My last role I had before, the last role I had three months ago was a civil engineer project manager for my organization and overall service manager. Sort of on the other side of the fence rather than being in the [inaudible]. In customer service, I was a customer my self so I was able to, [inaudible] of did my job the better. So for my service manager duties, had a team as well, so I was [inaudible] do things the way that we taught customer do that. Over 10 years, I was second manager career. So I worked at locations overseas and [inaudible]

Interviewer: By now what kind of facilities are you involved with, which type of facilities and square meters?

Interviewee: I actually just came on Visa stay here in UK, so last few months I have been basically taking my summer skills and camp. I enjoyed my time off. But I can essentially provide information going back to my previous role if that is helpful.

Interviewer: Yes, that is absolutely fine. What kind of facility you were involved with then?

Interviewee: Most of the facilities geared towards support roles and aircraft machines, that is probably that is the best word I put it. Military support that is probably the best way to put it down. There is not need to go into further details now.

Interviewer: No, I don't need any further details. It is more like...

Interviewee: I don't want to bog it down in details. 30 thousand square feet of multiple stories, high security studies, and that I think is adequate.

Interviewer: Okay, fine. Just to get an idea don't need details about that. So in terms of looking in into sustainability, did you have a policy that you need to align with during your job?

Interviewee: We have a installation policy which I was being drafted. The main point of it was energy conservation, water and That was the main points, conserving energy and water usage.

Interviewer: So the key points are energy and water usage basically.

Interviewee: Yes, I had access to smart meter system like view are, energy consumption and hardest part really was to calculate that, sortie to sort of wrong internally with new additions, IT related. Instead of reducing our power consumption they were generating larger because we had more items to size. So that was [inaudible] cause for me when I was helping around. Throwing out the printers, [inaudible] weekend etc. things like that. The little things, talking about. It is custom enforcement. So working just once if you get an email, it was a calls to reminder me and demonstrating what action to be taken to get my mind set. When I was posting things on posting boards and following up with emails and discussing further. That's way you only needs to be there, it is very difficult to tell beyond that.

Interviewer: Okay, so this is basically how you deal with these policy or these goals you had into the actual operations of the building.

Interviewee: Yes, it was essentially monitoring the energy usage and water usage and letting assuring the Tele's are turned off and water and much of it. That was the biggest part for me.

Interviewer: Do you work with the staff or just one person managing the whole thing?

Interviewee: I was the main of point of contact. I had a team of about ten and [inaudible] of sortie managers but essentially was a part time role for them, visiting hours. That was main point to contact us.

Interviewer: You mentioned board and anything, how do you get them involved as well as the supply chain, if you had any supply chain into your sustainability requirement and working towards energy safe and use of resources.

Interviewee: We had to just relay the information to my team of sortie managers, make sure they are aware of the policies and enforcing them. That was very [inaudible] of it.

Interviewer: Did you had sub contractors on site?

Interviewee: Yes, I was the point of contact for the contractors.

Interviewer: Did you had any formal requirements for your sub contractors in terms of sustainability?

Interviewee: Not at my level. There would be [inaudible] there would be [inaudible].

Interviewer: So you didn't have any formal targets that you needed to match, it was just an idea of working towards these two goals, you didn't had to meet certain reductions or percentages or anything like that.

Interviewee: There was a goal for reducing the waste landfill, there was a target, I am trying to pop it up. 35 percent diversion goals for waste in case of from landfills to recycling centre. That was the goal of top organization, the head quarters in this case.

Interviewer: How did you work towards, did you had anything to achieve this goal, did you had any process or specific projects in place, anything like that?

Interviewee: That was more a task of enforcement and a technical member there was, It was known as a America Recycle day. That used to give a [inaudible] based on with the cooperation of American staff and we incorporate American traditions in such. Just [inaudible] instructions to that. That being said, there was actually base of cyber information booths and events to promote the over there self recycling.

Interviewer: That was a nice way doing it.

Interviewee: Yes, we reached about, during my report we reached 40 percent. So once, twice had percentage go away. We are trying to improve upon on that.

Interviewer: What do you think are the critical factors of implementing sustainability in FM, so what are the problems, what are the challenges?

Interviewee: Little bit I touched on before when I trying to reduce energy consumption and while your organization is growing. I can't catch the..., I have to go back to that, as an example, the prime example is, my role that was tough because I would see the, the smart meter readings and was trying to push for accounts cancellation. I would see the equipment rolling into building and being connected our frame work orders to have more power outlets installed. [inaudible] power system is installed and facilities, backup power systems, generators and things of that nature, all of these that was there. So that was difficult, how can I [inaudible] that increase in IT and mission related equipments, saving larger energy consumptions, that would be the most critical. Did I answer your questions.

Interviewer: If we think about something else, for example, what about waste or resources use, is it always linked to the volume of business, or what you are inside, is there anything else that you can think of?

Interviewee: I don't think anything else. I had enquired about, for this example, this [inaudible] but water trying to utilize, rain water for use. All that facilities, that wasn't [cast?] usable, so we would [cast?] install, that is the main. Recycling water and filters everything except it wouldn't be costly. I had asked the very question and that was, so I received the steps, they had run some tests, some sampling and detailed investigation, that was the outcome, it wasn't cost usable. We are trying to think of a means to conserve water and actually we don't think of not feasible to reuse storm water. Hard move past that.

Interviewer: When you wanted to try something like this or someone suggested something like this, did you had to present the case to someone else, to prove that is feasible or analyze the cost and then present the cost to someone else, or is it a decision that you can make yourself?

Interviewee: No, if something like that happen, I would report to the energy conservation office, there was a department that handled that. So for my level that would not.

Interviewer: In terms of procurement, the tender was processed in your hand or someone was taking care of that as well?

Interviewee: That wasn't my level, wasn't effectful.

Interviewer: Right now, you have been the tenth person I have interviewed, and some of the things are coming up quite constantly. One of the points obviously has made clear right now, is that there is a different stake holders involved at different level all that time. That makes everything a little bit more complicated because obviously all of the time you need to refer to the head quarters or finance or another department. It is always complicated to get them, understand why or what will you like to do.

Interviewee: For me my role, the project that has came down were already deemed as required and funding wasn't an issue. That is in another thing, in the military round you are discussing finances, truly that thing already had been paid for use in advance, and the money had been set aside for the projects.

Interviewer: Your experience in FM?

Interviewee: I have been FM since past 12 years now. I started off in health and safety sector and quickly didn't like that. Then moved into the operational customer services side of the facilities management. I started off in a charity environment and then moved to finance and [inaudible] and then through various positions from there, from BDA, to aviation to and back to finance.

Interviewer: Right now what are you, within your role what do you do and what a kind of buildings do you work with?

Interviewee: I work in one building and it is in the city of London. 12 floors and roughly a thousand occupancy. It is in the finance sector and I am a contract manager. So I am responsible for all of the soft and hard services on site.

Interviewer: So basically it is mainly an office space here?

Interviewee: Yes.

Interviewer: So you take care of everything?

Interviewee: Well, I don't do but my team do.

Interviewer: How big is your team, how many people working for you?

Interviewee: At the moment it is 50.

Interviewer: Does your company (not your clients), do they have sustainability policy?

Interviewee: Yes they do.

Interviewer: How do you align with these policy?

Interviewee: On the accounts we tend to align our self more towards the client's sustainability policy. If the sustainability policy in certain sections are better in my company then we will go for that. I guess you can say, it is best of, it is best practice

for [inaudible]. If the client's is low on one thing, my company does it, if the client's is better then you do the client's.

Interviewer: Between these two policies you align with is there any formal goals that you need to meet or achieve in terms of sustainability?

Interviewee: It is based of my KPIs. I need to achieve 100 percent landfill diversion, which is nearly impossible but I am off there, I am at 99 percent.

Interviewer: Is this only formal requirement that you have right now?

Interviewee: Yes that is right.

Interviewer: How are you dealing with achieving this target that you have? You said it is 99 percent.

Interviewee: When I first took over the contract, I would say we were in the mid nineties. That was little bit thinking out of the box rather than sending my cardboard to a dirty [inaudible] to be separated. We already segregate this cardboards and send it straight to recycling. It is just kind stepping back and looking at the ways through themselves and saying, Okay, look we know that for hundred percent that is confidential and ever since [inaudible] paper. We can raise that to hundred percent rather than actually spending, ten times [inaudible] somebody verify. Looking at our sanitary waste, asking the supplier to go back and do change, that is my one percent of sanitary waste that is going to landfill. I am challenging my suppliers to implement the ways to linking the incinerator, return the energy, heat generation to energy.

Interviewer: You mentioned you have a staff working for you, do you also have sub contractors or do you do everything with your team?

Interviewee: Yes, we do have sub contractors.

Interviewer: How do you pass on your requirement to your staff and your supply chain?

Interviewee: There is two ways that we do that. I work for Marie, our procurement team, report the company's requirement to the supply chain. As well as our clients, they pass on those specific requirements to our supply chain. It is there already.

Interviewer: So mainly they are on procurements?

Interviewee: Yes, it is majority of [inaudible] procurement. We have a couple of clients, to be dealt whether they will get on with the job. But they are quite specific and one of the things is they do want 100 percent landfill diversion goal. We do push for that, obviously not [inaudible] much.

Interviewer: So it is hard for the procurement team to combine your company's requirements and the client's requirement?

Interviewee: Once we get the contract from the client they have to made in standard first, once they pass that, then it comes to contract, that is when I say, Okay look my environment policy needs you to do 100 percent landfill diversion. You has to control your... you has to do, no waste, all the [inaudible] trackable. They fill one criteria and then they got to [inaudible] have to fill another.

Interviewer: You do have KPIs for your supply chain to meet in terms of sustainability?

Interviewee: Internal may be, yes. Most of our sub contractors, which is local KPIs, basically which determines [inaudible] the KPIs headquarters will assign.

Interviewer: What about your staff?

Interviewee: Do I have KPIs for them, yes I do. First of the things my staff do, have KPIs from, for example, recording time frame, document time frame they have to send to. Yes they have KPIs. They all are aware of those KPIs. Implement [inaudible] when I have to get them done by so I pretty much let them manage the KPI section themselves.

Interviewer: What about passing on your company and your client requirement to your staff. Kind of communicate what you know has to be done in terms of sustainability to your staff?

Interviewee: Yes, they are well aware of that, they do know the KPIs of [inaudible]

Interviewer: So it is mainly based on KPI events?

Interviewee: Yes. For example, even the ways we doing, as an example I do allow my contract coordinators. Do allow the flexibility to look and think outside of the box. If we were challenging our waste supplier to do something else and kind of challenging and give you the same thing. I rather have give them an idea to find a solution than to just go and say I want you to do that.

Interviewer: Yes, it definitely makes sense. So far everything I have heard this is the most unusual thing.

Interviewee: Yes, I rather have two set of people looking into a major challenge than one. It is so much easier, it is really easy to go and say. You are my supplier, we have a challenge, take it, rather than saying, what we currently say, we have a challenge we are going to look at it and I might come up with an idea that you might not follow.

Interviewer: We talked about waste management, do you consider also other aspects, for example energy use or as a kind of resource use or anything like that.

Interviewee: We just now starting to look at that building, we will be using ourselves next year, buildings already green certified, we know that there is a lot of locations that needs [inaudible] we as a company, I am looking at way of saving them more money and trail down the energy use in the building. Set up some little small configurations, within the [inaudible] system, the electricity that is all. Unfortunately, my client doesn't have a big appetite for that, it is not on their way right now. If I walk in there and say, I can save you 150 thousand pounds next year, they will be interested because [inaudible] 150 thousand pounds, [inaudible] I will be focusing on 150 thousand pounds.

Interviewer: In terms of your supply chain you have your procurement department that takes care of that. If you have any idea or anything you would like to implement you need to present it to the client obviously?

Interviewee: Yes of course. There is some small things that I can just implement and let them know that this will mean cost savings. That would be the single changes rather than the change [inaudible]

Interviewer: What if you want to do something bigger, how do you generally?

Interviewee: Give them the informal notification and let them know we found some of the stuff, let them know that IP (Intellectual Property) that we lately started to looking at and found it through intellectual property and then starting going through the discussion stage or whatever. I am actually going through that right now, it be manager [inaudible] that [inaudible] client.

Interviewer: The client side the main instructions they have is more towards money I guess, so if you want to implement anything how much it is going to cost me and how much it is going to come back to me?

Interviewee: Yes, exactly. The low line switch they love to have achieves quick gains, but the longer term stuff is everybody is forgotten, presenting ,discussing that they know the time frames are.

Interviewer: Since you have quite a bit experience in FM in general. You have been working there for a quite a long time, but you do have experience in another fields as well, as a general thing, how much do you think sustainability is important in the FM industry. Just for you and your clients, do you think FM as a whole can have impact on sustainability?

Interviewee: Yes, I see FM as a first line of either making or breaking sustainability. Most facilities, I would even go down to the Assistant coordinator provisions, should be thinking about sustainability in their day to day . How can we reduce waste and how can we save time by reducing, waste. I nearly think that FM

industry are a big win the match mainly because we are the frontline of everything, of most about.

Interviewer: Ideally as an industry FM is an industry that can help a lot in terms of sustainability but what are the challenges, why this is working through specific sense but it is not as big as it should be since it is such big area, what are the challenges of implementing?

Interviewee: This is where I am going to bring my international experience under. I think in the United Kingdom the sustainability is not so much of a bigger subject. If for example, you go to Germany, Italy or France, a majority of your day to day discussions are going to be around sustainability or at least a portion of that would be reducing waste. In my experience [inaudible] residing in UK, I don't think that it is a big of a sector here in UK, as it is in the western Europe. It is growing, when I got here in 2003 there were no recycling boxes.

Interviewer: So we are kind of getting there.

Interviewee: I don't want to say anything from [inaudible] it is pretty move here. Rather than the incentives, people are starting to think about it. You got lot more recycling companies. It is not as big as it is in Germany where, I don't want to say the German efficiency machine has gone mad but it is a part of the day today life, you can't walk down a street without seeing a recycling bin box, bank, [inaudible] it is everywhere not in UK.

Interviewer: So industry wise saying is it is more about developing the growing towards sustainability and make it part of a daily work of an FM.

Interviewee: Yes, exactly.

Interviewer: You obviously work for the client, in terms of that environment what do you think the challenges are there?

Interviewee: When you say that, the compliance faults or...

Interviewer: No, everything else that is notobviously the compliance is law driven so you need to have that, otherwise you can't...

Interviewee: Really I guess from that point of view, the majority of the drive comes from the clients now. I am [inaudible] my client lot in the section here, because they do have .. it is an German company, but it is all UK based. So you do have a little bit of that procurement reporting, how much tonnage waste we have to go through but as far as challenging me, the client challenging me to reduce the numbers, that haven't happened. It is more of a, how can we reduce, the numbers were low last month, why are they higher this month, rather than saying the numbers were low last month , they are higher this month what can we do to go back to that.

Interviewer: The KPIs you mentioned briefly before related to the waste, the one hundred percent, is it coming from your clients or are they coming from your company?

Interviewee: It is from the clients. My current contract has been in place for the past six years, now I have been on this contract for just short of two years. In the KPIs have been changing all the time, but as far as the numbers just haven't changed, we just don't have an appetite for.

Interviewer: It is still good they have a kind of interest, I think by now, you are the eleventh person I have interviewed and you are the first one who actually helped me, there are KPIs in place for something related to sustainability. That is the new one.

Interviewee: Yes, like I said they gave KPIs in place but are there punishment if I don't make them, No.

Interviewer: So it is not one of the KPIs that is part of the money you get out of the contract KPIs.

Interviewee: No, it is not.

Interviewer: So why are they measuring that KPI?

Interviewee: I have no idea Julia. Of my 17 KPIs every month I report on, I know I am going to pass that one. So I like reporting on that.

Interviewer: That is good for your size. Well it seems to see that they do have something in place but it is not really used for anything. It is more of an exercise of saying, yes we do have KPIs, probably when your company won that contract back in the days, they did have some kind of sustainability requirement but that sort of translates to KPIs but it is just for the sake of, have been there.

Interviewee: They haven't changed in six years so.

Interviewer: If they whether turn of anything in terms of, I would say something related to energy or energy savings or anything like that.

Interviewee: We do have, this is the thing I told you, that solar panel here on my building and they feed back into the building into the main. It is not enough for them to make any difference. It probably won [inaudible] all the local [inaudible]. We have been trying to think of ways of saying the amount of electricity that you generate in the months, I can honestly say that you operate the reception and [inaudible] well electrical consumption. Even by trying to celebrate that the client has no interest.

Interviewer: So it is also part of one of the Greenback Barrier they were discussing, obviously as an industry wise it is the FM is not there yet, the interest is not there yet. But also the clients aren't really driving.

Interviewee: Exactly.

Interviewer: Probably I would say it changes from client to client. You are the first one with the KPIs but your clients aren't driving it. So it is just funny to find out.

Interviewee: I am also have been in the aviation industry, obviously the less waste that we produce is less efficiency for the airplanes, so they have really big push for the recycling, not taking anything on the plane you actually don't need and getting rid of your waste over the turn around station, get rid of it, it is less waste you have on the plane coming back. There was a really big push in the aviation industry for recycling properly and getting rid of your waste. It is all about efficiency.

Interviewee: Yes, it is part of my space team so I got space and time tabling manager, who has got a team who manages all of our space and all the time tabling. We don't need, we centralized it, from towards the end of last year.

Interviewer: I guess that is quite complicated.

Interviewee: Yes, it keeps me busy.

Interviewer: In terms of team, who many people are working with you, or for you, how big is your team is about?

Interviewee: I have got about 25 to 30 in house staff. But in terms of the contract we got hundreds of staff, obviously we got cleaners, security and reception. So it is about 30 in house staff.

Interviewer: Talking about sustainability does the university have a sustainability policy?

Interviewee: Yes it does have.

Interviewer: How do you align with these policy, do you have a translated version of the policy for the FM department or you try to align with the overall policy of the university?

Interviewee: We don't have anything at the moment that sort of translated into FM but generally all of our policies and procedures have an element of sustainability there. We try to align ourselves with the main university policy. We sit on the sustainability committee etc.

Interviewer: In terms of general sustainability in FM do you have any formal goal that you need to meet in every year, or anything specifically you need to comply with.

Interviewee: The only one I am aware is of carbon reduction targets. We are just in the process of reviewing the policy and the strategy of sustainability. I think we will have more individual targets. At the moment, the only one I am aware of is the carbon reduction commitment.

Interviewer: And it is more related to the hard part of the...

Interviewee: yes, it is all related to the energy use basically.

Interviewer: You mentioned briefly that obviously part of the everything you do has got a bit of sustainability into it, how do you translate sustainability into operation, both in house and for the supply chain.

Interviewee: In terms of procurement of contract we include an assessment of the sustainability of the companies we use, like do they have ISO 14001, do they have sustainability policy etc. So all of our contractors are now scored on the element of that. So it is not a huge amount, it might be 2 percent or 5 percent depending on the contract, they are scored on their sustainability.

Interviewer: This is at procurement level, once the contract is awarded when they become your sub contractors, do you have anything in place like KPIs or similar to a sustainable behavior, for example, you mentioned cleaning, do you have anything related to use of sustainable products or stuff like that.

Interviewee: We specify in our contracts to use certain types. But we don't actually monitor their own sustainability, probably something we ought to do. Other than on the cleaning contract which covers waste, we actively monitor recycling levels for example.

Interviewer: In terms of staff being in house staff that works for you, how do they deal with sustainability, is there anything they required to do related to sustainability or it is just a matter of , if that can be sustainable, let's just do it.

Interviewee: In an ideal world we would have things in job restrictions etc. but we don't, it is broadly best endeavors. They are required to comply with any procedures, we guide, which has got sustainability elements in them. But there is nothing actively, sort of manage them on achieving sustainability targets, when they should be.

Interviewer: Since you are at University do you have any initiatives to work with staff or students as well. You mentioned the recycling or I guess energy use as a part of the move are applied, do you try to work with the people there, half part of the university?

Interviewee: We do, we have a sort of volunteer group of students called the 'Green Beings' who are involved in our sustainability initiatives. They are brought in, we consult with them. When we are looking at any waste strategy, for example we consult with them. They run a series of initiatives, running estates and groups. They manage themselves green spaces, try to give to recycling and that sort of things.

Interviewer: So there is a little bit of involvement.

Interviewee: A little bit, it is not right at the heart of everything but there is involvement of the students.

Interviewer: I understand that sustainability is not generally one of the top priority for.. there is a series of reasons there, we will touch that in a second.

You said that you didn't have any measured target that you need to achieve, we are just talking about the fact that the FM is important, but how much do you think is important and how much is actually doable in an environment like the one you work for?

Interviewee: I think it is considered important, it has got a high profile but sadly there is no huge amount of action. There is focus now on the academic side of things. Our sustainability committee are working with one of the schools, try to embed across the curriculum. In terms of facilities management point of view, the challenge is yes, in any business case we make, we try to make it sustainable as possible. You can use modern technology for example but it doesn't always get approved because of the initial investment required.

Interviewer: So every single time, you want to implement or do something like this, how do you deal with it, do you make a business case and you present it to the university?

Interviewee: It depends, we got our own budgets for maintaining the estates, where replacing something is broken, replacing some lights, we will use sustainable solution. If we are looking to do any improvement, that is all done by business case. So for example, if we were refurbishing the building, we will have to build up a business case that will include a great deal of the costs. What usually happens is rather the money being... we design something which meets the need and it is the best solution and finding the money for that. Usually there is a posse of money available which we have to design our solution to meet, it is very rare for us to make the most high performing, the most sustainable building, the posse of money available isn't there.

Interviewer: When you say, you got a part of money that you, if something breaks down and you try to make a sustainable choice for replacing the item. How do you go with that, how do you do that assessment?

Interviewee: Usually what have in house team of, we got an in-house architect, in house surveyors, so there will be a project team as well. I am using their experience, they will put forward the proposal for the best solution to the problem, the best design. They will look at what is new in the market, what sort of materials what sort of technology and that will be proposed. But sometimes that gets agreed, other times it gets evaluation done.

Interviewer: You mentioned, that money is one of the big challenges in terms of implementing sustainable initiatives, can you think about anything else that you believe is a challenge of implementing sustainability in FM?

Interviewee: I think in terms of things like the recycling and anything in our residences, getting students on board is very difficult. Our recycling rate particularly in our residencies is terrible, students don't seem to buy into it. I would have imagined there would be younger generation buying into sustainability. That has always proves to be quite a challenge, getting students to buy into what you want to do.

Interviewer: That is interesting.

Interviewee: I always expected students to really push on the recycling and on the green side of things, but in here and in my last organization that has not been the case.

Interviewer: It is kind of odd, because you would expect students to be frontline of, I want to save the back wood, it seems justify that out.

Can you think of anything that you need to comply with related to the sustainability?

Interviewee: We comply with... when we got a new building, we obviously design that to be 'BREEAM' standards, we design buildings to meet that standards. We purchase furniture to meet certain environmental standards. We tend to pick and choose there is nothing set by the universities corporately which say you must comply with this.

Interviewer: So the university even though does have a sustainability policy doesn't really try to capture it down to you as one of the prominent managing at their stage.

Interviewee: Not at the moment

Interviewer: Your experience in FM?

Interviewee: Probably that is 12 years plus and got senior management role at the moment, having just moved here, actually being here a month now. So I have done hard and soft ,mixed projects, always through in house. I never worked for an out source provider or an FM provider. I never worked on FM contract.

Interviewer: Because you just moved to a new job are you happy to talk about the new job or you prefer to discuss the previous one?

Interviewee: I don't mind probably just depend on the nature of the questions because I haven't got a grip on lot of stuff here yet, so might be better to just to refer back to previous employer then.

Interviewer: In terms of the facilities that you managed in your last job, what kind of buildings they were and how big they were?

Interviewee: [inaudible] is a agent group, so predominantly there was about 65 properties, 2 of which were typical Head office locations, and office buildings. Rest of been High Street, the agent branches.

Interviewer: Did your company had a sustainability policy?

Interviewee: They did but they were quite early on in that process. They wanted to get a grip of it, but weren't fully in control of it. I don't think they really understood what direction they wanted to be going. They played with it a little bit but never really went for it.

Interviewer: Within these policy or these guidelines that you received, did you had any goal that you had to meet?

Interviewee: No.

Interviewer: So there were nothing that you had to achieve?

Interviewee: No.

Interviewer: In terms of managing such big estate like number of buildings, did you had people working with you or for you?

Interviewee: Yes, we had a helpdesk team and couple of maintenance guys, and administrators, people who got out and visited the branches, they are quite wide range.

Interviewer: While you were doing your job were sustainability something that you were considering or there was no...?

Interviewee: Yes, definitely, obviously it was easy to do the quick wins over the piece of things that you are passionate about. It is all like recycling and incentives, looking at electric cars, also we were London based so taking advantage of those. Looking at switching all our lights to LEDs.

Interviewer: These kind of initiatives where do they start from since you didn't have any policy or anything?

Interviewer: Internally, because obviously we were running quite an experienced FMG, so everybody had experience with elsewhere. So just looking at light turn off policies, switching computers off. Trying to drive down energy usage, looking at tail end management to help suppliers contribute towards that. The simple example would be, we used to let them order stationary every day and then we said no, we are going to consolidate that, you can only have a delivery once a week because it was just ridiculous, our stationary company delivering a box of pens, which is just crazy doesn't sync with what we are trying to achieve.

Interviewer: In terms of letting the staff or team inviting to these initiatives, was it something that you worked with them or was it more of let them understand what you were trying to achieve?

Interviewee: You get people to genuinely feel quite passionate about, next generation they want to recycling and they are quite used to doing in a domestic arrangement. They can see how they transfer over and obviously it is quite hot topic

in FM business to sustainability, in terms of how we operate the building, now they are sustainable.

Garbage heaps around they impact future generations, I think FM [inaudible] be quite passionate about anyway, where we need is some buy and we set them on instructory energy course, Coffee what it was called now. Coffee it was called, it is all like a one or two day course that we send them on, we subscribe that to themselves, proactive in their role.

Interviewer: So actually you had a proactive role to send your staff to course event, training to understand better.

Interviewee: Yes, the FM I can shape it to be where I wanted but you don't get the source support from the top management. It is very difficult to move on with an intent.

Interviewer: In terms of supply chain you briefly mentioned your program from the stationary and the delivery of the stationary, did you have any requirement for them, even during the procurement stage or anything?

Interviewee: Yes, when we ran the tender process, we were quite keen to be with CSR policy to, what their incentives were, some of them run to Green Van, donate, Rail on electric, we took into account but it wouldn't have driven the decision entirely. That would have been a cost decision, we wanted to know what they were doing.

Interviewer: Once the contract were awarded, there were some kind of KPIs or anything that were connected to sustainability?

Interviewee: No, there wouldn't have been. I think that was totally with that company. It is one of [inaudible] because they knew the questions sort what to do within, they didn't do any up. You are maintenance, that was there. We wouldn't follow it through. We would not say, you told us some staff to do the contract, this was you. You declared your values and how you are going to do it. We never really checked it.

Interviewer: This is the kind of the answer I got from most of the people. They worst one was we do have KPIs related to sustainability but we don't measure them.

You briefly said, sustainability in the FM as a whole is an important topic in the [inaudible] driven towards that. How much do you think the industry is ready or is getting there for sustainability?

Interviewee: I think it really depends on the company you work for, if you are in the environment were driving a lot of the company's core business and they see how sustainability, or their CSR are aligned to deliver in their core business. I think it is very active and engaged. You got a lot of FMs around, they are just playing with it. They all know they got to do something but it is not massive in there. I think FM is an industry quite well placed to being informed on it and deliver on it. I don't think most of us working people or the companies are not really that engaged in it.

Interviewer: In terms of challenges to implement sustainability so obviously, the drive from the company itself is something you think challenging right now? Is there anything else that you can think of?

Interviewee: I think it is easy to get these incentives, especially if you report it to finance which most FM people tend to, is to get the buy in for cost saving exercises. If you going to say, I am going to recycle these stuff, and our branches in business improvement district, one of the things we pay for free recycling, and get about my waste and out it there and reduce my waste or if you looking at, and time switches turning, heaters online, just in terms of electricity.

I don't think they make the connections between how about then impacts on your brand and your core business, your values, principles and how consumers of your products. My choice road were not, if you got all these things going on. So it is easy to get the cost reduction stuff in, but not so easy for the other stuff.

Interviewer: You said, you report to finance. So if you want to implement something within the company or within your work, what do you need to do, you need to present the case or the business case for that?

Interviewee: Yes. If you can demonstrate return on investment all the better. If you can't, then I think when you talking to people that count money and push pennies around, they become a little bit disinterested in it.

Interviewer: So there is something else there. These kind of challenge right now.

What about the people actually working in the building, do you engage with them?

Interviewee: Yes, some of them are definitely from the younger generation coming through as a consumers themselves, they got quite interested in those. I think some people just value more than others. You quite often get 50 percent, why don't we do this type of stuff because they are genuinely interested in it. Somebody of the older generation perhaps don't really quite care so much.

Interviewer: Is there anything that you can think of in terms of compliance, that you have to comply with related to sustainability?

Interviewee: Not massively although we were just starting to look at the EFF, Compliance code, it was called now. Base of compliance in terms of grading your properties and departments. The other thing we have to deal with Aircon, five years, check of it. But you have to do to make sure it is obviously performing to optimum levels to reduce your energy.

Interviewer: Your experience in FM?

Interviewee: I have been with FM around 13 years now, prior to this I have been an assistant and [inaudible] and for the past 5 years I have been doing the role of a facilities manager in the same company I started with 13 years ago.

Interviewer: In terms of the facilities you are managing what kind of buildings they are?

Interviewee: We got three buildings that I manage and they range from, the building that is predominantly used for storage and office space within them. Two processing buildings are a mix of warehouse, operational space and office space. The number of staff ranges from around 100 up to 950 at peak processing time.

Interviewer: So they are quite big, in terms of the company that you are working for, does your company have a sustainability policy or an environmental policy?

Interviewee: Yes we do.

Interviewer: In terms of your role as managing facilities, how do you align with these policy that you have?

Interviewee: A member of my team looks after the health and safety and environment of the two buildings that we manage. So we are responsible for implementing that policy and making sure as much we can, the people adhere to what is in the policy. So we do things like recycling, printing double sided, we buy SST paper from Post office. We are responsible for implementing that policy within our building.

Interviewer: Within these policy or in general do you have any specific target that you need to meet in terms of sustainability?

Interviewee: We do, I suppose, I don't know what the targets are, what KPIs are, but they are set by CSR department and generally we have target that adapt, one for electricity and one for water. We also have one for waste as well. We are given a

date, with that figure and then we have to work from those targets, to look at whether we are reducing or actually increasing our footprints on those utilities.

Interviewer: To achieve these target do you implement specific project or is it more of a long term view that..

Interviewee: Yes, we have done in the past and we have been doing a lot of environmental work since about 2008. So we do things like changing lights to LEDs or probably [inaudible] safe [inaudible] so that communal places, accounting. If nobody use [inaudible] cut off the lights, well beyond. We change the air conditioning system to make them more efficient. Obviously [inaudible] run on while doing the bigger project, it become more difficult to sustain, that has been the way of reducing the utility consumption, especially because we need to do big projects early on. So we are looking at things like, at the minute, the boilers and things have been changed to be more energy efficient and because of that we have been able to put in less boilers. Changing the lights outside in the car parks to LEDs and all sorts of things. So a lot of have been project driven, because at peak times connections runs 24/7 for so many years, we will have an increase in the electricity to keep processing, it just the nature of the business unfortunately.

Interviewer: In terms of your work towards sustainability, do you involve the staff that works with you and also the supply chain. How do you deal with them, if you sub contract anything.

Interviewee: In terms of staff we have an health and safety and environment committee. For locally on our site we meet at the couple of months and we encourage people to come to table with ideas for environment and things like that. In terms of supply chain, a lot of it is dictated by our procurement department and what they actually put into the contract. I don't believe we have any requirement for the companies that we deal with to be ISO 14001 accredited or ISO 18001 accredited.

But we do, when they engage with us and come on site to do any work they have to complete our contractor inductions. That is how our requirements are in terms with the environment, we make sure we get [inaudible] things from them. So we would treat a supplier in the same way we would treat our own staff on site in terms of

legislation and requirements from them, we will treat many differently inside while your suppliers are [inaudible] they need to adhere to that, that is not the case.

Interviewer: So you do have a procurement department and they takes care of the procurement as a general as a whole I might guess, they just give you the name of the suppliers is going to come on site. What happens when you want to implement one of the project that you mentioned, so who comes with the idea, how do you develop, how do you decide for example, how and when do you need to replace your boiler, and who do you need to present to, if needed?

Interviewee: We have approved suppliers, the biggest contract is J. K cleaning and maintenance. We have approved suppliers that is generally based on site with those on a daily basis. So if there is any work that we think would benefit from an environment point of view, for instance changing the toilets to a flush lift design or [inaudible] design or something like that, we would have our management contract to build a project that would have [inaudible] the cost for the work we do. Also what the energy savings would give us back and then if we saw that it was worth while, we would then do the business test and we would send that off to my chain, through my line manager to the hierarchies of finance to be signed off.

We always down to the signed off, if you have limitations in terms of the like certain amount as years pay back and it is above that, it won't even get looked up. Obviously financial or utilities savings are looked up as well. It is that the level of [inaudible] not something that the company look at either. So we build the project, we build the business case and we submit it for approval.

Interviewer: In general when you think about facilities management how much do you think sustainability is important and how much does it impact the way the industry work as a whole. In terms of sustainability in FM. How much do you think it impacts the industry and how much do you think it is important for FM.

Interviewee: If taken my point of view, I think it is quite important because the environment side of things is very much FM dependent for each block of building we look after. So the business says may be not fair because they different business set the environment and quality in that within different departments. It is not always an

FM thing. But still I can say it is very important and it is a big part of our day to day job role. It is the environment and we deal with a lot of paper, the trail and the supply chain with papers is a big thing as well as packaging. We deal a lot with plastic packaging and yes for all these it is a big thing and have a big impact on our roles.

Interviewer: What do you think are the challenges of implementing sustainability project or measurement or improvement in your company or in general?

Interviewee: I think it has been able to prove that if you are going to get the savings that you say are going to get and in our business, because we are very reactive and our work fluctuates up and down through the year. We could say that we make savings but if the trend changes down the line then savings may actually become negligible because the business changes and the business needs. So what we made sell our business case on, two years prior, down the line about three years it might not exist any more because business change and actually we remain open 24/7 a year, so would knock those savings out. I think that is the biggest challenge for our office, it is just be able to sell the benefit, to sell the savings to the people that hate the change the most.

Interviewee: FM? Kind of goes back 28 years working within MNE in a retail environment and then MNE projects, and then I left out to working FM for an IT company, that was about 17 years ago, that was kind of worse. I started off with a couple of small offices to manage, manage a region but stretchy from Birmingham up to the north of Scotland and republican northern island.

Interviewer: so you ended up basically in a firm kind of?

Interviewee: Yeah, I was a construction engineer by qualification, like everyone else kind of fell into it.

Interviewer: That's great, and you stick with it, so that's good.

Interviewee: Yeah, it's interesting.

Interviewer: so talking about your role by now, could you please tell me what kind of building you're managing and what you do with them? Are you covering the old services, are you more into construction engineering, more [1:41] services, what do you do?

Interviewee: It's total FM, MNE, cleaning, security, catering, vending, pest control, landscapes, project work, [2:00], security systems, access control, printing?

Interviewer: What about the facilities, are they mainly offices?

Interviewee: The majority are offices with a couple of small warehouses and some data centers.

Interviewer: And your role within these facilities is to manage the total FM, all the contracts and everything? Clearly you're the person in charge.

Interviewee: Yes, pretty much.

Interviewer: Now, moving to sustainability, because that's focus of my research right now, does your company have a sustainability policy or environmental policy or anything similar?

Interviewee: Yes we do, we've got an environmental policy, a sustainability policy, we won responsible business over the year 2015.

Interviewer: That's great; I'm definitely going to get something interesting out of you because you're right now one of the leaders [3:26]. So you do have policies in place. An internal FM, how do you align with these policies, do you have formal goals that you need to meet?

Interviewee: We have objectives and targets, environmental safety, I'm trying to go through our sustainability policies and see if I can find anything from there, if you can bear with me for a few minutes. We just revamped our internet; it might take me a moment or two. There is global sustainability, so we've got sustainability strategies, targets, policies, processes, methodologies, product technology, usage expertise and experience vary to some extent across the regions according to local differences in legislation and customer requirements.

Interviewer: Ok, that's good, and in terms of your role of managing the facility and everything, how do you align with this? So you do have policy but what do you do to make this policy into action?

Interviewee: One of the biggest thing myself and my colleagues who are involved in is a accreditation [05:32] for about 8 years now, we've gone through re-registration and we've gone through audits on a regular basis and we have objectives and targets around reduction of carbon and waste volumes, all those kind of things and we are part of the carbon reduction commitment energy efficiency scheme and we've got in our data centers when you look at the industry guidelines around green garden, our usage effectiveness.

Interviewer: So you are actually really good. So you mentioned you do have targets, you mentioned carbon reduction and waste. How do you achieve these goals? So do you do projects, how do you work to achieve this?

Interviewee: Sometimes it's projects, we won the green apple award last year for installing inverters in one of our buildings that brought about energy use reduction on hundreds of air conditioning plants, [07:24], so that would have been a project and

then you've got the day to day housekeeping type activities, switching off, monitoring new spy; staff monitoring new spy contractors monitoring the electricity looking for trends and anomalies and making sure that we can iron them out. So there are ongoing day to day things as well as projects, if we were to install new plants in a system then we would need to use energy efficient replacement equipment or LEDs, inverters on handling plants, pumps etc. [8:23] probably look at paybacks, was it worth doing in an environmental way, we are also part and parcel of the ease of scheme and we've carried out ease of audits.

Interviewer: You're like the 20th person I've interviewed and you're the first one that actually mentioned the use of- that's good. Obviously, in the day to day you mentioned that you monitor the amount of energy used by the staff, do you have other involvement with the staff, do you do initiatives or anything to make them aware or try to reduce the wastage or the usage of energy or anything like that?

Interviewee: That is not relatively mature because how we came about to the beginning of our journey with 14001 was probably 8 years ago, so it's quite immature. We're still monitoring things, we're still looking at waste reduction programs which is a little bit of a challenge because so many things happen and you may pick up a new client or you might get a peak in workload of an existing client that produces more waste than you would normally produce.

Interviewer: SO even trying to achieve goals is more complicated when you have this problem with the client or issue with the client asking or maybe [10:22] waste. Ok, that's interesting. And what about your supply chain, do they get involved in your sustainability policy, do you have any requirements for them to be your service provider or sub-contractors or whatever they are for you, do you have KPIs in place for them?

Interviewee: I'm not 100% on that, I know that one of the drivers for us going down the 14001 accreditation was some of our clients were asking for that, and some potential clients ask for that as part of their prequalification. So it's expected that you would be credited 14001.

Interviewer: Also you mentioned that obviously you have a day to day part of the job, that you also have new projects, [11:39], when you want to implement something new, you mentioned obviously the payback period hierarchy elements I guess, for example if you decide to replace light or any piece of equipment you might have, how do you make the decision of what to choose and is there a chain of command that you need to go through, for example if some FM people need to go back to finance to have their approval?

Interviewee: I'm sorry it's going to be signed off by- we put [12:14] a business case working with our engineering team and we put together a proposal this is what we do because this is going to bring about savings or reduction of carbon or whether it's a viable project. At the end of the day cash is king to quite a degree in the current environment, so it's got to be financially viable or have a very high visibility.

Interviewer: And also you said that obviously part of the job for you to engage with sustainability on clients because for example some of them are webbing on to you to have a 14001, do you think that's the main reason why you are doing sustainability initiative?

Interviewee: If I was being cynical I would say yes, but I also think that the company recognizes that there is a wider agenda that we need to fit with around sustainability and it becomes the right thing to do, if that makes sense.

Interviewer: Ok, absolutely. I understand what you're saying, that obviously clients are driving it but also the company starts to realize that there is a need for sustainability. And do you think that everything FMs do, can they have an impact in the overall sustainability?

Interviewee: Yeah definitely.

Interviewer: And how much do you think is the importance of sustainability in the FM industry?

Interviewee: I don't think it's very key to what we do given the current environment; the current awareness around the green agenda.

Interviewer: Ok, so there is a green agenda, but why not so popular? I would say what are the challenges of implementing sustainability in FM? We kind of all know that we need to do something towards that but as far as I can see from what I've done so far the actual movement towards that is not so- there is not really a movement towards sustainability except from some exceptions like your company. But why do you think it's a challenge to implement sustainability in FM?

Interviewee: One, you've got to make sure everyone understands the benefits and whether that's people seeing the management, seeing the variations in the business, dealers challenges is demonstrating and trying to talk to people or working on the call center who are targeted and managed tightly on dealing with the X number of calls per hour, their business is responding to client needs and picking up the phone calls and answering them and making sure they process the calls and they don't have anyone waiting for longer than 8 minutes, whereas we, our focus is on delivering the service to the customer and the green agenda may not be as important to them, and that's where it becomes difficult trying to get through to people like yes you need to segregate your waste, yes you need to switch off when not being used when the pressure is on them to deal with meeting their KPIs for their clients.

Interviewer: Ok, so you said some of the clients required you to have [17:15] related to sustainability, do they have any other requirements for you to comply with related to sustainability that you can think of or is it just that?

Interviewee: I'm sure there are other things peculiar to other clients, you've got OHSAS 18001 for health and safety, you might expect that, you've got ISO 22301 for business continuity which we've implemented in the last 2 years and clients would kind of expect that you've got some kind of business continuity plans in place and may well stipulate that that's contractual part of the arrangement, and in the 22301 we've got some way to satisfy that, similarly 27001 around security.

Interviewer: Certainly you need to comply with a lot of stuff to make your client happy.

Interviewee: The [18:44] to become accredited to trials; 27001 for security, 22301 business continuity, 18000, 14000, 9000, I'm sure there is a raft of those around the IT world as well.

Interviewer: Obviously, the kind of review you do is mainly related to the accreditation of renewing [19:17] for 2001, right?

Interviewee: Yes, as well as compliance with CSA, [19:32]

[19:35]

Interviewer: Ok, so basically the initiatives that you do and everything that you implement is working towards the accreditation or renewing that accreditation, that could be users or the 14001 or any of the other- you get their point basically, you don't go beyond that point.

Interviewee: We would live to do what not only satisfies the audits but we try and reach best practice as well. We go through continual improvement teams to keep things moving forward.

Interviewer: And in terms of best practice do you benchmark against someone else's or it's just an internal best practice?

Interviewee: It's just internal.

Interviewer: That's definitely interesting. Ok. Let me just go through my list. I think I've more less covered everything that I wanted to ask you. Is there anything you would like to add related to sustainability?

Interviewee: No I don't think so. I read you're doing your PhD?

Interviewer: Yes

Interviewee: This is the research for the form passing pass for your PhD?

Interviewer: The research itself is about obviously sustainability in FM and how the information modeling can be used to achieve sustainability in FM.

Interviewee: I've heard of BIM, I've been to a few different seminars in the past, it's not something we've really embraced.

Interviewer: When you say we, do you mean your company or the FM?

Interviewee: The Company, I know some companies are so heavily into BIM and the technology and having stuff on handouts for engineers so they can bring their building plans and O&M manuals and things like that but we don't have anything quite like that. I would suggest the majority of our sites don't even have a building management system.

Interviewer: Yes, it's one of the biggest struggle that I've come across in my research obviously is kind of talking about futuristic stuff that most of the people managing buildings are not even related with, it's not part of their job because it's not there yet. But obviously this is why you start doing research in an area is to try to find a solution to stuff, and so far what I've kind of identified is that BIM can be useful for example when you say you make a business case for implementing a new project, for that part of analysis BIM can definitely be useful. For the overall sustainability in FM not for everything, for example getting your staff involved or for more day to day activates, maybe not as much as more for a long term plan.

Interviewee: To some extent if you were given a blank piece of paper and you would design your portfolio or estate, then the list of everything that was all interconnected and would have a consistent standard of systems across buildings that would all link together and it could all be brought together through a network and it could be managed centrally, but when you've got portfolio [24:28], diverse properties and different ages, different plants and different equipment it becomes difficult to have something.

Interviewer: Absolutely, and also one of the biggest problem the existing estate of course because obviously if the mode; goes through design and construction then it's easier to have a model available for a firm but if you have like you said a building that's already there or portfolio building that's already there then there is a problem absolutely, I'm absolutely aware of it.

Interviewee: In an ideal world with lots of money you can throw at it then you'll make everything fit together but in the real world when you've got buildings with different [25:25], different ages, different sizes, different functions it becomes more difficult.

Interviewer: And as you said, money obviously is the driver kind of everything even though we shouldn't be saying that, it is.

Interviewee: Yeah, we really shouldn't be saying it.

Interviewee: Well I started off as a security officer on the client side, spent quite a few years doing just that. Then after few years I decided I could be more to FM than security, decided to get a degree in facility management, got that and soon after got a job, entered another job as a facility assistant in one of the London universities. After two and half years in that place, I got another job back home at another university, which was on a supervisory level.

Interviewer: And in terms of what you do here, obviously I do know what kind of facilities you work with, what's your role here? What do you do?

Interviewee: According to my job description, I'm responsible for soft services; so that's obviously security, cleaning, waste management, pest control, that's part of it and a few more. The reality is, more often than not, I deal with harder firms as well. That's not mechanical or electrical things but refurbishment or minor works as well.

Interviewer: Ok, fine. Does the company you work for have a sustainability policy?

Interviewee: Yes we do have sustainability policy.

Interviewer: Ok, and in terms of your role in the FM kind of thing, how do you align with this sustainability policy?

Interviewee: We obviously have a dedicated sustainability team. I wouldn't say sustainability is the top of the agenda for my department, but we work closely with the sustainability departments who guide us and advise us on what to do and how to do things in a sustainable way.

Interviewer: Ok, is the sustainability department just for you or for the whole organization?

Interviewee: No, it's for the whole of the organization, so it's not dedicated to our department. There is no dedicated sustainability person within our department.

Interviewer: Ok, fine. And do you have goals in terms of sustainability that you need to meet or it's just guidance from them?

Interviewee: We do have goals but the goals, again, are for the whole of the organization, not just for FM as far as I know. So we've got that big document strategy for the next 5-7 years; the carbon footprint reduction and things like that. I don't think or at least I'm not aware of any FM-specific goals from their team.

Interviewer: So basically when you're working, there is nothing you need to comply with yearly with sustainability?

Interviewee: Well are ISO 14001-certified as the FM estates department, so obviously we need to comply with a number of regulations related to that, so we do actually take that into account. I don't know if I should expand on that or maybe there are other questions later on?

Interviewer: No, that's fine, if you want to talk about that, I know that most of the union companies I've interviewed are ISO 14001. What do you do to comply with that because I don't really know how it works?

Interviewee: Well basically we get audited once a year and we also self-audit. I'm one of the internal auditors. I got qualified last year and I do internal audits, not of this campus because obviously that would be a conflict of interest but I do Medway or Abraham. So I basically do whatever a real auditor would do. So I would just go around and check – I've got a checklist, a spreadsheet of what I need to look for, I don't know if you would like to know, for example simple things like solids in bins, if it's correct, if people know how to dispose of recycling. Other things, kitchen outlets, if they supply their stock from sustainable sources, local suppliers, storage of hazardous materials that's not hazard safety but that could have effects just in case of a spillage, so you're not going to have environmental problem. So we check for things like bunding in storage areas, in the event of spillage we can contain the hazardous liquid. So we check all that and we get all the checklists solved and we get recertified every year.

Interviewer: The reason why you're ISO 14001, is this part of the university strategy you were talking about?

Interviewee: I don't think it's a legal requirement to be certified. As far as I know we are certified as the FM department, not as the estates, not as the university as a whole.

Interviewer: So it's just the FM department that is certified as?

Interviewee: Yeah

Interviewer: Ok, that's good. So obviously you covered soft services, so you are engaged with sub-contractors?

Interviewee: Yes, that's correct.

Interviewer: How do you deal with them in terms of sustainability? Do you have anything in place or it's not something you look at?

Interviewee: It's not something I would look at, but again, as far as I know there are sustainability matters raised with the contractors before the contract is signed, so that would be with our procurement team probably, and again on advice from sustainability departments to align those matters in the contract. So for example, many supplies would be very local rather than, you know, we would use contractors to be based in London rather than in Liverpool to not to generate so much carbon footprint from driving up and down the country.

Interviewer: So it's mainly at the procurement level.

Interviewee: I would think so, yes. At my level right now, I would not necessarily point at the contractors and say well this isn't sustainable enough for us.

Interviewer: So in terms of your job, we're talking about the supply chain, but in your day-to-day job, do you think about sustainability? Is there a matter of sustainability in your job? Obviously you take care of waste management, so I would say that causes sustainability thoughts, but in your overall life...?

Interviewee: Yeah absolutely, well again a simple example would be procuring goods for office supplies for example. I would not order from one single supplier three times

in one day. I would wait and place one larger order in order to avoid more than one delivery for example. We do take care of other things.

Interviewer: Is this from your personal point of view? Do you think it's good for the environment or for any other reason, that's why you do it or it's from the university?

Interviewee: No, it's my personal view. I don't get asked by anybody to do that, but I think most people would do that anyway without being asked. It's simple things like switching off the lights in the office or turning off your PC. Most people will do that. It isn't like a policy that we have to. Maybe there is one but it's not being communicated to us.

Interviewer: That's a really interesting topic

Interviewee: Because I'm sure most people would say exactly that – communication is the main issue

Interviewer: Absolutely. Obviously your main focus is soft services but you also take care of projects and minor projects. What about that? Do you have a part of sustainability in that or is that not something you consider in your projects?

Interviewee: I would consider that as well. Waste management, so obviously you would ask the contractor to install the waste securely and issue the waste transfer notes for hazardous wastes. So yeah, we would definitely not let them spoil our sustainability efforts.

Interviewer: Ok. Since this is such a big organization, you have a lot of people coming and going. What about your engagement with students and staff? Do you have projects, I kind of know part of the answer to this, but do you have projects that involve students and staff? Do you do anything with them?

Interviewee: Actually that's a good question because next month in September, we are due to organize Sustainability/Recycling Day that will be in one of our buildings, but that will be run by our waste contractor. They offered to run such a thing free of charge, basically have a stall outside or in the foyer to educate staff and students on waste management and ways to separate and recycle waste. There are initiatives. In

this case, this is quite surprising to me that coming from the contractors. Normally they're not very keen or they're probably more money-oriented.

Interviewer: Fine. No, that's good. So this is an initiative you have. Do you have anything besides what you're having next month, have you done anything in the past involving student and staff?

Interviewee: Not from within our department, but I know again sustainability team have their sustainability champions. So each department – I think it's voluntary – so if you care about sustainability, you can just volunteer, put your name down and be active. There are people in certain offices that are actually involved in minor sustainability projects.

Interviewer: Ok, that's interesting. In terms of an overall, so if you think about the FM industry, how much do you think sustainability is important and how much can FM impact sustainability?

Interviewee: My personal view is income generation – generating income is the top of the agenda, so it's most important for most organizations than sustainability. It's becoming more sexy. It's good for our company image definitely, but reality is I think a lot of the times it looks good on the paper for the executives to show off. At the ground level or frontline level it doesn't always look as good as it seems.

Interviewer: You said obviously money is the top priority.

Interviewee: Especially in the private sector, probably the public sector is a bit different. Yeah, certainly for the private sector, income generating is the top.

Interviewer: So you think that sustainability is more about a matter of being sure that you're good. It's not about believing in sustainability and being part of saving the planet. It's more about whenever it's going to come to us and see that we're sustainable?

Interviewee: Yes, that's probably what I would say. I think less people actually feel that way than they act. They want you to think that they're doing something for sustainability, but they don't really care about that.

Interviewer: You've kind of answered this already, but what do you think are the challenges of implementing sustainability? Why, if not?

Interviewee: Again it's cost. A lot of times it generated additional cost or less income, which is really not very attractive to most organizations.

Interviewer: Yeah absolutely. Well you don't deal with contracts so that's for the procurement.

Interviewee: What's the question?

Interviewer: If you have any requirements in the contract with the university, I don't know if you do have, but with your supply chain?

Interviewee: I don't know if contractors or suppliers will include any sustainability matters in their side, requests or asked to do something, I don't know.

Interviewer: That's fine. You said also you do small projects around the campus. I don't know what you said about sustainability in there? Is that a matter or it's just again about the money?

Interviewee: Projects.

Interviewer: If you do it in the small projects you were talking about?

Interviewee: Again, I don't really with projects.

Interviewer: Okay, but you mentioned when we walked here that this is from...

Interviewee: Oh yeah, furniture, obviously. If a project involves disposing of old equipment or furniture, we always try to reuse it.

Interviewer: That's still something very good

Interviewee: Yeah. I can talk you through it. Basically first we try to use it on the campus or install it on the other campuses. If no one wants it, we'll probably offer that to staff for free, then if no one wants it, we'll just give it to charity.

Interviewee: Okay, alright well I'm a consultant, work with clients and almost exclusively, helping their buildings to be more effective, better run, less waste, and their FM operations to run smoother.

Interviewer: Okay, great. And how do you ended up being a consultant? What, how many years have you worked in the field?

Interviewee: Well, I started working in FM in 2000; I started in construction, worked for a construction company, in heavy construction to start with

Interviewer: Uhummm

Interviewee: and then moved into sort of building maintenance and the hard FM side of things. And then from there moved into FM and added a bit of landscaping, bit of cleaning and eventually I went to, I did a masters from [Redding] and then I've been doing FM ever since. So before, before I became a consultant, I ran the FM operations for [GVA] on the landlord side.

Interviewer: Okay, and so you're covering both, when in your consultancy role, you're covering both the hard services and the soft services?

Interviewee: Ahh, yes

Interviewer: Alright, point. And okay so obviously as a consultant I believe you have different clients. Because the interview focus on, obviously I'm looking, I am interviewing both in house and outsource procedural managerial consultant.

Interviewee: Yes

Interviewer: And if it's possible for you, if you'd like just to focus on one of your clients would be [g..], would be good

Interviewee: Yeah, that's, certainly

Interviewer: Obviously your experiences is with different so you can always pick up stuff from the others but if you can just as we go through if you can think of one and just stick with that would be great

Interviewee: Yeah, okay

Interviewer: Umm, so the first thing is, umm, from your company point of view, so not your client, do you have a sustainability policy?

Interviewee: Sorry? You said a sustainability policy?

Interviewer: Yes or environmental policy or anything like that?

Interviewee: Yes we do, we are ISO 50000 accredited.

Interviewer: Okay, and within this sustainability policy, do you have goals that you need to meet at company level?

Interviewee: Yes we do.

Interviewer: Okay, and what kind of goals they are?

Interviewee: Its things like minimizing our own [carbon] missions through [travels] or anything we do, waste reduction,

Interviewer: Okay

Interviewee: and using public transport instead of [driving]

Interviewer: Okay, right. And if we change perspective and we go from your clients' side, so how does it work in terms of sustainability when you obviously I guess one of your main focus is linked with the environment? [by the way]

Interviewee: Yeah it's I mean, sustainability from a client point of view is most often lead from a financial benefit point of view.

Interviewer: Okay

Interviewee: So, 03:42 _____ thing one of our clients, they do it because it's the right thing to do but at the same time it also allows them to spend less and save more.

Interviewer: Okay and when you talk about this kind of initiative where obviously you spend less and saving more, what do you have in mind? So I guess is again carbon reduction, energy?

Interviewee: it's mostly; well carbon reduction is sort of secondary,

Interviewer: Okay

Interviewee: and I think mostly the focus is on energy and waste reduction

Interviewer: Okay, so

Interviewee: and then the fringe benefit of that is carbon reduction almost automatically.

Interviewer: Yeah of course, absolutely. And so when you talk with your clients, how do you implement this kind of initiative?

Interviewee: 04:31 – 04:32 _____

Interviewer: So in terms of reducing waste or reducing energy as we said.

Interviewee: Okay, well that's three (3), that's three (3) different levels; the first one is in terms of 4:45 _____ policy.

Interviewer: Okay

Interviewee: so, alright, same client, I'm still 04:50 _____ the same client they started with an idea that they needed to do something in sustainability but they doesn't have any plans,

Interviewer: Uhummm

Interviewee: so we set that for them and then the sort of practical implementation of it; so looking at the how to in terms of energy and waste reduction and there is various ways you can do that you can do that and then also the soft skills associated, so getting, getting, buying internally in particular

Interviewer: Okay

Interviewee: when it comes to sustainability.

Interviewer: And how does it work in terms of these three (3) levels? So I guess what do you do to achieve the three (3) levels in terms of initiatives?

Interviewee: Okay so if start with strategy I might, we might write a goal level strategy on sustainability

Interviewer: Okay

Interviewee: which could be, it's quite a lot of work but it could be a one page document to just says we'll be sustainable.

Interviewer: Uhummm

Interviewee: And then in terms of the tactics it's implementing that so we might be looking at things like [plant] replacement, [pv arrays], everything you can imagine

Interviewer: Okay

Interviewee: and then the soft skills is mostly about behavioural items, getting people to understand what reading their computer screen actually means,

Interviewer: Okay

Interviewee: what 06:34_____ actually means, what leaving the windows open and the air conditioning is running actually means, so educational and the easiest way to achieve that is to link the environmental targets to their day jobs essentially.

Interviewer: Okay, 06:51_____ and in terms of all your clients are you also working on having tangible objectives or goals that you need to meet or it's just a way of achieving that strategy that you set up in the first place?

Interviewee: [No, no] it's always tangible, it's always and it's mostly its driven by legislative process, things like 07:19_____,[CRC] and so forth

Interviewer: Uhummm

Interviewee: it's also driven by financial pressures;

Interviewer: Okay

Interviewee: things like energy costs needs to be done.

Interviewer: Okay

Interviewee: but the one line instruction that we start with is more often than not is we want to reduce energy by five percent (5%) or we want to reduce our carbon emissions by forty percent (40%) on the 2015 total, something like that.

Interviewer: Okay; and so from this stage you move on then obviously to what you call the tactics and but for example replacing 07:57_____

Interviewee: Yeah

Interviewer: or things or implementing things in the building itself. And how do you make that decision in terms of what is best or do you do some study

Interviewee: Okay

Interviewer: or you do some market research or something like that?

Interviewee: It's mostly study; market research isn't really applicable to this because every organization is slightly different.

Interviewer: Uhummm

Interviewee: It's about building a business case for each scenario, so if you're looking at CHP, that's a twenty million (20,000,000) investment,

Interviewer: Okay

Interviewee: you might be looking at a longer term offset benefit and cost benefit as well so you have to consider, well the client I'm thinking of the reputational benefits of something like that. It's intangible but its far more valuable than the pure pounds and pennies .

Interviewer: Okay [absolutely]. And do you also deal with client supply chain and sub-contractors or is something that you don't really look at?

Interviewee: Yes we do.

Interviewer: And what is your relationship on that end so how does it work?

Interviewee: For the most, for the most part we're looking at it from a sort of a trusted advisor to the client.

Interviewer: Okay

Interviewee: So we're there representing the client and their needs and we're also because we can sit on both sides of the fence; we can understand what their concerns are. So for example, we've been involved with implementing some [EPC] contracts

Interviewer: Uhummm

Interviewee: where our appointment has been from the client but actually in terms of delivery it it's working very closely with the supply chain.

Interviewer: Okay, absolutely. And in terms of your client requirements for the supply chain, do you see there is a, some kind of drivers towards sustainability? Do you see like there are like APIs in place where they [could just set up] sustainability or any kind of requirement to that end?

Interviewee: Yes there is, yes I would say yes but it's not always formalized. There is also in many cases, there's an operation, operational and reputational benefit to the supplier chain

Interviewer: Okay

Interviewee: in emitting the sustainability targets.

Interviewer: And moving away from the client perspective, as a business, as a generalized facilities management, how much do you think sustainability is driving facilities management? And how much is important [as a topic?]

Interviewee: It's very important however I would say that the key driver is the cost behind it not the sustainability itself

Interviewer: Okay

Interviewee: and I would say that the benefits to be had after saving, after achieved reductions far outstrips the sustainable 11:25 _____, the sustainable angle however you're almost accidentally hitting all your sustainability targets as a result.

Interviewer: Okay. And so you think when we talked about challenges of implementing sustainability in FM obviously money is one, because that's what,

Interviewee: Yeah

Interviewer: is there anything else that you think is a challenge in terms of sustainability?

Interviewee: I wouldn't have thought so, see I think it's, no I don't think so. I think it's pretty, it's pretty ..., I don't know how to phrase it. No let me try it phrasing, I think that people won't do it because it's the right thing to do

Interviewer: Okay

Interviewee: however they need to justify to themselves that there's a benefit in doing it more than just it being the right thing to do.

Interviewer: Okay so is the two (2) together; is none mainly the financial aspect of it, is, there is a path of we have to

Interviewee: Yes

Interviewer: do it because it's good.

Interviewee: Yes there is but there's a lot of [Semitism] about climate change, I mean people accept it but I think there's still reluctance to accept the harsh reality of it. So people are sort of being dragged, kicking, screaming into it and the real value comes when they can see the added benefits of doing something like that.

Interviewer: And how much do you think the legislative side of everything is driving
13:16 – 13:17 _____ FM?

Interviewee: It's limited, I mean I happen to know a bit about this, there's well over three hundred (300) bits of environmental legislation so that in itself is a bit of an issue at times.

Interviewer: This is, one of the things that I've tried to do is actually to come up with a list of norms of regulations and processes management needs to comply with in terms of sustainability

Interviewee: Uhummm

Interviewer: and basically every single person I've tried to talk with they all say "Oh, I absolutely no idea; they're a part of something else or I just have some contractors or people for doing me these things, I don't really, I don't really know

Interviewee: Yeah I think that is the problem, its, the legislation is obviously important for a reason, I'm not a legislative expert but in my experience dealing with people you're far better to gain [by-in/buying] through a common sense, this is what it really means approach.

Interviewer: The first question is, “Could you please tell me your experience in FM?”

Interviewee: I’ve been working in FM for five (5) years.

Interviewer: Okay and how did you end up in FM?

Interviewee: Like most FM’s by pure accident; right place, right time or wrong place, wrong time

Interviewer: That’s good, depends

Interviewee: I suppose how you look at it

Interviewer: Okay and right now what kind of buildings are you managing? So what type of buildings and how weak they are?

Interviewee: My buildings are mostly commercial, across a mix of different industries so one government body, a charity, investment company, consultancy and a software house as well. The smallest is about ten thousand square feet (10,000 sq ft) and the biggest is about thirty three thousand square feet (33,000 sq ft), something like that

Interviewer: Okay and within these building what is your role? So do you take care of everything or you just do specifics, specifics?

Interviewee: No, it’s very specific it’s primarily health and safety

Interviewer: Okay

Interviewee: Dealing with 01:18_____ compliance [from] 01:22_____ managing the supply chain contractors so all the providers for 01:28 [M & E], in some cases cleaning

Interviewer: Uhummm

Interviewee: a few of the lesser top services like Ziptaps, fires extinguishers, oh fire alarms as well

Interviewer: Okay

Interviewee: so any of the life systems

Interviewer: Okay

Interviewee: that kind of thing

Interviewer: Okay so you're talking about your company, do they have a sustainability policy? [Hey/they]

Interviewee: Yes

Interviewer: Okay and how much do you know about the sustainability policy from your company?

So how do you align to that?

Do you have goals that you need to meet?

Do you just work with some kind of general idea and you work towards that?

Is there any guidance, specific guidance or anything?

Interviewee: I'm sure there is

Interviewer: Okay

Interviewee: I just see various receptacles around the office and just put my waste in the appropriate place

Interviewer: Okay, fine, and in terms of cascading down to your job, so as part of the company are you required to do something while you're working or not really?

Interviewee: No, not really I don't think

Interviewer: Okay and change your perspective in talking about your client point of view.

What are they asking you in terms of sustainability, if they do ask you anything in terms of sustainability?

Interviewee: Their questions are more focused on services that can be provided to fulfill their needs as far as sustainability and it's probably more based towards how

they deal with things like confidential waste, normal issues like that and how they can reduce their carbon footprint like gas, [two beautiful thing] is like how much power they use, electricity that kind of thing.

Interviewer: And do you have, again, do you have goals that you need to meet or is some kind of requirements, general requirements of being more sustainable or working towards more sustainable?

Interviewee: Certainly my goals general seem to be more financially driven.

Interviewer: And that's the kind of answer I always get, [just enough], okay. Do you work managing the building or you're managing, do you work by yourself or you got a team of people that you work with?

Interviewee: I, primarily by myself although for the building there is an in house or client based FM team

Interviewer: Uhummm

Interviewee: So they deal with day to day issues from my side we have a service desk that deals with any reactive calls, any planed maintenance.

Interviewer: Okay and do, how, if you think about the way you work and your work and your requirements or any kind of being more sustainable coming from the client. How, do you translate that to the people you work with? Or

Interviewee: Clients doesn't seem to push it too much but I on a personal level would much rather work with as little paper work as possible

Interviewer: Okay

Interviewee: That's purely from a health point of view because I don't want to be dragging half a library around with me

Interviewer: Okay, fair enough, that's a good point. And so you mentioned before that you're also working with a supply chain of contractors?

Interviewee: Yes

Interviewer: And do you have any requirements? Or do you do for example a [tender] level, anything related to sustainability for this [wide] chain and for sections of sub-contractors?

Interviewee: No

Interviewer: There is nothing in their tenders,

Interviewee: No

Interviewer: or nothing [matters]?

Interviewee: No

Interviewer: Okay, okay so if I don't [cancel] the questions just keep on. Okay thinking about FM as a general industry, how much do you think sustainability is important?

Interviewee: I think its, its, sustainability will be driven by cost.

Interviewer: Okay

Interviewee: I think so if it's financially viable then my view is it's a road that all FMs would happily go down but you know it's got to be measurable and economic as well to do

Interviewer: Okay and in terms of financially viable, when you want to do something different, when you want to implement something or create a new project or I don't know think about whatever you'd do,

Interviewee: Yeah

Interviewer: is that the main way, so you need to make a business case to your client, whoever's going to pay for

Interviewee: Yes

Interviewer: and the final go ahead and do it

Interviewee: Yeah so for instance if I was looking to change all of the lights across the building from standard lighting to LEDs which are you know obviously much

more efficient to run and they are cheaper to run as well that would be part of my big business case because the initial outlay would be more expensive, would be much higher. But if you look today over the course of x number of years from a replacement of lamps, the cost

Interviewer: Uhummm

Interviewee: of actually using all of that lighting would really be big fact and would be something I would push towards the client.

Interviewer: And how does it work in terms of implementing this kind of initiative do you need to make the case, give it to the client, give it to a financial department, give it to, who do you give it to? Who do you make your case to?

Interviewee: To my, my main points of concern to the client

Interviewer: Okay

Interviewee: because they ultimately have the final say or sign off from our perspective, they obviously would then need to take it to their internal teams.

Interviewer: Okay and when you think about creating, implementing a solution like this for example, replacing all the lights with LED. How do you identify the possible solutions? Okay, so fair enough, normal lights to LED is kind of an easy selection.

Interviewee: Yeah

Interviewer: If it's something a little bit more complicated, if maybe you had different options where you can choose from, how do you select the one you think is more?

Interviewee: It would be based on I guess life cycle of whatever I'm

Interviewer: Uhummm

Interviewee: looking to change, cost again as you say, impact on the environment, practicality of it as well is got to be a fairly big solution. Yeah that would [like] sort of the general pointers for that.

Interviewer: And is there some kind of research that you do or you rely on engineers and people?

Interviewee: Mostly we rely on engineers and colleagues as well and from their experiences, yeah

Interviewer: Okay

Interviewee: but you'll have a limited experience but the more you ask the better picture you can get.

Interviewer: Absolutely, that makes sense and what are you think are the challenges? We kind of touched it a little bit of implementing sustainably in our field.

Interviewee: Human nature is the biggest challenge,

Interviewer: Okay, that's fine

Interviewee: its changing habits; lifelong habits of people so one of the things I really liked to push on one of my sites is to remove under desk bins.

Interviewer: Okay

Interviewee: That would be several reasons for that, one it would be more cost effective from cleaners point of view but also we would need to provide suitable central points for all the staff to put their waste into but it would also then be an educational point of view of trying to educate staff into putting their waste into the correct bins which I think is probably the biggest challenge for anything like that.

Interviewer: And have you tried to talk with the users about these initiatives?

Interviewee: I have and at the moment there is a lot of push back, certainly for my main point of view and I would guess that's something that we like to maybe do but not right now. Part of that I think has been because there's so many changes going on within this particular organization

Interviewer: Okay

Interviewee: that one more change right now, the timing is not good right now.

Interviewer: Okay and in terms of these initiatives for example in 10:20 _____, the user buildings

Interviewee: Yes

Interviewer: what is your relationship to that end in terms again of sustainability, do you do initiative like this quite often or it's every now and then there is something that involves education and talking with the users?

Interviewee: It's every now and then kind of scenario, I'm not on site frequently enough to push things too often.

Interviewer: Okay so in terms of challenges, the, the biggest challenge there you think is there is actually human beings?

Interviewee: Yes

Interviewer: Fair enough, that's kind of a tiny thing just to know and move on and do you think there is any other challenge [there/though] that doesn't allow you to, don't allow the industry to develop a more sustainable side or to carry on and then

Interviewee: I think its education as well for, the education and people's understanding is improving but also an awful lot more work that needs to be done for people to actually understand and probably for me I think the best of people, to get people to [buying/by-in] on Sunday is to the actual impact on them as a [part] that rather the industry as a whole.

Interviewer: Okay and thinking about your client, obviously you've got different clients, how much, so we were talking about one client

Interviewee: Uhummm

Interviewer: right now, how much your group of clients are driven towards sustainability? Do you have any client that's really keen on trying to push it or the average is if it doesn't, if it's not economically viable I'm not going to go for it

Interviewee: I think it's the latter, I think if it's not economically viable then we'd put it on the back burner and look at it again in the future.

Interviewee: So, I think, I've worked in FM for about eight (8) years, basic office management sort of stuff, I've always been the back up for the Office Manager for the, my whole time here so for the past ten (10) years until I was then given the position myself; so I looked after a small office first of all of about seventy five (75) staff and we were on one floor in a multi-tenanted building that greet about a hundred and twenty five (125) people and then took on a second building which was about three hundred and fifty (350) staff across eight (8) floors; so I looked after those two building together working underneath the Facilities Director, then we did the London move project so I managed the facility side of the fit out, obviously Gareth being project leader he didn't get 00:50 – 00:52 _____

Interviewer: 00:52 – 00:53 _____

Interviewee: which was quite challenging and that we had quite a short times scale to complete everything in but I learnt late you know that was really, really interesting and then, then we closed down the other two (2) buildings and opened up two (2) new ones, the main one being here at [Gretchen] Street so we've got about five hundred (500) people here and [Buckley/Barclay] Square is about twenty five (25), thirty (30) people and again tenants in a multi-tenanted building so looking after a landlord and tenants relationships. Making sure PPMs are being done, reactive maintenance, we also look after the front of house contracts so,

Interviewer: Uhumm

Interviewee: reception and catering services, we manage the stationery contract, branded items as well but we don't look after the branding, you can see that's the marketing team and we get pulled into all sorts of areas, bits and pieces. So printing, gosh it varies quite widely and then of course sustainability which has become a growing part of FM.

Interviewer: Okay

Interviewee: particularly we started off we did ISO fourteen thousand and one (14,001) and that has grown and grown and grown; we've also did fifty thousand (50000) on one but then we decided to drop that earlier this year because clients weren't asking for it

Interviewer: Uhummm

Interviewee: so although we did all the work to get it and we're still doing that kind of work. It wasn't worth going through the accreditation because it wasn't giving us any further benefit; so that's my FM in essential I guess.

Interviewer: What is your main area of managing the London buildings or is also the other 02:37 _____ offices?

Interviewee: So historically I was just looking after London

Interviewer: Uhummm

Interviewee: and then when my predecessor retired in February, I took on responsibilities of all the occupied estate nationally.

Interviewer: Okay

Interviewee: So now I am responsible for eleven (11) offices, there is a Office Manager, we got Regional Administrators, they're all reporting to me

Interviewer: Okay

Interviewee: and I then have to report in to Adrian who is a Director for the estate.

Interviewer: And you have managing people on the site,

Interviewee: Yeah

Interviewer: on the different sites. Do you also have another, a team working for you or with you; is the team just a managing people on site?

Interviewee: Yes, its each region has their own facilities team, some of them are larger than others, so see London, Birmingham are the largest facilities, they have the bigger teams, Manchester as well, the other offices a lot of their duties are split between facilities and front of house or facilities and 3:34 _____. I don't have so much to do with the teams, the people that work below the Regional Administrators

Interviewer: Okay

Interviewee: because they are managed by the Regional Administrator but I do step in if there is a large issue and they need the extra assistance with that; so that's been happening in the Birmingham office recently.

Interviewer: Steeping in and fixing, okay, that's good. Okay so talking about your company

Interviewee: Yeah

Interviewer: do they have or do you have a sustainability policy?

Interviewee: Yes we do.

Interviewer: Okay and how in terms of FM do you align with this sustainability policy?

Interviewee: Just in most things that we do we try and be green; so when, for example in our stationery ordering or any other of the sort of physical items that we procure we try and get items that are sustainable, so they come from a sustainable sources, they have some sort of recycled content unless they're completely recyclable which is great, and if there is a cost differential between non recyclable and (sorry) a non sustainable product and a product that's more green so long as it's not over price cap of ten percent (10%) price difference, we'd always go for the green product.

Interviewer: Okay

Interviewee: In day to day, it's a lot to do with the ISO standards as well so just generally trying to run the building as efficiently as possible so reducing our energy consumption, so lighting, 5:04____, gosh, reusing stuff instead of [building/bidding] and buying new where, again where possible

Interviewer: Uhummm

Interviewee: so generally just always having, being green in the back of your mind as you carry out your day to day job.

Interviewer: Okay and in terms of your sustainability policy, do you have formal goals that you need to meet or it's just a guidance in the back of your head just keep on telling you to be green?

Interviewee: So separate to the sustainability policy

Interviewer: Uhummm

Interviewee: we have tax target action plans and we also have group objectives. We use to have; each office would have its own regional objective alongside as well

Interviewer: Okay

Interviewee: as set alongside the group objectives but we're finding it more and more difficult to set those because we've been doing it for so long, we've already attained so much and we're getting smaller and smaller windows

Interviewer: Okay

Interviewee: of what we can change. So if we say, look our target for next year is have a four percent (4%) energy reduction, we can't keep having four percent (4%) year on year because it gets less and less and less and our staff are growing so we're having to change the kind of targets that we set to be less. Setting figures and more measurable in other ways,

Interviewer: Okay

Interviewee: so, sort of staff welfare or changing, gosh (you put me on the spot now),

Interviewer: [Don't worry]

Interviewee: 06:33 _____ not necessarily things about reducing and increasing but about stuff that we use or I can dig one out for you later on so you can see the kind of targets that we set,

Interviewer: 06:45 – 06:45 _____

Interviewee: they're less about percentages and more about the general stuff.

Interviewer: Okay [well/no] absolutely and so you mentioned staff well being, how do you pass the sustainability [obviously of] requirements or the sustainability ideas that your company as to the staff?

Interviewee: So in induction everyone's given a section of training on sustainability

Interviewer: Uhummm

Interviewee: so we talk through, we talk very briefly about what the ISO standard is and what that means in relation to staff so there's a lot of stuff that goes on in the background that staff don't know about at all, the waste legislation and the more complicated things like that that people don't really realize. So the message that we really push out to staff is about them thinking green so not wasting resources, being conscious of again lighting and not so much air conditioning as we don't have much control over that. We set the times for the [plant] to run but and the main one that they impact is waste and recycling and

Interviewer: Uhummm

Interviewee: so it's really about educating them about what bins to use and some people might feel like it's teaching them to suck eggs but its amazing how many people don't know what bin is the right one. And we don't separate that much, we just have DMR, general waste, food, glass and then batteries and toners, things like that. We all separate those and handle them separately so generally day to day they have limit, they have four (4) different bins that they can choose to put things in and we've done a lot of work on posters and designs and guidance by each bin

Interviewer: Uhummm

Interviewee: so that when you come to a recycling station you've got an informed choice of what bin to use so we never have a standalone bins now, all the bins are always grouped together so you can't just, you can still but they don't so much, just throw it in the nearest bin to you then because you've gone through the effort of away from the desk, gone to the nearest recycling station and they have the choice of bins in front of them with all the information on each one saying, with pictures so you don't have to read anything and you can see which one is the correct bin for you.

Interviewer: And in terms of the initiative there you say, I don't obviously you say you involve the staff into this waste management issue, is it actually effective? Is it, does it work? Is it working?

Interviewee: We just did a waste audit yesterday actually

Interviewer: [Really?]

Interviewee: to check how well the signage has impacted things so we're waiting to have the report back to see how much contamination is in the non recyclables and the recyclables

Interviewer: Uhumm

Interviewee: so fingers crossed it's reflecting what we think it is. So we suspect that the messaging has helped; I'll also say there's still some way to go but that's partly to do with our clear desk policies as well because we don't have under desk bins and we ask people to clear away all their waste at the end of the day. If you've gone to lunch you get a plastic, a paper bag from prep; everyone just uses that as their bin for the day, fills it up with stuff and then dumps that in the bin rather than separating out, so while messy while we're working is different practices that people are having that, we then need to tackle which is a separate issue.

Interviewer: Aright, and going the other end, what about supply chain, so when you procure things

Interviewee: Uhumm

Interviewer: how do you pass your sustainability requirements to the supply chain?

Interviewee: So we recently come across two (2) [using] ASQs and we ask the supply chain to provide their environmental accreditation so if they have fourteen thousand one (14,001) or green dragon or any of the other sustainability standards, we prefer to use suppliers that have those. We always do a cradle to grave of all our waste as well so, (sorry, that's the opposite side of the supply chain)

Interviewer: 10:44 – 10:45 _____

Interviewee: but as 10:48 _____ for our stationery we try and ordering things that have sustainable, have green content and a price capping between green and none green items. During the fit out we went for [scar gold] for this office, and we went for bronze or silver for the other office, I think it was bronze in the end and so in a lot of the materials that we used have green credentials so it was like paint that has low emissions and the counter tops are made of a product called richlite which is really, really compressed, recycled paper

Interviewer: Uhummm

Interviewee: We had ecoglass for the reception desk and there's loads of things that, we had to really consider it particularly for the fitting out. Now since in here is fairly new, we haven't had to buy too much recently other than stationary

Interviewer: Uhummm

Interviewee: which we've already talked about but as we are, as we will get/buy things in the future we're always thinking about the green credentials.

Interviewer: And in terms of actually checking the contractual side, do you have a set of PPIs that you use to measure how they behave or anything like that?

Interviewee: It depends who they are so if it's like fit out contractors

Interviewer: Uhummm

Interviewee: then I don't get involved in that side of it; I believe that was part of the project

Interviewer: Yeah

Interviewee: but if it's archiving contractor for example they don't really have much impact on waste in the environment other than if we come to a destruction exercise so once a year we destroy anything that's older than fifteen (15) years

Interviewer: Okay

Interviewee: and again that goes through a secure destruction process and that paper then is sent to be recycled so those kinds of things. If we have a significant 12:40_____ list we check that and obviously any external waste contractors that we use we check all of their credentials. We go cradle to grave of where, what happens to it since it leaves our property, before we give them the contract we deliver a 12:53 [care of duty].

Interviewer: Okay, so and, I was thinking, [I forgot, it just slipped mu mind], anyway I'm just going to move on, I was thinking about something but I just forgot it. Oh yeah, so if you, let's talk about kind of project, obviously this place is brand new right?

Interviewee: Uhummm

Interviewer: If you want to go and implement something new so for example the example is you want to change the lights

Interviewee: Yeah

Interviewer: and first of all, how do you, what is the chain of command? If you've [obviously] implemented something there's a hard level so changing

Interviewee: Uhummm

Interviewer: actually pieces of the office

Interviewee: So you need to put a business case together for it first to say why you need it

Interviewer: Uhummm

Interviewee: and then you have to then justify your business case and take it to the exec, so we've put a change to our process in place here where someone will say to us you know for example you say, "We need to change all the lights." We'd do the, put it together, speak to the stakeholders, so whoever the interested parties are so it might be each business unit head, it might just be the exec; it depends on that particular project. Then you look at the reasons for it if there's a payback time for

Interviewer: Uhummm

Interviewee: them, if we went to more efficient lighting it would pay for itself within seven (7) years or however long so then we weigh that up against how long our lease is and all those sorts of things. We look at costs and obviously for any of those things any environmental gain so I know for the fit out we did extra things that we've haven't done in sites like [CO2 sensors] and the OC sensors as well which are pretty interesting.

Interviewer: And when you do this kind of, when you put together the business case

Interviewee: Uhummm

Interviewer: do you do the research or do you do rely on engineers or so on who can actually help you out to identify solutions that might be having a shorter pay off or

Interviewee: Yeah

Interviewer: a environmental

Interviewee: Again it depend on what it was

Interviewer: Of course

Interviewee: if it's anything like related to the physical property since we're property consultancy if we can pick the brains of others in the business.

Interviewer: Okay fair enough

Interviewee: So the lighting one as an example that was looked at for our Birmingham office and our building team did some research into that and made recommendations so to see if it's something I'm not an expert in then of course I'd get third party opinion on that.

Interviewer: Okay and within your different aspect that you mentioned how much is sustainability actually a key driver and how much is pay back and money cost of implementing anything?

Interviewee: Yeah, there's not so much monetary cost I don't think, it takes a lot of time, there's a lot of paper work and a lot of process behind it and some people find that a bit burdensome but overall because it's required for our clients and it's best practice and we just you know it's the kind of thing that we like to do, we like to tell people that we're a green and responsible company

Interviewer: Uhummm

Interviewee: and we demonstrate that to clients, we, they put it in their, in their tender process

Interviewer: Uhummm

Interviewee: that do you fulfil all these criteria, it brings the company financial benefit from f that because it helps us with work.

Interviewer: Okay

Interviewee: And but also is an environmental benefit it's just being a responsible company.

Interviewer: Okay and as an overall, how much do you think sustainability is important as, for FM as a business, not as a business as a company but as an industry
16:37 – 16:38 _____

Interviewee: Yeah I think it is important to have a responsibility to make sure that we're not negatively impacting the environment, also if you, a lot of sustainability helps you save money so if you put in more efficient lighting you're saving loads on your electricity. If you run the air conditioning in the building more efficiently again you're saving money on that so a lot of it goes hand in hand with cost saving.

Interviewer: What about the actual staff because that's the tricky bit because I see the actual savings from turning off the lights and the air con it's not, can be done easily.

Interviewee: Yeah

Interviewer: What about staff well being how much, do you think it's ..?

Interviewee: Yeah then you're sort of leaning in to CSR and things like that and so we do, we did some staff surveys, we did a pre-move survey for when we were in our old offices and then we did a post-move survey and we did another survey a year on from that so some of it is also to do with the [building] environment and we've really concentrated on giving people lots of good fresh air, a lot of natural light where possible, we put plants in the office; we've had a bit of problem with the plants and insects, we're working through that, we're think we're nearly there so we're going to put more plants in but we don't want to do that until we have the insect problem under control. So from the feedback from the surveys is that everyone's really enjoying the new environment, there's a few people that they feel they're were worst off perhaps because they had a window seat in the old office and in the new environment they don't but in the old office there were more areas that had no natural light or a lot less natural light so on the whole everyone's benefited for the better in terms of lighting

Interviewer: Uhummm

Interviewee: in terms of the environment as a whole it's a huge difference and everyone just seems happier, more productive

Interviewer: Uhummm

Interviewee: as well and I mean I don't know if you want to go in things like us providing the fresh fruits and a breakfast that's perhaps not the sustainability but

Interviewer: But no, it's all part of the well being of obviously [though/but]

Interviewee: Yeah

Interviewer: Obviously you can understand the financial benefit of implementing something as changing the lights. What is, what do you think is the benefit of doing or seeing, you've mentioned productivity, people seems to be happier, seems to be more productive. Is that the driver for implementing this kind of initiatives?

Interviewee: Uhummm

Interviewer: Or having a glazed floor or 19:12 _____ gas, natural light, having an air con that goes on and get a fresh air out to people so why is the company investing in policy, it's a 19:23 _____ question but there are companies that are not doing it so

Interviewee: Yeah

Interviewer: why are you doing it?

Interviewee: [I suppose I think] it's best practice to take the environment into consideration and it helps us with work and I think that possibly the two big drivers and day to day stuff like how we manage our recycling and I don't think that necessarily has a direct impact on staff other than knowing that they don't particularly like not having their own bin under desk, so that's possibly a bigger benefit elsewhere but things like having an efficient lighting system, an efficient air conditioning that defiantly has an impact on staff and if you're air con's not running well and generally means it's inefficient and costing you money but also its having a bad effect on staff as well. So they're either freezing or they have not enough fresh air so falling asleep at their desks

Interviewer: [(Like I want to do right now)] and actually looking at the other problems so what are the problem of implementing sustainability in their firms? Both at company level

Interviewee: Uhummm

Interviewer: and as a whole as an industry, what are the barriers?

Interviewee: Sometimes it's challenging to get 20:36 _____ from other people who don't deal with it day to day so and [recently sometimes struggle] getting staff to use the correct bins, we done a bit of a drive on that so hopefully that's improved, the waste order will tell us that, and if there is ever any cost associations then again sometimes that can be tricky to get that signed off because not everyone sees the benefit of sustainability but I think that's certainly got less of an issue as the years have gone on and it's become more high profile within the industry.

Interviewer: Okay so mainly is people and money that you think are the biggest [barrier] in implementing sustainability.

Interviewee: Yeah I think so, as i said before there's quite a lot of administration that goes with but you can say that about a lot of things.

Interviewer: 21:30 _____

Interviewee: There's a lot of paperwork for various aspects.

Interviewer: Alright, that's basically all the questions I had to ask you, is there any sustainability statements to leave? Anything sustainable that you could talk about?

Interviewee: Ahmm, gosh

Interviewer: Any aspects that you think we haven't covered or anything like that?

Interviewee: Just having to think about the things we go through

Interviewer: That's good, 21:57 – 21:58 _____

Interviewee: I mean a lot of it here centers around waste and where waste goes and how that's handed so if you have a spillage or contamination that can contaminate the land, contaminate the air, if you think sustainability is linked in with fire as well so if

you had a fire obviously that's smoke going into the atmosphere and [possibly] the staffs' lungs and anybody in the building.

Interviewer: As part of your ISO specification, what do you need to do? A lot of stuff? [I know]

Interviewee: Yeah, there's a lot, you have to demonstrate that you, obviously you have to be complaint with the law, that's basic; I mean that's a given if you've got ISO standards or not but you have to prove continual development and continued dedication to it so it's not that you tick all these boxes and one of those things and then you just stay at it, you constantly have to prove you're continually trying to improve and look at better ways, plus the standards change as well. So they just released a new standard, I think in the last year, we haven't had an audit yet for that, to the new accreditation level

Interviewer: Okay

Interviewee: but I mean 23:14 [Chris Weston] is probably the best person to speak to about all those sort of things because he gets involved in the whole process where his mind's just more the facility side of the ISO standard

Interviewer: No, no, that's fine, no, no but the, linking back to what you said earlier is obviously if you look up cost of reduction and you look at numbers

Interviewee: Uhummm

Interviewer: you cannot just carry on reducing four percent (4%), four percent (4%)

Interviewee: Yeah

Interviewer: because it's getting smaller and smaller, how can you for the eyes of accreditation proving that you are constantly doing something to develop further?

Interviewee: And that is a challenge.

Interviewer: I can imagine that, I can definitely imagine that's a challenge.

Interviewee: So that's where you start coming up with different targets so where you demonstrate to the 23:51 ____ that we're as efficient as we can be in this particular element, over the past five (5) years we've say reduced it by fifteen percent

(15%) and then you get to sort of stagnation, you can't reduce it any further without perhaps sacrificing quality.

Interviewer: Okay, yeah

Interviewee: And so then you start having different target so for you say okay your energy target is to make sure that all of our energy comes from green sources instead of brown energy or (gosh, I'm struggling), I'll get out the target action plan and that shows you all the different kinds of targets that we've had to go through over the years. I mean sustainability also, it depends on what aspect you're doing if you're building something out of the ground or if, I mean we've got a whole environmental team that talk about contaminated land

Interviewer: Uhummm

Interviewee: and whether you can build on it and if you have factory here what will impact that has on the land around it so I don't get involved in that side at all

Interviewer: 24:57 _____ focus on

Interviewee: it's a much wider topic

Interviewer: why researchers exist in the States

Interviewee: Oh yeah

Interviewer: so it's managing buildings that are already there

Interviewee: Yeah

Interviewer: and that can, kind of 25:08 – 25:11 _____

Interviewee: Yeah

Interviewer: or end of 25:12 _____ and just want to be refurbished

Interviewee: Oh, okay

Interviewer: so it's 25:15 _____

Interviewee: Yeah I mean there's a lot of [one day commission] as well and [Fgas] and [RS2] that's been phased out and how that has to be handled, I'm sure you've heard lots

Interviewer: 25:24 - 25:25 _____

Interviewee: about that from 25:26 _____

Interviewer: so basically the main thing is that obviously you, every now and then you just shift from one target to the other

Interviewee: Yeah

Interviewer: because you've got to that level where you cannot really do

Interviewee: Yeah

Interviewer: unless there is some recent kind of new, brand new LED lights that would will

Interviewee: Yeah

Interviewer: just last forever and then at that stage I can yes I can prove it the better but right now we are

Interviewee: Yeah

Interviewer: Who makes that call in terms of ...? (Oh my God they gonna kick us out)

Interviewee: Okay

Interviewer: in terms of you got to the level where you're not actually achieve anything better 25:58 _____

Interviewee: I think we do that in collaboration with the sustainability team, we'd look at the data trends and discuss what avenues we can go down and if we've exhausted all of them without having to use something as you say like change all the lighting

Interviewer: Okay, well I guess it's good to have a sort of sustainability team that is actually helping you out

Interviewee: Yeah absolutely, I'm sure not all the FMs have access to that kind

Interviewer: No, I can tell you

Interviewee: of resource so we'll definitely benefit from their knowledge.

Appendix 2 – BIM and FM focus group transcription

[...] and captures the knowledge and learnings and the understandings that get little there that are maybe not being recycled in the right way now. We've got a fairly educated client, what I see on this table in comparison to some of the contractors and consultants that we come across, and i think there is a real disparity between the educated and the non-educated at the moment. So that framework and basic knowledge is really important, and that's exactly what FM will probably get out of BIM straight away, is getting a structure around how they can impact the culture within design and construction phases as well.

We then discussed some of the issues in terms of the FM phase around equipment selection, reviewing access, and we were talking about sign offs on design and etc. Do they have the kind of actual capability to sign off on design? Then we talked about costs on procurement. That came back up at the start and how to--we all agreed I think that FM involvement in education of the clients, if they're not, I am like sure they are involved in contributing stuff that is important but we weren't in agreement in particular on how we procure that and whose cost that is. Where they are actually as clear as it should be currently in terms of the guidance out there or in terms of contracts, and when we are as a contractor tendering for work, it's touched on and it's talked around with the government soft landings, but there is no a specific client requirement identified generally out there at the moment in and around that.

Again we wouldn't get there, agreed that the early engagement with the FM is vital to have the impact I guess thinking about this sort of finally embark to the best practice, right? It ends up going the other way. if you don't get the right people around the table upfront. It's difficult to control once the horse has bolted I guess. Going back to that sort of skills and knowledge gap really, I think we are in a bit of a lag at the moment. I think we are all working forward with that but we are not quite there yet across in the industry; and that is perhaps where we got to.

I am really surprised. Basically we went back to a little bit to basics. I am sorry I pushed you guys a little bit in this direction. We're never going to answer any of these questions without a plan, without strategy. We're busy down the weeks with this conversation we're having at the moment when it's lifted out to understand what is it that we're really trying to achieve. I think if we continue in the way it's to be we may

achieve 20% versus saving all our total saving could be certainly might not get the 33%, our strategy is to save 33%. From the level 2 BIM work we've done, we're down here. Level 3 might get up to 33 if we're really lucky. Squeezing in the existing model may give you 20%, getting 13 is a third of your cost base, is kind of game changing, life changing. Trying to answer the questions that we've got on the table right now, we're not going to get to our 33% for sure. We went back up and looked at some other things that we did with BIM strategy and there's no apologies that BIM started with delivery and, the factor is the contractor. So that's where I started, I started where I needed. The intention was as always BIM to come down to operations. We tried to put together a plan where we had a push and a pull, a pull from the client and a push from the supply chain, because we created a market, and if we don't create the FM market, I understand is what we're trying to do, both from the client and from the supply side, we won't get a collection, we won't get a hit and we won't get the changes that we really need. We do have some really important drivers from the clients. We've got our 33% saving target, we've got a [CO2] target. That's a legislation, we're not going to change it. You know the 50% reductions and reductions, aren't going to go away unless there's the government change, so we have a good reason doing this stuff. So it won't be hard to understand what those pulls are. We have a government that has a 40% to spend in the UK who is keen to do this stuff. That is the lever that we have to pull on our behalf. It's bloody almost--it would change the market if we choose to ask it to pull the right lever. So, understanding how we build this strategy. That then drives at a whole load of other things but I can only speak of on this piece of paper on this board which are tactical things to support that strategy. Yes, data standards are required, we know that. Yes, the system that allows us to set outcomes and test against them through feedbacks, proper feedback and loops like we have in normal systems, will enable us to start to really drive out these numbers but by just diving into let's pick a data sharing strategy or an application strategy or produce BIM everywhere from FM isn't going to solve the problem. We're going to go back to the root cause, understand what that is, proper push and pull together, create the market, and then the market will fill that requirement. Actually so we're on the market's behalf. Only one of our basics isn't going to work.

We tried to answer the questions. We didn't quite get down the list, but here we go. So, how can FM be involved in the As well we think this is actually an issue like

client education. I think we started the debate around about public sector clients, I think you some education there. The government is behind BIM and the FM initiatives, but we thought "okay how was your staff being manifested itself? We could be looking at internal FMs staff that were already parts of client organizations that initially broke into the project team to be advising and working with the design team, project manager and the quantity surveyors. If there isn't one present, perhaps we're building a new facility. Then we should be looking to bringing in an external consultant who advise on the FM, the implications of design how they manifest themselves going forwards. Or we could be looking to procure an FM consultant to engagement within that team. Then we opened it out a little bit, and so if we can get -- i think at the mail book, what about product developers who may be looking to build an asset and then sell it on very quickly. Do they have evasive interest in investing in a facilities management consultant? if they're just going to sell the building six months afterwards to serve a cost that they would like to remove, well quite possibly, but again this comes back to the education and if we can educate developers to say, well, actually the value of your completed asset maybe increased by capturing FM issue early on, and that's going to be advantage to you. What might happen is that here is an average asset value without a BIM model, we might see a marginal increase if a newly built office block for example does have BIM model. But in time BIM model becomes the norm, and what we'll see is that actually the BIM may not be an added value but it would just be expected and if you don't have a BIM model then you will be falling short of the market and the market norms.

That was part 1. We then moved onto software tools and so how they can be used and adapt it to give them best operational knowledge on systems. Quick drawing on transition from construction to operation and we have this colorful diagram. Essentially we have the one single source of truth which is the BIM data. And actually what our facilities managers needs are usable information. They don't need reams and reams and reams of numbers and figures that actually may be quite meaningless to them. That is the information that is usable for them and then in their data, their operations. The route from BIM data to your information, it can be COBie, does that fit the purpose from Excel? but we did things that Excel is quite a simple tool that people are familiar with and will be well received. We then had some additional discussion that branch down. We had two alternative routes for going from the BIM

data to your information, and one was that using Management Information Systems. These are automated processes that would be just happening behind the scenes, that you use to provide reports to your facilities managers on a day to day basis, telling them what they should be doing for the week ahead or month ahead, and then there could be ad hoc decision based tasks. The DSS which is Decision Support System, again these are not automated but could be reactive to particularly the needs of an asset or of an organization at any given time. And what we have here is actually a feedback loop, so the data going from the information but then as we change things, perhaps we extend or upgrade or improve our facility, all these information that are used to be fed back into the one single source of truth and that's cycle goes on and on. All of these sits inside the integrated workplace management system. I think that's probably about as far as we got out of this one. Just in terms of how FM and BIM can improve whole life cost, well I think it's fairly [inaudible FM can economize but investing more upfront will reduce our whole life cost going forwards. I am curious, so that's kind of grinding into me. [laughter]. I think in the public sector that is well recognized. The private sector probably could pretty learn an extra criteria from the public sector in that regard but again it depends on the business models, investments and funds that are available at the time. Any other comment to mine? [background noise]

Right, interesting question sets on here which took us to run around the circles a little bit. We just started to look at soft services and really trying to define what the soft services mean and does it include cultural and behavioral aspects of the users of the space and we then decided that yes it should. We should be capturing that as well. Obviously spacial data and a lot of soft services information will sit within the BIM model and that information will then be taken forward to put it into a special awareness platform or CAFM system or whatever your tool, to map some of that activity. We've been looking at sort of things about evacuation access, egress and that and trying to map the --we got on to term of using same as what we've seen in the health sector: the patient journey or the business journey to understand the movement dynamics of what would happen in the property, to try to look at productivity because we're looking at large numbers of people, potentially operation people and salary cost of those. There are big cost in there that we want to be able to maximize the effectiveness of those users. So for us it was about how do we look at that information

and feed that information back into the design process. Here was an area where we were thinking that the FM have an ideal opportunity to actually consider that those dynamics and be really part of the initial process of influencing the design so that we can maximize the operational aspects of that building. We saw there's some samples I think in ministry of justice, they've been looking at some of these in terms of guarding and the sort of journey distance, or how many guards they might need over this certain spacial area. They can reduce the number of that by having a better use of that space. So, some good examples there. We then moved on to the sustainability agenda. And again we started to think about what does sustainability really mean in terms of definition of that? And all sums up to the question, how sustainable is the building in its use for the people working in it? It again comes back to some of the points that are maybe for the first question. It is about the adaptability, the flexibility of the building. the fact that as part of the business journey, that business journey over its life cycle may change which may influence the way the building is being used and therefore looking at how that building can accommodate the changing full process of that business over its life cycle of that building. Because again that all impact the productivity of the use of building etc., so an important criteria for us in terms of sustainability. We came to looking at the additional functionality, am I running out of time? Looking at the data and the data storage, where would we hold some of these data? Because we talked about BIM model which tends to concentrate around the construction activity, where all of that is pulled together, then we're talking about potential CAFM system moving information over. There's also going to be HR data sets and others. We're saying to start to re-think about where all these information, the right place for it to sit. And then having somewhere to integrate and pull these information together instead of duplicating information and data, and therefore wasting time, energy and money. It's about mapping that, looking at unique reference numbers and making sure that we can define exactly where that information is. So, think about it

Right, we've focused on soft services including BMI, we focused on cleaning as a source of a typical good FM as it we are and how do we focus on getting the inputs from the FM side into the process. I think generally the FM understands the usage of the building probably better than anybody else through the maintenance and what goes wrong with the building. So actually getting that input in as a part of the early

would be really beneficial to have actually total cost ownership of it. We talked about cleaning but there you talk plus lots of other things, actually I get FM are involved because the material selection, actually understanding what components are in the building and how easy they are to clean to maintain, will have a really big impact on the cost going forward. So these various examples about picking certain types of urinal or whatever, actually affects the whole running cost of that building. They also allow you to design and optimize by understanding what basically had broken or where the pinch points are on building and optimize the actual design of the buildings to minimize cost. So therefore it reduces the cost. I think all of us agree that getting the soft services in at the very beginning is a powerful action to much make the building better, and actually they should be a stakeholder. They should be signing three milestones at the beginning. Let's say actually they've got to sign off on the design or the overall to make it work. Sustainability. There was a lot of work around intelligent buildings, smart buildings and talk into latest things in various--and basically all buildings now are made of components that are sort of intelligent. They've got networked, they report back when they're failing. They can do lots of things and actually you can connect all that up into the model and you can then help for that to develop. You can connect it to your tool, to mobile devices. The connected world we're living in today is all going to make it a much better, easier to do things and to build things, the NBS integration. You design to reduce resource, so actually we talked a lot about actually making effective use of the getting the back at the FM, input into the design so you've actually minimized the amount of hours, resources and time to build it.

We think that actually if we get the BIM process working properly, it would compress the actual time to build things, and actually that then if we've got the models that tell us how the building will work. If we do the POE, the Post Occupancy evaluation, better. That will feed in to the model, then that would speed up everything. So we're onto a high level of actually getting things done quicker and better and we all learn as long as we can.

That's the modeling piece, and then operational needs for FM definitely mobile devices using all of the technologies that are currently available other than the ones that we've probably even thought of at this point in time. And your secret to tools is

actually in Maximo because i think from my experience we've got all top CADs, we've got Maximo, there's talk about integrating all the tools sets across the pitch it doesn't work quite right yet and actually we need to get a proper set of tools to support this process. I am sure it will come with time and actually part of it is getting standards evolved. Once the standards are there then the software developers can develop a [CAD] and we're not quite there yet.

We kind of did a similar thing, we kind of lifted up the horizon a little bit and started to think about how do we enable this thing to work? And what's driving the outcomes and what have you around that's making the sustainability work. The sustainability breaks into 3 chunks. We've got social, economical and environmental. Understanding the impact of those 3 things is the first step. How do we affect those and what are the independencies between them, If I solve one I could cripple the other. So actually they are dependent on each other. Understanding from this building point of view, this asset point of view, how they really work, how they interact. This diagram here shows design, build, operate, business outcomes and social outcomes. As we start to look at some of these things as a picture, and it records them back against their relative values. Design and build, we spend all our time arguing about 20% of the total cost of an asset, when actually that's probably the last thing we should be worrying about. Roughly 80% of the cost go into operations, 300% maybe to business outcomes, the delivery of the service from the building, the daily operating theatres, the bonanzas, car parks and whatever it may be.

The impact of the society in particular will crack it up. You have 3000% bad schools is a real disaster for generations of kids. I remember when I presented with Paul Morell right back at the beginning of 2011 up to, he said at the of 20 minutes which is the slot you get with those guys, fantastic you sold 20% of Tuxedo, what used to be sold 1% of this one because actually this is one had a massive impact on the country. This will have a material impact on our tax bill and we vote MPs on the basis of pretty much of the level of taxes fundamentally with a few drivers but what they are costing us is a big one. We've got to focus up here somewhere, not down here

A few sentences and what have you isn't going to solve that problem. Applying these measures against your building down here, not just at operational level which is kind

of where we have been in the past, and what's the cost on the FM to run the building? Actually involving the stakeholders, the operators, the potters, the cleaners, all those guys in the business delivery actually you start to solve the problem. And then you have an impact on the social outcome which is actually the big deal. Along this middle axis I have drawn a little target and in the middle of the target is the bull's eye, so I call that 100% and on the outside is zero, and what we do is we expect some poor background over here that usually had architect to--usually who is pretty unequipped to do this, to take a brief and his target should be up here, usually it's down here. This is only a building. And that architect usually looks at a building and says, "I want to love your hate room" [laughter]

Fantastic, you're building a school for kids to pass exams and generate revenue

My gosh it really is...

He's designing you a hate room which is probably unmaintainable and I can't reach to clean it. To try and get GSL to work, we start to come up here and drag the operators involved in assets but actually it's the business guys, it's the technicians, it's the teachers, it's the police, the fire service, all those kinds of guys that actually then stop to help us out there. It's not a surprise that we're not the kind of savings we want. 20% savings, we might get down here, same point as before, if you are up to 33, up here somewhere, so drag these cells up here. So again having a plan, 5001 [the oil pipes] the oil pipe is ISO 55, is it?

ISO 5000, which is a new energy management firm.

We were talking about and saying if you build in your strategy having that plan at the beginning of your models, and make that compulsory, then all of a sudden there's a whole lot of stuff, actually a lot of our research are showing that the buildings actually end up using a lot more energy than they say they use but if you do 5001 and you can provide your FM with a tool to prove that you're lucky and you aren't actually using energy and at least they can either yes it's bang on or at least allows them to analyze the building and say well maybe it's because users have changed their behavioral

This is interesting one because we did call of an analytics on schools with this stuff, with the small metering and repeatedly they were over using but it actually up here and it wasn't actually that they were being heated and cooled poorly. They were [briefed] for school to operate and they were outdated. But actually because they weren't fully funded, they had to do 3rd party letting which means they were running 20 hours a day . So actually then that's some break. So you start to see the independencies between these. One of the biggest problems we've got right now is high speed 2, example in one minute, hasn't got one of these. It's got at least one of the potential target that is at least somewhere. So we're trying to design high speed 2 right now to have some social outcomes, to have some business outcomes which are nowhere near the target that it's being designed against. If we were really designing against these targets, we won't be designing a railway, the could have built because you know you'll take too much in there. The train is still weighing 2000 tones but still slowing it down and speeding it up again. We're flying men in plastic aero planes right now. It's 80% to compensate. So why haven't we got to a plastic train?

Number 3, what kind of data does FM need in order to use BIM? We went back to the task of understanding from the beginning what it is we need at the end, because there is no point getting to the end of a project and handing your cover box for the data because you know it's going to be the wrong data. This unfortunate diagram is grown since we first started. It is a little bit higgledy-piggledy but basically this line here is the contract and these are the data drops that exist in the current level 2 which now you may not see. We started with zero which is briefing, No 1 is capital approval No 2 is tendering and supplier selection, no 3 is target cost, no 4 is handing over, no 5 is post occupancy evaluation. At the end if this doesn't tell we gather them in terms of data in census or that kind of stuff. Those requirements for those data drops have been derived from these big decisions that client makes. One of the big decisions that client makes is a rarely done in operation strategy. PAS 55 is the internal document that we use to understand how to have to put together an operation strategy and from that we can work out our questions, from our questions, we can work out data requirements. So those data requirements go into data drops and they go into the employee's information requirements or EIRs they form part of the contract. So when the contractor passes these data across we know that is the construction requirements to put that data in there. So we go along the process and we start with no data and we

grow to this point here, our hand out number 4 where we've got all the data that we need to move over into operations, into our Maximo records etc. or to planet FM or whatever the system is that we want to populate and we started to think about what is the impact of whole life cost on that set of data, and on a traditional contract we wouldn't see the whole life cost information until the hand over. But if you were to put a whole life cost clause into a tender actually it's got to be at the [target cost] stage. So maybe there are data sets to grow here to get more data target cost stage to give us our whole life elements to then move into our operations there. At this point we may throw some of the data away because we don't need it. It's always is a work in progress. These data has been created by the supply chain in delivery not in operation. So it maybe that we track them away but then we go forward with new sets which grows over time as we transact on it, we gather that elementary data and add it in there. But the key thing is that this is a data set that is generated by lots and lots of different tools. It's not one BIM. One of the figures we've got to think from one of our picture is that here is we took the word BIM, and tracked the letter B away and tracked the letter M away so that actually we're just sticking with the engine, the I" in the middle, the information, because that is the bit that is really important. The models are generated by as many tools as you can decide to go by. So it could be an acoustic tool, it could be a PES tool, it could be the FM tool. It doesn't matter, it's just a tool. The tool that the market provides for. So it's the need, the market will provide it, but it will only provide these tools if the stands available. We've got a few stands emerging now. We've got COBie, we've got digital plan of works, we've got Uniclass which is being worked on at moment and that's starting to give us a bit of stability around level 2 data. It's not perfect but it will help us. And we did a very quick picture, we got 1 minute left? Yeah we did a very quick picture of what COBie look like and how some of the things we talked about here kind of work. At the moment this is a data model for the computer guys in here of an institute relationship model of COBie. we have facilities, we have floors, we have spaces. Spaces can be lapped designs, so you are going to make this strategy that is designed. You can zone it up, you can do skimpy zones, fire zones, whatever you like. But anyway spaces may have systems attached to them. A floor system is attached to a room. I think otherwise we would be without floors. So this over time a floor, and the floor system is made of some components. There's some carpet, there's some screen, there's some slab etc.

This is where the costs are, sitting down here for delivering that piece of information, but this type of system has a maintenance information attached to it. We have jobs, we have some resources do the jobs and we have some space. And traditionally this data is put together by the designers. That's where we derive this this data. Construction procures stuff, the system so that contractors usually populate these kinds of things because it is the operation stuff. If we want to do a whole life costing where we've been making decisions around cost, even this small has got to be dragged into there. We've got quite a big shift to make if these are to decide generate data much earlier than we would have been if we are in the industrialization process. The key thing is we need the standards and we need some move of an understanding what these things are before we can start to understand some of the questions in here.

So, lots of what we'll starting to talk around was BIM forms parts of a connection of a number of other systems that link together to provide all of the data that we need. That will vary on an FM by FM basis. So it's sort of services or the deliverables at the time or place but also upfront into the construction hindsight as well. So the data the connectivity that exists in the data transfer. So we have CAFM system, Finance system as I mentioned and so on. What we're talking around is the 2 way flow of information that exists between both of these parties there. It's about having data links this up. The question of whether BIM data becomes an element in itself or becomes a wider element was I guess, similar conversation is what we're talking about here is information. It's about the information about the building in itself rather than BIM as a tool directly.

I think the main thing that came across was the need for common information between all of these different systems or opposite trees and it comes back to that single source of truth. What we don't want is repetition of data that then becomes inconsistent and unmanageable, and that comes back to having some standards the industry needs.

Speaker: We also explored the amount of data you'll throw away. That you don't trust. The suggestion that was that probably 10% is what is needed. We have some discussion about whether that was a consistent 10%. In other words it didn't depend

upon tenure, it didn't depend upon building type, it didn't depend upon business type. The suggestion was that it was independent. One of the things that well, maybe the first thing we need to do is identify what 10% value is. Obviously it could be anything. What 10% is coz if it is inconsistent they're not going to help to actually put some flesh on the drive on the model over there. So I noted that is something Julio want to do.

I am really following this. We did actually ask an interesting question I would argue. And you really saw so many as interesting because I was the one to decide my question as interesting. Is there such a thing as a universal truth? Because is the BIM model? Is all of these data actually true? In other words it never changes? It's unequivocal, it's always the same in whatever circumstances? Now maybe that's a very academic question to ask but a research is saying can you build up a whole life cost model with a future scenario based on the sum of the input of the design stage? In other words if you ask every component supplier to give you a little bit of information about how that can component performs over the life, and you sum all of those up, will the sum risks that everybody build in, I don't want to be sued, actually meant that at the end of the day put this whole life model? But now no one else believed because we all know, and that's it because everybody's risk is critical. We used example of- we've just commissioned a report on a [...] and we've sent it back to the consultants three times saying "you've been too pessimistic, you're covering your basis too many points on this decision tree. Ultimately we said "look, we're not going to sue you if it goes well because we're going to do this, we want a realistic report and that's why when we were discussing, I said "No, we want to carry on talking because that's the bit we were trying to offer there. the question was, can you actually build up from "an incremental data in any information to something we believe in the end?"

You get different levels of accuracy. You have to understand or define validity and checking and certification of those data. You have data that is valid but incorrect, and that's the problem you get with these sorts of data. We've got a strategy where this traditional plan works on there. All that is going to do is validate these level of data is being delivered not it's the correct data, because there's a subjected measure on there.

If you are applying over there is around the ascetics the data could be perfect, will you hate it?

Speaker: One thing which impressed me is when I was working of PFI contracts, we used to have to replace assets or put in assets. And we would have to cost them for the whole of the remaining 28 years of the contract. One of the massive arguments we always had is, what is the life of an asset? Right? Because obviously from the clients point of view, if they can say it's 15 years and they say they might only have to replace it only once during the remaining period, if you say it's 10 years and what I always found is it's incredibly difficult to go to any one place where you could say this is the recommended life of an asset. The manufacturers will always try and push it this way. You know we would very often get to a point where we would say this is at the end of its life and my engineers would come to me and say are you bogus? You just replace something, there's absolutely nothing wrong with it totally. We can stretch it for another 7 years.

It also depends on our strategy because this is great if it's an in building you're building a whole life and you want all that to stay, it's absolutely the right thing to do. But if you say this system to stay and actually you're managing it to fail, we're in different scenario which I'll give us, so we want the model and look at it in way.

One of the things we've got to work out is, what's the minimum data that we can survey to get the same outcome?

We did touch on what about the future scenarios and future strategy. We didn't quite look at alternative methods to manage it or something but we did look at how would you build in future demand strategies and future climate strategies and stuff like that, because if everybody is giving you that bit of data with different assumptions about that, then yet again, you're combining either by recording inconsistency or whatever and it brings a fundamental question, should we ever try to collect data which isn't robust, that it doesn't change.

The fact is that we always do. There's some work that, and I saw for the **and** others looking at the tolerances of error of decisions. So if you have perfect data or data that is 50%..

You've then got a decision that you're making on top of that data that has a tolerance error. So you're compounding a poor decision on a poor data set, and you're living with that decision because it's the best decision you've got. And so that's why you end up...

You're pretty mistaken there, you show in the point after the 3 spaces, and yeah 1% error there is going to be...

if you plus which we have easy decisions along that axis and you plus the answer connected to potential tolerance but then you remove 1% of tolerance, you start to see the impact on the outcome is enormous.

absolutely

I'll stand up. I think to be honest we're all talking the same thing. The only thing that we can probably add is a kind of information required there. Performance specification vs like for like. So when we come to replacing plan in plan implementation structures and what have you, looking back to the original specification, not just going up to our light board, I am just going to swap that for web that is because that could have been value engineered to be something completely different from its original purpose. So adding up there additional things, what was previously discussed is as far as the structure of the strategy, I think the thing we add there is the [color], culture and contracts that we have in place puts the facets between things. We would be trying to come to an agreement of what is BIM? What is CAFM? What's those system? What's their web? to be honest the only reason those distinctions is because of how we contracted our labor or just over time how the culture is built up, and the fact is the technology is there, we just need to work on how we distribute or how we do work and what have you.

Consistent set of EIRs, you know we have been seeing how many different versions we have or how many we all receive and how many get returned, and a platform for sharing that kind of information because our transaction cost in dealing with these things are ridiculous. Maybe that's somewhere central likely task we've been looking at how the house get construction distributed or is there any other way of looking at

that? But I mean to be honest it is pretty much the same stuff but those are the two main things that were different really.

One of those things that occurred to me was plans to put together good examples of working practice because one of the things we use to find is there's a lot of people out there have done things and some of them have done it very well but you find that you work in isolation and suddenly you find and I think if you're great, just to try and promote, this is a good example, that's a good example, and then you create that added value of people's knowledge and experience by actually putting it up there rather than just we always create will than don't make sense.

There's one of our case studies up there. We're quite careful with this. I am quite careful with this, [we kind of get this into a better machine in order to publish]? [laughter]. The official bonus is quite typically on the average, economical that is.

No you can do that from an earlier judgment as a government project, if you do it as a case study that's not actually a government project in any way. Yes it's tougher but you can always do it

So we've something...

That's awesome

That might be interesting from a research perspective to do a decent work on this occasion

There is also a fairly repeated resource reception as a lesson to that stuff which is just raw bullets of what your house actually does...

Well, that's actually key to everywhere and lesson learnt and if there are positives at the moment, you can actually build on it.

When you see that and look at your service, you can add to it and build

You can see that information if you look on the internet, how many models of how you want to go on and solve...we can do on this table

For our research subject, so the first one we're going to go on to is the FM. Looking at how collecting the information or case studies to the people who can go to their businesses with relevant information to run their facilities management, articulate the agreement that's supposed to made.

We will mainly talk about, how do we articulate the evidence to have a conversation with people that finance these things to go and do the essential government data that's...

So, I've heard the bottom line, FM contracts tend to be low margin so therefore, actually the people who run the FM companies are under accounted. So that's nothing new. To translate them that it's worth doing this you need to have a huge body of evidence to say that it's going to save them money, bottom line. I know it's what government mandated and that's one of powerful lever and that's what [characters] seek to expose, and if they can see that actually it's going to be good for the bottom line to implement this sort of technology they will be foraged straight away, but that research doesn't really exist yet. If you've got body of evidence showing that there's going to saving it other than extra 2% at the bottom line on every contract, wow, happy days, but then you won't crawl for that.

absolutely.

I presume the government does have access to data from existing PFIS contracts for people in the FM that it keeps not anonymous previews to provide some evidence.

Absolutely not. We won't carry the whole PFI data. Actually it's not very transparent. That's probably more consistent.

New contracts have got these data of performance

The new ones have, yes but not the old ones.

You could request it though?

No, you can't. We have tried to unpick this from some of the PFIs that we want but it's just almost impossible.

This would be really tricky for consultants that are being asked to do tender evaluations to appoint someone or they're doing a project coming forward that needs to consider their way as part of a process. How do they actually go into this from one contract to another, the analysis of what theory is going to bring without some benchmark data?

Benchmark we set. From the beginning we certificated you under construction contract. That's when we set your benchmark. We've based on the existing data that you have. Known by your existing portfolios. That's your starting point, but then you want to build on that real outcomes, when you were to chip that, that's when you'll be mentioning carried forward.

How can I even mention that...

When you want your real outcome you're going to work on a lot of change. You can articulate what your outcome should be.

or you are going to appoint someone on the basis of something that's going to be achieved.

You know these things, stop laughing dude. It's a bit articulate. It's just like handcuffing. It's just one crazy data I've used Twenty years ago. Then I didn't know how to use and the machine got crazy and I was responsible for it. The COBie led me to bounce it at their zone to let me have the data. To let me have the data for example they choose your stuff to use to measure to see exactly what it is. It was very hard at the time, maybe because as we get more experience in using their data set and then start to analyze, you just start to switch more and more. When you're switching up the big bang, it doesn't appeal...

When you repeat, and that's when it appeals. The more you do it the more you build the feedback and then keep going in the field there. I don't see the issues with measuring something you've asked someone to deliver. What is the problem with that? I don't understand what the issue is.

The computer institute wants property learners score badly, and ask them to build up what they've learned a little bit. Where we've learned I think big bangs we end up with PFIs, we end up with DSS, you end up with this poor disastrous...you know you're not good at that because you're lack sense of the data strategy.

Number 4, does that contract limit specify industry? Is it very clear about what data you need to collect in order to be able to measure? That's one of the things I found on the PFIs advertisement. When you get benchmarked, everybody suddenly says "have you been collecting all data"? Then people think they've been collecting it but when you then try to benchmark it, it's in a way that doesn't quite work, doesn't quite fit and you end up in a complete bloody mess because you haven't clarified up front what you want.

When we talk of variables, we've got any methods of measurements and any methods of classification where your aim is [crosstalk]. Part of what we're saying that we'll talk about even in histogram is data plan of work which is consistent, a classification system which is consistent and it seem that these guys may stand out on your home as I make the measure. We end up with a fairly few data measures one data set, one classification system on one hand data system, we end up to start to equivalents under much bigger sets of data. We have no consistent data sets, We've no system of the measure, we all make up our own classification system, so we wonder why we try and compare because that would have been absolutely . not give you straight ones. That's exactly why that someone who has been replacing [...] really was about learning about how to get consistence data set. so the first requirements of very recipient Cobie has a requirement and it has to be a content which you're required to conform. The next project had its magazine, so that sounds quite okay, if you've a engineer that knows a better way of doing than that is a more insurance to stick to everything with one goal and the things we were supposed to do.

Okay, there is a challenge, there's one for them. There is a challengeable mistake, to get all these information and to learn lessons, you need to put in head count and that affects the cost up and actually a lot of these contracts were very... they can be done on impossible cost. If you're bidding commercially against-- or against or whatever and it comes down to those cost. You've always the balance between doing job well properly or whatever and getting winning the bid.

I guess he's right, and one other thing is that we brought—it took us full three months to get down BIM strategy and form notes on that ideas to focus on them and the feedback to the push and pulls, so the feedback to the industry was giving the opportunity to learn how to use the tools which is one value to them and the other ones was we'd already proven what was like a benefit than trash pits anyway. The savings they took in they power back into helping us create our data sets. I think one of the research things that you you should be thinking about, what is it about feedback to the industry that FM didn't do? Because if you end up without that the two...

Yeah, yeah. Affect your circle or whatever.

Can I also mention one other thing we talked about, this probably didn't make it up onto the board. It was just very new to BIM, forgive me but just listening to some of the conversations around the table and even some of the questions that we talked about research and education in FM and then earlier on we were talking about your very different disciplines of design and construction and anything else. Now they are actually talking to each other, I like talking the same language so that we have a different set of data drivers as the different way of measuring whether they've succeeded or not? Or it's just having the keys or whatever it might be. One of the dangers of generic traffic if we just do our research based on FM and just our education, creating education programs, training completions just round FM, we might not necessarily be solving all of the problem and maybe we need to look across that matrix that got drawn up various different parts of how we work with those other disciplines to build in parts of training and indeed into each other's programs and even if it's just about helping designing constructions and understand a bit more about what makes FM to take more data and just offline, and how they'll measure it and relate that back into BIM

Okay, right research question. This was interesting, we put all the hard stuff in here. The first thing we really need to understand is what's the minimum information we can derive from an existing assets rather than new asset that gets us to this point because we can't start the game until we got some data. This on existing asset doesn't happen, so we will start the game here. so we want to try and find out what is that minimum point and what's the cheapest quickest bank robot into the generating that data set? and is it walking through with a nice phone and a checklist? Is it the latest technology or something different? I don't know but we need to do some research on what's the minimum that we can enter that point at, and the second thing was how do we generate a set of questions here to apply to that data? What's that's strategy going to be? I have inherited an asset, someone else has done a deal on the number. So I've got a crappy asset and I've got no money. I'll now build some data, I now need to apply a strategy to it. How do I generate a strategy while someone is having that conversation about fixing the price rather than just giving me the asset and say you got no money to administrate and manage it? Those two pieces of, what's the data and what's the process? I guess the two really important piece of data for an existing asset, including condition survey.

So if we're looking at a heavy serviced asset and if were looking at a heavy serviced asset, always has a much bigger impact than a residential maybe. So how does that work? We've spoke about using Cobie to integrate lots of different data sets together. If you got a Cobie with its hierarchy that we talked about four, and we spoke about existing data sets that just kind of spread about and spaces register is typical one. You can just attach your special data into that data set and it starts to grow over time. So that's some research and tools about how we do that very quickly. There's one question around is from memory on employees requirements and contracts.

When employee is in a contract as a specification I think we've said it in one way or another that the contract has to include an employee's requirements, otherwise it's never going to happen. You're going to need contractors and particularly I guess FM contractors only do what's in the contract, inclusive of me. So if we're contractors we will do the minimum to execute the contract not the maximum to execute the contract. The data was not there, you go and get it, so it's absolutely essential. we have an EIR in the contract.

We spoke about education and opportunities and this took us back to the original conversation. You don't go to school to become an FM. You don't aspire to be an FM, that's just a fact of life. How do we create a career path that actually gets you to the chief executive if you aspire to be an FM somewhere? because most people when it can't work get on their old slippery slides. How does that work and how do we create an academic and a vocational training structure around that kind of thing?

The final one was around database of case studies and I am happy to host case studies if you want to give them to us, there's no problem at all. There are other people that can do it as well. If they are officially measurable ones that cabinet office signed off, and maybe cabinet office can host them as well. There's a lot of options around that. I think one other thing that's interesting that got raised was lots of people hope to host case studies. What we need to do is to link them all together so you search for one and you get multiple, maybe there's a good one with taking conversation along those lines. We also spoke about trying to join up existing research. There's lots of research going on right now, so we can follow a list of research in this area. The final one was papers. If we join that pool of area in notes we could probably have about ten thousand papers that were quite useful as well that will be indexed. We can probably do that according to me as well.

We started to talk about education and the different forms of education and awareness. We talked about the need to educate clients and also our chain, cross pollination across professionals. Contractors might be unaware of what we do in FM and FM guys understanding what the contractor is doing, understanding how that comes about. We also talked about the change of the kind of new entrance. How do you introduce BIM to new entrance? Is it kind of an evolution of traditional methods, it is a base methods and then there's BIM or is it a whole kind of workshop topic in itself that has to be captured?

Then that kind of got up and went on to roles and defining roles and competencies and extending from more different organizations and exceeded the competencies of cost consultants and designers architects, and when you reach there all you're doing, is doing some of that. It's competent. Also as you have the change management, this is the people, the existing people. How do you change their perception of the way they

always do things? and then apologies to the BIM managers in the room, when we kind of start to work out, what's the life cycle-- life expectancy of a BIM manager?

Similar to the CDM where you start getting the planning supervisors and all those, the industry starts craving lots and lots of specialist's roles and that's not really what we want in this kind of wider working. We want to educate everyone up to the same level and then really the BIM manager is just the lead designer or the lead constructor or the lead FM team. That we felt was quite of a key bit. In terms of research absolutely touching on forms marked there, we did as many case studies, models of how we can do things, standards, opportunities, the way we manage information and data and trying to understand standard. Then we started talking about the and raising that awareness to the FMs. it's so easy in construction because it's obvious crash detection saves money, design twice build once is a no brainer.

In the FM world it might be about de-risking the FM. Traditionally they come in and validate all of the asset database. If they've got the confidence that that information is good, then they may de-risk the whole service and obviously then with that the cost come down, they make more profit. The overall cost of FM comes down. So it's picking up opportunities out there to start the industry pulling and driving this instead of just BIM pushed from top down. I think that kind of captures it.

I think the need for commercial requirements and money, touch on it ..., but [and you see it now and cruising there], and obviously there's a BIM protocol but I think there's need to extend it.

I agree with you. It's absolutely common. It's got to be embedded in any contract whether it's construction management or measurement contract or fixed price it's very common, as an up roll, and that's also embedded in the FM contracts to maintain and we all recall that we pay these service providers lots of money to manage that data. They go away and then the next crowd come and they come and validate that data. The usual crowd come back and they charge again to validate that data. So it's them helping confidence but also us managing them to manage our information, or we do it ourselves, and do it to tell us about-- which we've considered [saggy] do we want to be managing that data? Because that's

but really, and this is close to my heart because we're working for the RICS, yes it's the measurement standards, you speak so much about measuring, something that we continuously improve. If we don't measure to a structured data set, that information loses its power and its richness because we lose that ability to compare, and that's a role for the RICS, in particular to try and embed those standards to professionals who are working on that. There's more to be done.

benchmark on the asset probably

Exactly yeah

Okay, we've about 15 to 20 minutes left, just for 5 minutes or so, Is there any context or any questions that perhaps should have been asked that maybe weren't? Is there anybody who's full of anything or you're all worn out?

Yeah, it's obvious questions. We always raise that question. BIM strategy. I like that one.

so is that so that when changes are made in the operational stage those sets of rules are not crunch...

Yes, particularly in the maintenance access

So you're saying you can use BIM not only to transfer the physical information but also the intelligence within the designer's head?

Yes

So that people that haven't got that level of the designs needed can still make sense with their decisions

Absolutely

And I suppose then if you say that, then the opposite is the case. If you give people the perception that they can do anything they want with the layer that they are building and then their naive facilities manager does it, then there could be actually a health and safety issues built in, and haven't thought that out.

when we talked-- we use to have drafters and then they went to [] engineers,

It was a far more intelligent. It's not social it's putting a lot of things together.

what we're building this is a separate platform to process and drop it there since you have exceeded the ___ seems to be [wide open] BIM keep that. You want to get in all to implement sort of if you're getting into it into to go and process one of the talents was that [] [get] better issues and get engineers productive, and there was about 16 bid to that lots of organizations [got] all of top guys throughout the main block interface geographical locations of those...

We don't want to create that in BIM

Maybe...could we make it more productive

get ownership of the building? [] It's a freebie something?

The question is what are the core disciplines of practice? Are you the intern to leverage technology and information systems or are you the intern to leverage people's behavior and to do something because computer is doing certain things really well and people do things really well. I think we live in the world where were trying to act like we are in analog world, and it's not working very well as we are trying to get all of them. I think it's the meaning of what one of the things this university have as opposed to what other researchers have at the other universities. and explain to you] we talked about integration of disciplines here, and I think for the research questions, it's what is it that you have? What asset have you got to put together? And those are close

One of the things that we were discussing earlier with the FM world guys and also the BIFM guys was just sometimes there's a lack of of a lot of the research work [that gets stand by and I think there's an age-old problem that academics and practitioners tend to operate/separate in set groups. Sometimes they are not particularly good at talking to each other. One of the things we're trying to do is to take some of research work, not necessarily just BIM's but to sort of say "well, we should be opening up and saying what do you guys want us to research as part of [] this work show] but then

secondly to say once we've got a product that we've done some research on, how can we make it available in places where people can actually all access it easily? And you say you know [that's how useful ---] A lot of guys who are in business are too busy to spend much time doing that. What we think we should be doing better is, where we find an information that we think can help the industry, is to put it out in the FM forums which is why we're talking to the BIFM guys and FM world. So if the stuff that we've that can help give feedback into the loop, it's because at the end of the day [we're only] here if you guys got something that you want for research.

Appendix 3 – Questionnaire survey

Exit this survey

Inefficiency in Facilities Management



You are being invited to participate in a research study titled "Inefficiency in Facilities Management". The study is being conducted by Giulia Carbonari from the University of Greenwich (email: cg57@gre.ac.uk)


If you agree to take part in this study, you will be asked to complete an online questionnaire divided into 3 sections. Section 1 includes general information questions, section 2 comprises questions relating to your job tasks and how efficient the process of implementation of these tasks in your workplace is and section 3 is composed of questions regarding your knowledge, opinion and use of information models. No previous knowledge is required and if you do not wish to answer any question please proceed to the next question. The entire survey will take approximately 10 minutes to be completed. As part of a research aimed at creating information models for existing buildings, the results of the questionnaire will be used to identify the information needed by facilities managers during buildings operation phase to enhance their efficiency.

- I have read the information sheet about this study
- I have had an opportunity to ask questions and discuss this study
- I have received satisfactory answers to all my questions
- I have received enough information about this study
- I understand that I am free to withdraw from this study at any time and without giving a reason for withdrawing
- I agree to take part in this study

* Do you agree to the above terms? By clicking Yes, you consent that you are willing to answer the questions in this survey

- Yes
- No

Next

Powered by
 SurveyMonkey
See how easy it is to [create a survey](#).

Inefficiency in Facilities Management



Do you work within Facilities, Maintenance, Building Operation, Estate Management or for an FM consultancy?

- Yes
- No

What is your job title?

What is your job position?

- Executive manager - responsible for strategy
- Senior manager - responsible for a building or group of buildings
- Manager - responsible for specific service/s e.g. maintenance
- Operational - team member
- Other (please specify)

Which of the following market sectors best describes your organisation? Tick as many as apply

- Office and Commercial
- Industrial
- Retail
- Utilities
- Recreational
- Educational
- Health Sector
- Government
- FM Consultants
- FM Contractors
- Other (please specify)

How would you define your organisation?

- SME
- National based organisation
- Multinational
- Other (please specify)

Approximately how many employees work for your organisation?

In what country do you work?

Prev

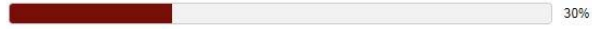
Next

Powered by



See how easy it is to [create a survey](#).

Inefficiency in Facilities Management



How efficient is your organisation in performing the following tasks?

Please rate only the tasks you're involved with and leave unrated the tasks you're not involved with.

Property management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Property management strategies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Day to day operation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Information management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asset records	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evaluation business performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Space management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Service provision

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Catering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cleaning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Help desk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Utilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Telecommunications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Procurement

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Market intelligence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contractor register	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bid process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tender process	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Outsource management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Raise purchase orders	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Budget management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Invoices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole life costs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capital projects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Client-stakeholders management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Relationship management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Satisfaction surveys	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Client reporting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Post-occupancy evaluation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Security

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Access Control	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Asset protection	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Keyholding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Guarding	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
CCTV	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Prev

Next

Inefficiency in Facilities Management



How efficient is your organisation in performing the following tasks?

Please rate only the tasks you're involved with and leave unrated the tasks you're not involved with.

Safety health & environment

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Strategy development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Emergency procedures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Safe working practices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risk management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving well-being	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Waste management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Building certifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Measuring performance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Staff involvement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Compliance statutory requirements	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Risk management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Crisis strategy development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Business continuity strategy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Business impact analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Staff training	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risk identification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Risk analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Maintenance

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Preventative maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Reactive maintenance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maintenance programming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Condition assessments	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Develop maintenance strategy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Evaluation maintenance strategy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analyse maintenance data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Completion of maintenance reports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Contract management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Service Level Agreement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Specifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contract management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Performance management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mobilisation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Supplier management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Project management

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Project development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Monitor project progress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Budget allocation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Budget management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task schedule	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assessment project output	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Prev

Next

Inefficiency in Facilities Management



Is there any task you would like to add?

Task 1:

Task 2:

Task 3:

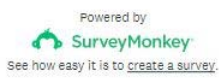
Task 4:

Task 5:

Please rate the tasks you have added

	Very inefficient	Inefficient	Fair	Efficient	Very efficient
Task 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Task 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Prev Next



Inefficiency in Facilities Management



Building Information Modelling is "a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward"

How would you rate your personal level of awareness/knowledge of Building Information Modelling (BIM)?
1= not at all aware/knowledgeable, 5= very aware/knowledgeable

	1	2	3	4	5
Awareness of BIM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for FM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Within your organisation, how would you rate the level of awareness/knowledge of Building Information Modelling (BIM)?

1= not at all aware/knowledgeable, 5= very aware/knowledgeable

	1	2	3	4	5	Don't know
Awareness of BIM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for FM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Within your organisation, how would you rate the level of awareness/knowledge of Building Information Modelling (BIM)?

1= not at all aware/knowledgeable, 5= very aware/knowledgeable

	1	2	3	4	5	Don't know
Awareness of BIM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for design	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Knowledge of BIM uses for FM	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Which of the following possible applications of BIM for FM would add value to your organisation? Tick as many as apply

- Locating building components
- Real-time data access
- Building visualization
- Maintenance
- Creation digital assets
- Space management
- Renovation works
- Emergency management
- Energy monitor
- Personnel training
- None of the above

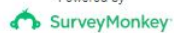
Other (please specify)

How many years have you used BIM?

Prev

Next

Powered by



See how easy it is to [create a survey](#).

Exit this survey

Inefficiency in Facilities Management

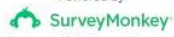


Which of the following statements describe most closely your organisation's approach regarding BIM?

Prev

Next

Powered by



See how easy it is to [create a survey](#).

Inefficiency in Facilities Management



How would you rate your expertise in using BIM?

What is the percentage of projects you are involved with that use BIM?

Has your organisation ever **created models for existing building stock**?

Never Rarely Sometimes Often Always I don't know

If your organisation has **created information models for existing building stock**, please indicate if your organisation is using the model for the following purposes. Tick as many as apply

- Locating building components
- Real-time data access
- Building visualization
- Maintenance
- Creation digital assets
- Space management
- Renovation works
- Emergency management
- Energy monitor
- Personnel training

Other (please specify)

Prev Next

Inefficiency in Facilities Management



How many times has your organisation **been handed over building information models after construction completion** for the buildings you are working with?

Never Rarely Sometimes Often Always I don't know

Is your organisation using the models received for FM purposes?

If you answer YES to the previous question, please indicate if your organisation is using the model for the following purposes. Tick as many as apply

- Locating building components
- Real-time data access
- Building visualization
- Maintenance
- Creation digital assets
- Space management
- Renovation works
- Emergency management
- Energy monitor
- Personnel training

Other (please specify)

Inefficiency in Facilities Management



Are you aware/have you ever used any of the following? Tick as many as apply

	Not aware	Aware	Used
BS 1192-1:2007	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PAS 1192-2:2013	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PAS 1192-3:2014	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BS 1192-4:2014	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PAS 1192-5:2015	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CIC BIM Protocol	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BIM Maturity Diagram	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ISO 55000	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ISO 55001	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ISO 55002	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Soft Landings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UNICLASS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Prev Done

Appendix 4 – IFC mapping

Property Management	IFC
Property management strategies	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement IfcResource
Day to day operation	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement IfcResource
Information management	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcPerformanceHistory IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement

	IfcSpatialElement IfcResource
Asset Management	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement IfcResource
Asset records	IfcProject IfcObject IfcActor IfcControl IfcActionRequest IfcPerformanceHistory IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Evaluation maintenance strategy	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent

	IfcTask IfcElement IfcResource
Space management	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Benchmarking	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcResource
Building Management Systems (BMS)	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset

	IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement IfcResource
Evaluation business performance	IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcTask IfcResource

Service provision	IFC
Catering	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Cleaning	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcSystem

	IfcEvent IfcTask IfcElement IfcSpatialElement
Help desk	IfcProject IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement IfcResource
Post	IfcObject IfcActor IfcOccupant IfcActionRequest IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcElement IfcSpatialElement
Utilities	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcElement IfcSpatialElement
Logistics	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcWorkCalendar

	IfcAsset IfcInventory IfcEvent IfcElement IfcSpatialElement
Telecommunications	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPerformanceHistory IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcElement IfcSpatialElement
Pest control	IfcObject IfcActor IfcOccupant IfcActionRequest IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcElement IfcSpatialElement
Transport	IfcActor IfcOccupant IfcActionRequest IfcWorkCalendar IfcInventory
Fleet management	IfcActor IfcOccupant IfcActionRequest IfcWorkCalendar IfcInventory

Procurement	IFC
Market intelligence	IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule

	IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcElement IfcResource
Contractor registers	IfcActor IfcPermit IfcWorkCalendar IfcInventory
Bid process	IfcActor IfcActionRequest IfcCostItem IfcProjectOrder IfcWorkCalendar IfcElement
Tender process	IfcActor IfcActionRequest IfcCostItem IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Outsource management	IfcActor IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcTask
Raise purchase orders	IfcActor IfcActionRequest IfcCostItem IfcCostSchedule IfcProjectOrder IfcEvent IfcTask
Energy Management	IfcObject IfcActor IfcOccupant

	IfcControl IfcActionRequest IfcCostItem IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
--	--

Budget Management	IFC
Invoices	IfcActor IfcActionRequest IfcCostItem IfcCostSchedule IfcProjectOrder IfcInventory IfcEvent IfcTask
Cost control	IfcActor IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement
Whole life costs	IfcProject IfcObject IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement

	IfcResource
Capital projects	IfcObject IfcActor IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement

Client-stakeholders' management	IFC
Relationship management	IfcActor IfcEvent
Satisfaction surveys	IfcActor IfcOccupant IfcActionRequest IfcCostItem IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcElement IfcSpatialElement
Client reporting	IfcActor IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcEvent IfcTask
Post-occupancy evaluation	IfcActor IfcOccupant IfcActionRequest IfcCostItem IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem

	IfcEvent IfcTask IfcElement IfcSpatialElement
--	--

Security	IFC
Access Control	IfcObject IfcActor IfcOccupant IfcControl IfcPermit IfcWorkCalendar IfcEvent IfcElement
Asset protection	IfcObject IfcActor IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcElement
Keyholding	IfcObject IfcActor IfcOccupant IfcElement IfcSpatialElement
Guarding	IfcObject IfcActor IfcWorkCalendar IfcSpatialElement
CCTV	IfcObject IfcActor IfcWorkCalendar IfcElement

Safety, health and Environment	IFC
Strategy development	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory

	IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Emergency procedures	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Safe working practices	IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcPerformanceHistory IfcPermit IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Risk management	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcPerformanceHistory IfcPermit IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Improving well-being	IfcProject IfcObject IfcActor IfcOccupant IfcAsset IfcSystem

	IfcEvent IfcElement IfcSpatialElement
Waste management	IfcObject IfcActor IfcOccupant IfcControl IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcElement IfcSpatialElement
Building certification	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcAsset IfcSystem IfcElement
Measuring performance	IfcProject IfcObject IfcActor IfcOccupant IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Staff involvement	IfcProject IfcActor IfcOccupant IfcElement
Compliance statutory requirements	IfcProject IfcObject IfcOccupant IfcControl IfcActionRequest IfcPerformanceHistory IfcAsset IfcSystem IfcEvent IfcElement

Risk Management	IFC
Crisis strategy development	IfcObject IfcActor IfcOccupant IfcControl IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Business continuity strategy	IfcObject IfcActor IfcOccupant IfcControl IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Business impact analysis	IfcActor IfcOccupant IfcControl IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Staff training	IfcActor IfcOccupant IfcControl IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcElement IfcSpatialElement
Risk identification	IfcObject IfcActor IfcOccupant IfcControl IfcPermit IfcAsset IfcSystem IfcEvent IfcTask

	IfcElement IfcSpatialElement
Risk analysis	IfcObject IfcActor IfcOccupant IfcControl IfcPermit IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement

Maintenance	IFC
Preventative maintenance	IfcProject IfcObject IfcActor IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement
Reactive maintenance	IfcProject IfcObject IfcActor IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask

	IfcElement
Maintenance programming	IfcProject IfcObject IfcActor IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement
Condition assessments	IfcProject IfcObject IfcActor IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Development maintenance strategy	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement
Evaluation business performance	IfcActor IfcOccupant IfcActionRequest IfcCostItem IfcPerformanceHistory

	IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcEvent IfcTask IfcElement IfcResource
Analyse maintenance data	IfcProject IfcObject IfcActor IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcResource
Completion of maintenance reports	IfcActor IfcControl IfcPerformanceHistory IfcProjectOrder IfcAsset IfcSystem IfcEvent IfcTask

Contract Management	IFC
Service Level Agreement	IfcProject IfcControl IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask
Specifications	IfcObject IfcActor IfcOccupant IfcControl IfcCostItem

	IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Contract management	IfcActor IfcControl IfcPerformanceHistory IfcAsset IfcEvent IfcTask
Performance management	IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask
Mobilisation	IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Supplier management	IfcActor IfcControl IfcPermit IfcEvent IfcTask

Project Management	IFC
Project development	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Monitor project progress	IfcProject IfcActor IfcControl IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcWorkCalendar IfcEvent IfcTask
Budget allocation	IfcProject IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcTask
Budget management	IfcProject IfcControl IfcCostItem IfcCostSchedule IfcInventory IfcSystem IfcEvent IfcTask
Task schedule	IfcProject

	IfcObject IfcActor IfcOccupant IfcControl IfcPerformanceHistory IfcPermit IfcProjectOrder IfcWorkCalendar IfcAsset IfcSystem IfcEvent IfcTask IfcElement IfcSpatialElement
Assessment project output	IfcProject IfcControl IfcActionRequest IfcCostItem IfcCostSchedule IfcPerformanceHistory IfcProjectOrder IfcAsset IfcEvent IfcTask IfcElement
Moves and relocations	IfcProject IfcObject IfcActor IfcOccupant IfcControl IfcActionRequest IfcWorkCalendar IfcAsset IfcInventory IfcSystem IfcEvent IfcElement IfcSpatialElement

Ifc definitions (From BuildingSmart website)

IfcActionRequest - A request is the act or instance of asking for something, such as a request for information, bid submission, or performance of work. Requests may take many forms depending on the need including fault reports for maintenance, requests for small works, and purchase requests (where these are to be made through a help desk or buying function).

IfcActor - The IfcActor defines all actors or human agents involved in a project during its full life cycle. It facilitates the use of person and organization definitions in the resource part of the IFC object model. This includes name, address, telecommunication addresses, and roles.

IfcAsset - An asset is a uniquely identifiable grouping of elements acting as a single entity that has a financial value or that can be operated on as a single unit. An asset is generally the level of granularity at which maintenance operations are undertaken. An asset is a group that can contain one or more elements. Whilst the financial value of a component or element can be defined, financial value is also defined for accounting purposes at the level of the asset.

IfcControl - IfcControl is the abstract generalization of all concepts that control or constrain the utilization of products, processes, or resources in general. It can be seen as a regulation, cost schedule, request or order, or other requirements applied to a product, process or resource whose requirements and provisions must be fulfilled. EXAMPLE Controls include action requests, cost schedules, project orders, work plans, and work calendars.

IfcCostItem - An IfcCostItem describes a cost or financial value together with descriptive information that describes its context in a form that enables it to be used within a cost schedule. An IfcCostItem can be used to represent the cost of goods and services, the execution of works by a process, lifecycle cost and more.

IfcCostSchedule - An IfcCostSchedule brings together instances of IfcCostItem either for the purpose of identifying purely cost information as in an estimate for constructions costs or for including cost information within another presentation form such as a work order.

IfcElement - An element is a generalization of all components that make up an AEC product. Elements are physically existent objects, although they might be void elements, such as holes. Elements either remain permanently in the AEC product, or only temporarily, as formwork does. Elements can be either assembled on site or pre-manufactured and built in on site.

IfcEvent - An IfcEvent is something that happens that triggers an action or response.

IfcInventory - An inventory is a list of items within an enterprise. Various types of inventory can be included. These are identified by the range of values within the inventory type enumeration which includes space, asset, and furniture. User defined inventories can also be defined for lists of particular types of element such as may be required in operating and maintenance instructions. Such inventories should be constrained to contain a list of elements of a restricted type.

IfcObject - An IfcObject is the generalization of any semantically treated thing or process. Objects are things as they appear - i.e. occurrences. Examples of IfcObject include physically tangible items such as wall, beam or covering, physically existing items such as spaces, or conceptual items such as grids or virtual boundaries. It also stands for processes such as work tasks, for controls such as cost items, or for actors such as persons involved in the design process.

IfcOccupant - An occupant is a type of actor that defines the form of occupancy of a property.

IfcPerformanceHistory - IfcPerformanceHistory is used to document the actual performance of an occurrence instance over time. It includes machine-measured data from building automation systems and human-specified data such as task and resource usage. The data may represent actual conditions, predictions, or simulations.

IfcPermit - A permit is a permission to perform work in places and on artifacts where regulatory, security or other access restrictions apply

IfcProject - IfcProject indicates the undertaking of some design, engineering, construction, or maintenance activities leading towards a product. The project establishes the context for information to be exchanged or shared, and it may represent a construction project but does not have to.

IfcProjectOrder - A project order is a directive to purchase products and/or perform work, such as for construction or facilities management.

IfcResource - IfcResource contains the information needed to represent the costs, schedule, and other impacts from the use of a thing in a process. It is not intended to use IfcResource to model the general properties of the things themselves, while an optional linkage from IfcResource to the things to be used can be specified (specifically, the relationship from subtypes of IfcResource to IfcProduct through the IfcRelAssignsToResource relationship).

IfcSpatialElement - A spatial element is the generalization of all spatial elements that might be used to define a spatial structure or to define spatial zones.

IfcSystem - A system is an organized combination of related parts within an AEC product, composed for a common purpose or function or to provide a service. A system is essentially a functionally related aggregation of products.

IfcTask - An IfcTask is an identifiable unit of work to be carried out in a construction project. A task is typically used to describe an activity for the construction or installation of products, but is not limited to these types. For example it might be used to describe design processes, move operations and other design, construction and operation related activities as well.

IfcWorkCalendar - An IfcWorkCalendar defines working and non-working time periods for tasks and resources. It enables to define both specific time periods, such as from 7:00 till 12:00 on 25th August 2009, as well as repetitive time periods based on frequently used recurrence patterns, such as each Monday from 7:00 till 12:00 between 1st March 2009 and 31st December 2009.

Appendix 5 – Sustainability policies case studies

Environmental Stewardship Policy

Protecting our resources,
reducing our impacts

GVA is committed to protecting the environment and minimising all harmful impacts as part of its corporate responsibility. Through our business operations we contribute to climate change, resource depletion and environmental degradation.

Who Is Covered By the Policy?

We will continue to ensure that our approach actively supports the prevention of pollution and we will conduct our activities in full knowledge of all compliance obligations.

An Environmental Stewardship Group will meet at least four times a year, including for an annual management review. The Group's purpose is to ensure continual improvement and progress against the goals and objectives. The Group will work with Environmental Coordinators in each office to implement and monitor initiatives.

The GVA Executive understands and is committed to successful implementation of this policy and will continue to provide leadership, support and financial assistance.

Simon Miller
Chief Operating Officer



We commit to the following two goals:

- › Reduce and offset our operational carbon dioxide emissions
- › Reduce the environmental impact of our supply chain

For the period 2016 through to 2018 we have set the following objectives:

1. Purchase 100% renewable electricity where we control the energy contract (and there is a renewable electricity tariff available)
2. Set environmental procurement criteria and engage with our supply chain
3. Specify environmental fit-out criteria, including a minimum Ska Rating of Silver on all major fit-outs
4. Continue to run an environmental management system certified to ISO 14001
5. Enable our colleagues to operate in a way that minimises their environmental impact through education and changing processes
6. Offset the carbon dioxide from our office energy use and car travel via the Woodland Carbon scheme
7. Continue to improve the accuracy of our data and reporting

University of Greenwich Sustainability Policy

The University of Greenwich has over 25,000 students and over 1,500 staff based across three campuses: Avery Hill and Greenwich in London and Medway in Kent. In recent years it has made significant progress in improving its sustainability performance and is now recognised, from the awards it has won, as one of the UK's sector leaders.

As a University we have a role in making further improvements in our own academic and operational spheres of influence. We should also enable our students to have skills and knowledge to make positive sustainable change. In order to achieve this the University will ensure that sustainability is applied as the driver that delivers our wider strategic goals, whilst enabling societies to flourish and to protect the natural systems upon which the institution ultimately depends.

Our decisions and actions will work to deliver sustainable outcomes. As a result, the University is committed to:

- Maintain or exceed compliance with all relevant UK legislation and regulations, and other relevant internal and external compliance obligations. We will retain our ISO 14001 certification and achieve its objectives and targets.
- Review all of our activities and operations, in order to identify, understand and evaluate all the direct and indirect environmental aspects and impacts. We will then prioritise action to address them.
- Ensure continuous improvement by establishing procedures and associated sustainability performance targets that are reviewed and externally reported annually.
- Protect the environment by reducing resource use and preventing pollution by reducing and eliminating sources of pollution and developing appropriate control mechanisms.
- Ensure that sustainable development is fully understood by staff and students and is enshrined within all aspects of strategy, planning and activities with resources available to enable such.
- Continually improve our sustainability management system to enhance environmental performance.

In order to implement this policy the University undertook a baseline review of sustainability and has determined the following set of key sustainability impacts and associated objectives:

- **Education and Research for Sustainable Development:** Actively encourage and support the teaching of and research into sustainable development in the University.
- **Energy and carbon:** Reduce energy use and to further explore the possibilities of less carbon intensive energy sources, either through the direct purchase of renewable energy or through an increased use of onsite renewables.
- **Waste and natural resources:** Prevent pollution by reducing harmful emissions and discharges and to promote the 'zero waste' principle (rethink, reduce, reuse, recycle) in order to minimise the environmental impact of the use of natural resources and waste

disposal.

- **Procurement:** Implement the University's Sustainable Procurement Policy that supports the purchase of more sustainable products and services from responsible contractors and suppliers.
- **Food:** Work with catering contractors to ensure our Sustainable Food Policy is met and the University's Fairtrade accreditation is maintained.
- **Water:** Reduce water use and establish a utilities monitoring and targeting system.
- **Transport:** Minimise harmful emissions arising from business travel, commuting and deliveries by implementing the University-wide Green Travel Plan.
- **Construction and Refurbishment:** Incorporate the principles of sustainable development into all new build and refurbishment projects and integrate climate mitigation and adaptation measures where appropriate and feasible.
- **Cultural and Natural Heritage:** Protect and conserve the heritage buildings occupied by the University and implement our Biodiversity Policy that actively protects and enhances wildlife on campus.
- **Community Involvement:** Build partnerships and take part in networks to share experience and knowledge of sustainability with the affiliated Student Unions and broader community and lead the debate on sustainability issues.
- **Staff and Student Wellbeing:** Use sustainable development activities to provide opportunities for positive stakeholder engagement.
- **Training, Awareness and Communication:** Increase the awareness and understanding of sustainable development and its practical application amongst all staff and students, through learning opportunities and training.

The University of Greenwich Sustainability Policy is fully supported by the Vice-Chancellor's Group and the Sustainability Management Board who have ultimate responsibility for setting and reviewing sustainability objectives and targets of the University. All staff, students, visitors, contractors and relevant external stakeholders share this responsibility. This policy is reviewed annually by the Vice-Chancellor.

Professor David Maguire

Vice Chancellor

27th July 2017

Sustainability Policy



BAM Construct UK Ltd

Introduction

BAM Construct UK has a responsibility to minimise our impact on society and the natural environment when we design, build and manage facilities.

We work closely with our employees, customers, suppliers and subcontractors on all aspects of sustainability. We strive to balance short and long term interests, and to make economic, environmental and social considerations integral to our decision-making. We engage in dialogue with our partners and those who are affected by our activities

We are committed to being a responsible business. This means conducting our activities according to rigorous ethical, professional and legal standards. We will not condone corruption, bribery or unfair competition.

People: adding value to customers, employees, business partners and the community

1. Customers: We strive to exceed client expectations

We work in partnership with our customers to deliver quality projects on time, safely and with due regard to the environment. We develop low carbon options whenever possible for our customers and encourage them to choose sustainable design, materials and construction methods. We aim to be the preferred supplier of low carbon solutions.

2. Community: We promote good community relations

By its very nature, our construction and refurbishment activities have an impact upon the local environment, end users and the wider community. We take a proactive stance in minimising disruption to our neighbours, and seek to make a positive contribution to the local community.

3. Employees: We are committed towards our employees

We create a safe and inspiring environment for our employees enabling them to develop their skills, and contribute to the growth of our business. The commitments to our people are as follows:

- **Health and safety** – Health and safety is our top priority. We are committed to continually improving the health and safety of our employees, subcontractors and those affected by our activities, including members of the public.
- **Equality and diversity** – We provide an inclusive working environment where everyone feels valued and respected. We are committed to equal opportunities, and ensuring that we do not discriminate against anyone on the grounds of gender, marital status, race, colour, ethnicity, religion, sexual orientation, disability or age.
- **Learning and development** – We promote a learning culture and provide opportunities to equip our employees with the skills and knowledge they need to run our business successfully and to extend their personal development.

4. Supply chain: We procure responsibly

We treat our supply chain partners fairly and responsibly. We work with our subcontractors and suppliers to ensure they operate in a safe and environmentally responsible way. Together with our preferred partners we promote and develop sustainable solutions and best practice across the sector.

Planet: we recognise our responsibility to future generations

5. Energy: We strive to reduce our climate change impact

We will improve our energy efficiency, reduce our CO₂ emissions and work with our clients to provide low carbon solutions.

6. Resources: We will improve resource efficiency.

We believe in reducing the supply of natural resources used in our products. We collaborate with our clients and supply chain to use alternative materials and methods to optimise the use of raw materials. We also promote measures to recycle and minimise waste.

7. Environment: We will limit our environmental impact.

We take all reasonable measures to ensure that our activities are conducted in a way that minimises our impact on the local environment. We promote good environmental practice and seek opportunities to enhance biodiversity on our construction sites.

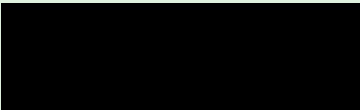
Profit: creating economic value

8. Innovation: We innovate to identify balanced sustainable solutions

Innovation is essential for our company's success. Together with our partners in the value chain we will provide sustainable solutions that balance economic, environmental and social interests. This approach ensures that we use materials efficiently and deliver value to our customers.

9. Prosperity: We believe that sustainability leads to economic prosperity

We aim to create value for our shareholders and society by operating both profitably and sustainably. We believe that by applying these principles we create value for our shareholders, customers, employees and the public.



Graham Cash
Chief Executive
BAM Construct UK Ltd

Appendix 6 – Publications