

**Management accounting and management control -
Cloud technology effects and a research agenda**

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Abstract

Cloud technology is a potential change factor of the management accounting function and the role of the management accountant. The management accounting function today has an inherent interest in the value of work processes and technologies (Lymer and Baldwin, 2012) that include technology development and evaluation (e.g. the decision whether or not to adopt and implement the cloud; cloud risk management), management process interfaces (e.g. issues when basing decisions on condensed information on small screens), resource use and value generation (e.g. shifts in the cost structure when adopting the cloud) and as a result, changes in the role of the management accountant itself. Based on this, we propose four potential research areas where cloud technology might impact management accounting, and thus may be fruitful avenues for future research

We apply a systematic literature review to determine the current state of the field in these four areas, and how the management accounting function and the role of the management accountant might influence and be influenced by what cloud technology has to offer. We suggest a research agenda for management accounting research that, as practice is pushing the cloud agenda forward, has the potential to provide insights and ideas from an academic point of view, opening an exciting new field to management accounting research.

1. Introduction

Management accounting has always been influenced by technological developments (Dechow and Mouritsen, 2005). In the early days, Hollerith tabulating machines resulted in the emergence of the accountant as quantitative information profession (Abbott, 1988). Decades later, ERP systems was another technological change factor to significantly influence management accounting and the management accountant (e.g. Caglio, 2003). Today, another major shift in management accounting is foreshadowed due to the technological developments that are currently discussed in the practitioner literature, such as mobile devices, real-time data processing, and cloud technology. These represent developments that have the potential to revolutionize interactions within and between organisations. In particular, cloud technology brings businesses face-to-face with a new of technology landscape in the early 2010s.

Practitioner literature (e.g. Gartner, 2012; Gill, 2012; Blandford, 2011) has long identified "the cloud" as a "disruptive" technology (DaSilva et al, 2013), enabled within the last decade by the advent of high-speed internet. Cloud computing and its anytime anywhere, provision of processing power to business is hitherto unknown. For management accounting and management accountants, this may have advantages, but also results in some challenges.

To this point, practitioners have taken the initiative and led the discussion about the benefits and drawbacks of cloud technology. Academia has fallen behind to some extent, with mainly computer sciences looking at the cloud. In this research note, we hope to encourage management accounting research to investigate how management accounting and management accountants may pro-actively embrace the challenges of this new area of technology, and thus, for example, see new ways of working, changes to roles, better decision-making information.

A CIMA report by Lymer and Baldwin (2005) links the management accounting function today has an inherent interest in the value of work processes and technologies that include technology development and evaluation (e.g. the decision whether or not to adopt and implement the cloud), management process interfaces (e.g. issues when basing decisions on condensed information on small screens), resource use and value generation (e.g. shifts in the cost structure when adopting the cloud) and as a result, changes in the role of the management accountant itself. Based on this, we propose four potential research areas where cloud technology might impact management accounting, and thus may be fruitful avenues for future research:

1. Impact on the basis for decision-relevant information (costs);
2. Impact on strategic decision-making, in particular strategic IT decisions, cloud adoption and risk management;
3. Impact on the technical usability of management accounting information on mobile devices;
4. Impact on the role of the management accountant

As we will identify in this paper, accounting information systems research has largely ignored the production of management accounting and management control information (Granlund, 2011). Although the study of management accounting without considering technology could be difficult (Dechow and Mouritsen, 2005), little is known about the underlying mechanisms which build the basis for the strong intersection between management accounting and technology. Therefore, we try to develop a research agenda to enable the provision of a comprehensive picture of possible effects of new technology on management accounting. We aim to achieve this using the example of cloud technology, whilst also providing some insights and paths for future research concerning a new technological era that is started by the cloud.

Although research on technology and its effect on management accounting practice is not novel in academic or practitioner literature (see, for example, Bhimani and Bromwich, 2010; Dechow and Mouritsen, 2005; Grabski et al., 2010; Granlund and Malmi, 2002; Scapens and Jazayeri, 2003; Wagner et al., 2011), much of the academic literature in particular has not yet explored more recent shifts in how technology is used, and how it alters businesses and organisational behaviour - including the behaviour of management accountants and managers. These technological changes (such as cloud computing) have in less than a decade made computing power and information access available to us anytime, (almost) anywhere, at a minimal cost and even customisable to our personal preferences and needs. While we elaborate briefly on some of these technology advances later (see Section 2.2), we could draw on terms like 'the cloud', 'smart devices', 'the internet of things' and 'big data' to paint a picture of how rapidly technology has not only changed how we personally do things, but also how business is conducted and information captured. Technology has always had the potential to change how business is done - for instance, Automated Teller Machines in 1959 changed how banking was

done forever. However, if we reflect on technologies such as smart portable devices (phones and tablets) and the cloud in a management accounting/control context, never before has access to information been so easy and widespread for managers and other actors in the organization, which is particular relevant for an information profession like management accountants.

Taking Granlund's remark that "there is probably no doubt any longer that IT, while still being fragile, produces transfers in management control" (2011, p. 4) in the context of contemporary technological developments, it seems a good time to reflect on a possible research agenda assessing the impacts of such technologies on management control. For example, easily accessible decision-making information directly, at any time, from any device and in any location may remove management accountants completely from any 'information filtering' role they traditionally held. The motives behind such observed behaviour are worth investigating, as the impact of e.g. cloud technology on management accounting and control systems might bear considerable implications, not just for the role of the actors within these systems, but also for the design of the systems themselves down to the cost information that is the basis for most of the decision-relevant information, putting the management accounting researcher in a challenging position – mainly, where to start, and what areas to look at.

In the remainder of this paper, we attempt to highlight the impact of technological change on management accounting with a view to past research, as well as a look at the new technological developments that could have an impact on management accounting. Then, with a focus on cloud technology, we discuss the four potential research areas introduced earlier. Finally, we identify aspects from the discussion to a point that helps us shape a research agenda in the field of cloud technology and management accounting and control.

2. Management accounting and contemporary technology

In the past two decades, the evolution in technology has brought about changes in society at all levels, financial and management accounting included. In the management accounting literature, drivers of management accounting change can be identified in three broad categories, namely: (1) increasing globalisation; (2) improved technologies; and, (3) improved methods of production (Scapens and Jazayeri, 2003; Russel and Siegel, 1999). These categories have

impacted on the general business environment over the previous two or three decades in particular and, in turn, have had an influence on some observable changes in management accounting practice. Although improvements in technology have been clearly identified as one of the main drivers of management accounting change, research into the impact of contemporary technology on management accounting - in particular decision-making - is scarce (see Granlund et al., 2013). The following two sections will therefore review current knowledge on the link between management accounting and change in technology in general to narrow our analysis down to what we here define as “contemporary technologies”.

2.1 Management accounting and technology change

Johnson and Kaplan (1987) are often cited as the ‘beginning’ of a realisation that management accounting was overshadowed by an emphasis on external financial reporting. Much has been written since then on new management accounting techniques (see for example, Al-Omiri and Drury, 2001; Bhimani and Bromwich, 2010; Dugdale and Jones 1998; Innes et al., 2000; Kaplan and Norton, 1992; Shields and Young, 1991). Also, since this time, computing power and capabilities for all organisations have increased dramatically. Not only have the capabilities of, for example, accounting software and enterprise resource planning systems increased, but also the connectivity of computers i.e. the advent of the internet and the large scale data networking it brought with it. Add to this the more recent developments in the last five years or so around mobile computing and networks, and a picture of a technology-filled environment for the management accountant becomes apparent.

Much of the earlier literature on management accounting and information technology focuses on the effects of larger scale accounting software - such as enterprise resource planning systems (ERP) - on management accounting. Much of this research is dated post the Y2K issue in the run up to the year 2000, perhaps because of its topicality at that time. It should be noted that ERP had not reached the “shakedown” phase (Markus et al, 2000) in many organisations at that time - this refers to the period when the ERP has been bedded into organisations, which may take three to five years. Granlund and Malmi (2002) suggest ERP can have both direct and indirect effects on management accounting, management accounting systems and management accountants.

According to Granlund and Malmi (2002), direct effects of ERP on management accounting may present in the form of change in reporting practices, i.e. differing layouts, content, depth of analysis, etc. Indirect effects may result from changes in business processes, practices and organisational structure which result from the integrative nature of ERP. Granlund and Malmi (2002) also noted the change relationship is one-way, as ERP modification is less likely than organisation modification (see also Davenport, 1998).

Scapens and Jazayeri (2003) examined the effect of ERP on the routine work of management accountants. They emphasised two issues: (1) a distinction between management accounting tasks and management accounting systems must be made when analysing for effects of change; and, (2) the research emphasises that reported change accompanied ERP, without ERP being necessarily a driver of the change. The research findings, which are based on a case study of a SAP implementation in a large UK company, cite a lack of “fundamental changes in the character of management accounting information” (Scapens and Jazayeri, 2003, p. 201). Likewise, no new or advanced management accounting techniques were reported, supporting the findings of Granlund and Malmi (2002). The availability of more detailed and timely information was cited as a major advantage, with up-to-date data providing the ability to produce better plans and forecasts (Scapens and Jazayeri, 2003, p. 221)

Scapens and Jazayeri (2003) also examined the effect of ERP on the routine work of management accountants and cite a lack of “fundamental changes in the character of management accounting information” (Scapens and Jazayeri, 2003, p. 201). They point to a higher level of “direct” effect on the work of management accountants (c.f. Granlund and Malmi, 2002). The ability to centralise functions such as accounts receivable quickly reduced the number of accounting staff and caused a reorganisation of the accounting function (Scapens and Jazayeri, 2003, p. 221). They also found that routine management accounting work was directly reduced for two main reasons: (1) the ERP calculated the majority of standard costs and collected actual costs, thus reducing the input of the management accountant; and, (2) responsibility for costs and cost management was devolved to cost centre managers, who could now witness where costs were incurred in real time and plan forward more readily. This also eliminated the need for mass-produced monthly management reports, the traditional realm of a management accountant

(Scapens and Jazayeri, 2003, p. 204, p. 222).

More recent literature has built upon literature such as that mentioned above. In particular, more recent research has had the opportunity to explore the more social aspects of how information systems such as ERP affect management accounting. Wagner et al (2011), for example, suggest that management accounting may not be easily captured in ERP. This may be due to the rules within the software not necessarily matching the needs (or routines) of particular organisations (see also, Burns and Scapens, 2000; Quinn 2011). Dechow et al. (2007) note how research on management control systems (which are within the broad definition of management accounting) cannot be studied separately from the technology underpinning them (see also Granlund, 2011), which brings out the socio-technical nature of management accounting. Grabski et al (2010) conducted extensive survey research and several case studies on management accounting and ERP. They reported less time was spent by management accountants on data analysis and internal reporting than pre-ERP. Their research also noted that the more successful and ERP implementation was perceived, the more dramatic the change in the role of the management accountant.

2.2 Contemporary technologies

Cloud computing, or ‘the cloud’ as it is more commonly known, refers to a configuration of computer hardware and software whereby the location of data and software is not necessarily related to where the end-user accesses information or processes data (e.g. DaSilva et al., 2013; Luftman et al., 2013; Boehm et al., 2010). Although the term has appeared in many professional journals and the general media in recent years, its origin can be traced back to 1997, when Irish entrepreneur Sean O’Sullivan and George Favaloro, from Boston, Massachusetts trademarked the term (Kennedy, 2011). The US-based National Institute for Standards and Technology (NIST) recently released its official definition of cloud-computed as follows:

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with

minimal management effort or service provider interaction (NIST, 2011, p. 2)

The NIST also outline the three basic models of cloud computing. First, Software-as-a-Service (SaaS) allows a customer to run software programs deployed on infrastructure in the cloud. Several accounting software products are currently offering this service (see Kristandl and Quinn, 2012). In this model, any internet enabled device (notebooks, personal computers, tablet and smartphones) can use the service. Second, Platform-as-a-Service (PaaS) allows a customer to develop or deploy applications/software using tools and infrastructure provided by the cloud service provider. Finally, Infrastructure-as-a-Service (IaaS), is the provision of resources such as storage and other hardware in the cloud. The customer in this instance may also deploy various operating systems, and have the most control over the use of the computing resources.

As noted by Kristandl and Quinn (2012), cloud-computing has offered many organisations the possibility to change their business models. And indeed, as they also note, cloud computing has also created new ways of doing business. In a nutshell, traditional ‘bricks and mortar’ type business presence is no longer necessary - as we can see in the likes of Amazon.com or Apple’s iTunes. Kristandl and Quinn (2012) specifically report on an accounting software company who changed their business model to a cloud-based model. The software company changed from delivering software via traditional ‘hard’ media such as compact disc and download, to a full SaaS model. In this model, the customer simply needs an internet enabled device to use the software. Cloud-computing has also generated many more opportunities to capture data than previously possible. For example, any smartphone owner is probably aware that a vast amount of data can be captured each time a photo is taken using such a device - for example, date, time and location using global positioning. Or, indeed the user may use social network tools such as Facebook and Twitter to share this same photo, meaning the aforementioned data *may* be available for use by these firms. Without going into detail here, it is easy to appreciate how vast amounts of data on people, products, places, habits, tastes, age profile and so on can now be easily captured.

The above clearly demonstrates evidence that contemporary technological developments have impacted businesses, business models and as such, management accounting. As stated earlier,

practitioner literature has clearly been on the case for a long time by now, identifying the cloud as an enabling technology that provides a change in a contextual factor for management accounting and the role of management accountants (see also Simons, 2012). Even more important, cloud technology has already entered a phase where overly enthusiastic expectations have mellowed, according to Gartner's Hype Cycle for Cloud Computing Report 2012. Cloud computing is currently seen in a phase Gartner calls the "Trough of Disillusionment" where technologies receive a reality check necessary in order to achieve eventual profitability from this development (Gartner, 2012). Cloud computing and other terms in the realm of cloud technology like "Big Data" are seen by Gartner as 2-5 years from mainstream adoption - in other words, considered more than just a "passing trend". The future potential of cloud technology is demonstrated in current market projections. For instance, the market for business cloud computing is projected to grow up to 53% in Germany in 2013 (Bitkom, 2013), and Gartner forecasts that more than 50% of companies worldwide will have developed some form of strategy for SaaS-based application use (Gartner, 2012). Interestingly, among the factors that drive the latter, Gartner (2012) identifies a high priority on customer relationships, gaining better insights through analytics, moving costs from capital expenditure to operating expenditure, and aligning their technology more efficiently to strategic goals. Moving to the cloud is more and more a business decision instead of a "pure" technology one (CDW, 2013).

3. Management accounting research agenda for the cloud

In the following four sub-sections, we outline the four research areas identified earlier. Due to the lack of academic research (at least from an accounting perspective) this area, we draw on publicly available surveys and questionnaires by practitioners, attempting a concise and structured overview of what is cited as the benefits (and drawbacks) of cloud technology to businesses with view on potential impact on management accounting and management accountants. We also draw on research from academic journals over the last five years (2010 - 2014) retrieved from the Swetswise literature database - using the search term "cloud computing" and restricting journals in the areas of the social sciences and technology

The following sections will attempt to establish four potential research areas in the field of management accounting and cloud technology, linking the above identified management accounting functions to previous research from computer sciences, information systems and

ergonomical studies. It needs to be noted that we are not necessarily trying to propose definitive answers; we are trying to open discussions on various aspects the management accounting function should consider when facing cloud technology.

3.1 Research area 1: Impact on the basis for decision-relevant information (costs)

The relation between management accounting (MA) and IT is not necessarily a linear one; as an enabling technology, it exerts its influence by facilitating, improving or generally influencing processes and system settings (Granlund et al, 2013). It does not automatically change the whole MA system per se.

One of the configuration factors found in any management accounting system (MAS) or management control system (MCS) are costs at the core of the majority of MA instruments. As such, we suggest that the cost of a product, a service, a project or an IT implementation is a major factor for MA to consider. Changes in the cost structure might impact subsequent decisions by management, either during implementation and adoption (see also research area 2), or during operation. As cost reduction and IT and business alignment are high on the priority list of managers and IT managers in Europe and the US (Luftman and Derksen, 2013), there is a vested interest to look to IT as a major capital cost contributor of organisations.

On-site computing has become a big part of an organisation's budget (Luftman and Derksen, 2013; Marston et al, 2011), with large computing capacities sitting idle and underutilized. Only up to a third of on-site server capacity used, and 5% of desktop computers (Marston et al, 2011), it appears that the resource allocation is not in an organisation's best interest. Luftman and Derksen (2013) report IT budgets as a percentage of revenue in Europe between 14.27% for the banking sector, 13.86% for computer and network consulting and 1.63% for manufacturing (10.63%, 13.33% and 2.38% in the US, respectively).

Table 1 shows costs associated with cloud implementation and utilization. We make a distinction between cloud deployment type (public or private cloud; Mazhelis and Tyrvaenen, 2012), as not all costs or cost savings are relevant to both.

	Public cloud	Private cloud
Implementation costs	Transaction costs from contract negotiation and policing (Lin and Chen, 2012; Martens and Teuteberg, 2011) Cloud training costs (Lin and Chen, 2012; Bean, 2011)	Capital investment (Sultan, 2013a) Cloud training costs (Lin and Chen, 2012; Bean, 2011)
Operation costs	Pay-per-use (per month/year/user) (Sultan, 2013a) Connectivity costs for storage and bandwidth (Sultan, 2013a; Dwivedi and Mustafee, 2010) Risk assessment costs (Bean, 2011) Risk management costs (Lin and Chen, 2012) Costs from security breaches (Kshetri, 2013)	Pay-per-use (per month/year/user) (Sultan, 2013a) Connectivity costs for storage and bandwidth (Sultan, 2013a; Dwivedi and Mustafee, 2010) Risk assessment costs (Bean, 2011) Risk management costs (Lin and Chen, 2012) Costs from security breaches (Kshetri, 2013)

Table 1: Costs in the cloud

For management accountants, the cloud offers an interesting and potentially beneficial opportunity to manage costs by selectively outsourcing information technology functions to the point where cost savings (see Table 2) outweigh the costs (Table 1) and risks of ceding control over one's data (Lee and Mautz, 2012). As can be seen, Many surveys find that it is the prospect of saving costs that is among the main drivers for companies to adopt cloud computing, especially SMEs (Gupta et al, 2013; Marston et al, 2013).

	Public cloud	Private cloud
Implementation cost savings	<p>Acquisition savings (Sultan, 2013a; Gupta et al, 2013; Lin and Chen, 2012; Bean, 2011)</p> <p>Cost of capital (Bean, 2011)</p>	
Operation cost savings	<p>Energy cost savings (Sultan, 2013a; Marston et al, 2011; Dwivedi and Mustafee, 2010)</p> <p>Lower CO2 emissions (Sultan, 2013a)</p> <p>Infrastructure cost savings (Sultan, 2013a; Gupta et al, 2013; Lin and Chen, 2012; Marston et al, 2011)</p> <p>Cost savings from real estate for housing IT (Sultan, 2013a)</p> <p>No specialist IT staff on-site necessary (Bean, 2011)</p> <p>Savings from lower IT skills training requirement (Bean, 2011)</p> <p>Software upgrade cost savings (Marston et al, 2013; Lin and Chen, 2012)</p> <p>Efficiencies from performance and load balancing (Bean, 2011)</p> <p>No server crashes and repairs on-site (Bean, 2011)</p> <p>Remote maintenance and automatic anti-virus updates (Bean, 2011)</p>	<p>Upgrade costs (Marston et al, 2013)</p> <p>Shared resources between departments and projects (Bean, 2011)</p> <p>Efficiencies from performance and load balancing (Bean, 2011)</p>

Table 2: Cost savings from changing to the cloud

As can be seen from Table 2, many of the cost savings that come from moving to the cloud are forfeit if an organisation opts for the private deployment model. The third cloud deployment, hybrid cloud, might be able to save costs, depending on the number of applications and processes

that run on the public cloud portion of the model. Security concerns drive organizations to often not fully deploy a public cloud model (see for instance Bean (2011) and research area 2).

These developments (more notably in a public than a private cloud) might change the cost situation in an organisation quite considerably. The management accounting function might find cost management benefits (Lee and Mautz, 2012) due to minimal upfront costs that reduce capital expenditures from hardware and infrastructure requirements (Blandford, 2012; Bean, 2011), as well as maintenance costs (operating expenses), to an increase in other operating expenses such as a pay-per-use fee, as computing power is consumed like a utility. These fees can be paid in a variety of ways (daily, monthly, weekly or annually per user), and savings on the cost of in-house IT support and training can materialise (Lee and Mautz, 2012; Bean, 2011).

However, these cost savings might not come to pass right away. According to Sultan (2013a), benefits might take a 3-year ROI to break even before they are felt. In fact, the cloud might be more expensive before (heavy connectivity demands, fibre optics installation). Many savings might not materialise until the mid- to long-term. Another factor in the considerations of the management accountant could also be the resulting lower cost of capital (Bean, 2011) and a lower IT asset base, impacting key performance indicators such as Total Cost of Ownership (TCO)¹ (Cegielski et al, 2012) or ROI that have been the basis of decisions in the past.

These cost savings lower barriers to implement and utilize up-to-date IT resources and computing power for SME in particular (Marston et al, 2011). ERP systems, for instance, were prohibitively costly to small businesses, requiring a large amount of investment upfront. Access to powerful processing and analytical resources has become affordable with cloud technology. Further implications for the management accounting function are the enhanced transparency, as computing power is consumed like a utility. Measuring where computing power is consumed is facilitated by the cloud provider, and cost allocation to departments and even functions (Lee and Mautz, 2012) is simplified. We see the management accountant as information hub (see also

¹ The total cost of ownership (TCO) of a cloud model that contains all post-cloud capex (in the case of the private cloud) and opex can be significantly lower than the TCO of on-premise IT (see for example Genesys|Echopass demonstrating potential cost savings from cloud contact centres <http://www.echopass.com/solutions/cost-reduction/total-cost-of-ownership>)

research area 4) working with staff to specify system requirements, cloud product evaluation, and with the IT function managing the technical details of the required cloud product.² Further cost control is possible even on a daily or hourly basis via the scalability and elasticity of services, as computing requirements can be adapted both up and down, according to the need of the organisation. The possibility to quickly ramp up or down what the organisation needs is cost-friendly (Gupta et al, 2013) and requires different planning premises for the annual budgeting exercise.

3.2 Research area 2: Impact on strategic decision-making, in particular strategic IT decisions, cloud adoption and risk management

Moving to the cloud to save costs is only one (albeit major) driver, particularly important for SMEs (Sultan, 2011). However, there is a range of other factors that make organisations consider moving part or all of their IT to the cloud. In this section, we look at perceived benefits of moving to the cloud that are strategic in nature, as well as the main risks and concerns. The management accounting function, as pointed out earlier (and will be amplified further in research areas 3 and 4), has an inherent interest of getting involved in the value of work processes and technology (Lymer and Baldwin, 2005) to increase and improve the organisation's information processing capability (Cegielski et al, 2012). This is an organisation's capacity to utilise and structure information in a meaningful fashion that supports decision making; the "home turf" of the management accounting function (similar Lymer and Baldwin, 2005). As IT has been identified as an enabling technology earlier, there is also an inherent interest of the management accounting function to get involved with questions about acquisition, implementation and adoption of support decisions such as embodied in cloud technology. Subsequently, questions around security, privacy, data integrity, and cloud risk management start to fall into the area of interest as well. In fact, a recent CDW survey found that non-IT executives are more involved in strategic cloud decisions than they were in traditional IT decisions (CDW, 2013).

Luftman and Derksen (2013) identify cloud computing and business intelligence (big data) as the two top technology developments in Europe and the USA. As organisations look beyond the sole

² Similar Lee and Mautz, 2012, who suggest the IT function to perform these tasks.

cost savings target, it is more often than not the first step towards cloud adoption, as confirmed by a KPMG (2010) study. Considering the strategic potential of a coherent cloud strategy that supports business functions and processes, it is no surprise that market and technology research institutions like Gartner (2012) and Northbridge (2013) predict a global market of \$158.8 billion in 2014.

Why adopt the cloud

So what other reasons are there for organisations to consider moving to the cloud? Researchers and practitioners identify various reasons like simplification of software access and delivery (Lin and Chen, 2012; Marston et al, 2011; Sultan, 2011), efficiencies from matching computing supply to demand (scalability; Lin and Chen, 2012; Marston et al, 2011; Sultan, 2011), higher reliability, higher analytical power (big data; Marston et al, 2011) or resource sharing either by using the same instance of software (multi-tenancy, virtualization) or use of personnel's own devices (BYOD - bring your own device). For many businesses, it is actually customer demand that triggers cloud considerations (demand-pull instead of technology-push; Lin and Chen, 2012).

The management accounting function can be a driving factor behind the decision for or against the cloud, but needs to be a driving factor behind the strategic fit of cloud technology to the organisation as well. Lin and Chen (2012) use innovation theory to determine the perceived attributes that are decision-relevant in this regard (see also Lian et al, 2014):

- Relative advantage: Is the organisations better off with or without moving to the cloud? Do the benefits (cost savings, efficiency gains, etc.) outweigh the costs and risks identified?
- Compatibility: Does cloud technology fit to my organisation, does it support my existing business model and IS environment, are customer needs met, does it conflict with our policies, is the data secure (see below on security)
- Complexity: Is the cloud adoption project complicated in terms of effort to adapt to the cloud, complicated business environment, difficulties to learn a wide range of new IT techniques, complication of existing dynamics between developers, ease of maintenance?
- Observability: Can the impact (relative advantage) of cloud technology be observed and communicated/reported to others?

- Trialability: Is it possible to trial parts of or the full cloud implementation to gain insight and first experience?

Evidently, the decision to adopt the cloud is highly dependent on financial and non-financial factors that the management accounting function will need to be aware of. Next to the organisational dimension (relative advantage, top management support, availability of adequate resources), the technology dimension (security, privacy, complexity, compatibility), and the environment dimension (government, industry pressure), there is a human dimension that is driven by positive or negative attitudes to adoption of innovative technology and the employees' technological competencies (Lian et al, 2014). The management accounting function needs to take attitudes in particular into account, as otherwise resources spent on the cloud strategy get wasted.

Why to not adopt the cloud

The strongest backlash for adoption of the cloud are concerns about security. Marston et al (2011) cited an IDC survey where 75% for IT executives and CIOs report questions about security and privacy as their primary concerns. Many authors and surveys support this notion (Sultan, 2011; Zissis and Lekkas, 2012; Blandford, 2011; Potts, 2012; Lin and Chen, 2013; Cegielski et al, 2012, Kshetri, 2013; Lin and Chen, 2012; Lee and Mautz, 2012; Gupta et al, 2013) - in fact, security is the main obstacle to cloud adoption, potentially influencing attitudes towards cloud technology.

So what is "security" in a cloud (or any IT) context? It can be any/all of the following: levels of security: user identification, device authentication (BYOD), data security (access, backup, integrity of data where only authorized parties can delete or modify or create data; Zissis and Lekkas, 2012; Blandford, 2011), information security (value from a combination of data items; Blandford, 2011), perimeter security ("set of physical and programmatic security policies that provide levels of protection on a conceptual borderline against remote malicious activity", Zissis and Lekkas, 2012, p.585). Figure 1 summarises the main categories of cloud security threats that should be considered by cloud risk management:

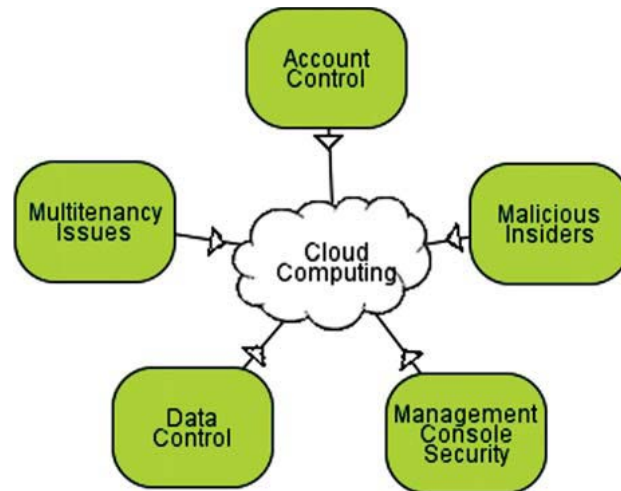


Figure 1: Categorization of cloud security threats (Zissis and Lekkas, 2012, p.587)

Data security, privacy and integrity are crucial for any management information system, so it should be at the heart of any strategic cloud adoption decision. Due to business information systems supporting the management accounting function, it seems reasonable that the management accountant has an interest in getting involved to ensure the alleged benefits and decrease the expected risks of adopting the cloud (or not adopting it), so a strategic move to the cloud will be a boon and not a bane.

This cloud scrutiny does not stop before implementation, of course. The management accounting function would be a major stakeholder in cloud risk management. Zissis and Lekkas (2012) detail the requirements of such a risk management function, including effectively integrating security controls with information systems functional and operational requirements (reliability, maintainability, supportability), centralization of security, data and process segmentation, redundancy and high availability through cloud. We are not claiming that the management accounting function should be taking this over entirely, but we are suggesting to work very closely with the IT function to ensure cloud integrity.

The main concerns detailed above about losing control and thus data security in the cloud seems to stem from perceptions about public clouds, where company data is moved outside the confines of the organisation. Blandford (2011) details this as losing control over the organisation's data to an unknown location and a potentially long supply chain where the ultimate provider of the service is unknown. Entrusting applications and data that are critical to an organization's success

to a third party without guarantee of high quality and data availability (Marston et al, 2011) will concern anyone involved, including the management accounting function. Ensuring data security and integrity is a vital target for the interaction between management accounting function, IT function and cloud vendor that requires detailed service level agreements (SLA) and statements of applicability (SOA; Blandford, 2011).

Blandford proposes to ask cloud vendors the following questions (2012, p.17):

- Who is the ultimate holder of the data?
- Where is the data held?
- Do you operate good processes, and can you prove it?
- What specific security standards and levels of security are you applying to my data?
- How can you guarantee that no-one else can get access to my data unless I specifically want them to?

Ultimately, a move to a private cloud deployment model might alleviate much of an organisation's concerns, but many of the perceived benefits (mainly from cost savings) would not materialise in this case. A hybrid cloud (as described in area 1) might be a good compromise in that case, moving low-risk data and services to a public cloud, and key data and information to a private cloud.

Legislation is currently lagging behind the requirements of cloud storage and the location of data in various jurisdictions. The EU in particular requires all corporate data to be stored in the EU (Marston et al, 2011; Sultan, 2011); some jurisdictions go even further and require their corporations to store data inside the country of origin. Most prominent example is Germany, where data needs to be stored on German servers. Companies like Amazon and Microsoft have reacted to the EU legislations by building server farms on EU soil. Evidently, in most (mostly practitioners) surveys (e.g. CDW, 2013; North Bridge, 2013; Cloudtweaks, 2012; Forrester, 2011; Gill, 2011, KPMG, 2010; ENISA, 2009), participants even state higher security as reason to move to the cloud since most businesses fail to develop the security intelligence gathering capabilities and resources the likes of Google and Amazon provide (Sultan, 2011). That includes easier security monitoring by authentication, user access and rights management (Marston et al, 2011).

Other concerns when adopting the cloud

Many other authors and practitioners have commented on concerns other than security, privacy and data integrity:

- Threat to corporate IT culture (IT job security at stake when highly skilled tasks are moved offsite; Marston et al, 2011);
- Bankruptcy of vendors (what happens with the data; Marston et al, 2011);
- Interoperability (ease of moving data to other vendors and platforms if vendor bankruptcy or quality issues arise; Lin and Chen, 2012; Sultan, 2011; Marston et al, 2011);
- Vendor lock-in (in case of a lack of interoperability; Sultan, 2011; Marston et al, (2011) mention efforts by the ISO project study group as well as OpenWeb Foundation or Google's Data Liberation Front to develop standards for cloud technology that enable better interoperability);
- Power outages (Cloudtweaks, 2012; Sultan, 2011)
- Lack of stable high-speed internet (Lin and Chen, 2012);
- Cyber-attacks, hacking, industry espionage, stealing trade secrets, malicious insiders (Potts, 2012; Cloudtweaks, 2012);
- Sunk costs from previous large IT investments, already purchased hardware, software and licences (Lin and Chen, 2012).

Ultimately, this paints a picture of a very cautious attitude to the cloud for many. We believe that the management accounting function needs to accept responsibility for getting involved in driving and monitoring the cloud strategy, from adoption and acquisition (including the decision if the technology supports the business model, not the other way around), to running daily business operations on a cloud platform. Risk management will be a crucial part of the management accountant's toolbox in this case.

Kshetri (2013) sees the transformational nature (organisational change) by the cloud as the main "culprit" for the inherent security and privacy risks. She suggests implications for cloud providers, cloud users and policy setters that we believe will also inform the role of the

management accounting function vis a vis the cloud:

- Cloud providers will need to gain trust from organisations, as they face pressure to protect what is rightfully organisation property. If the cloud cannot be trusted to perform strategic and mission-critical functions on it, organisations will discard further considerations; transparency and clear communication between provider and user will be critical;
- Cloud users are much better educated in what they need to ask for before making an investment decision. A one-size-fits-all approach does not work anymore (visible, for instance, from SAGE's or Microsoft's wide product range). The desire for keeping the governments out (especially after data scandals like the NSA) has added to the push for security and privacy;
- Policy makers will need to look at the geographic dispersion of data in the cloud. As mentioned earlier, Germany's requirement to store data in Germany might be a trendsetter, inherently restricting the "freedom" of the cloud to some extent. Kshetri (2013) states that this has been done individually, not EU-wide.

3.3. Research area 3: Impact on the technical usability of management accounting information on mobile devices

In early 2013, a study estimated that there are around 1.4 billion smartphones in active use in the world by December 2013 (Koetsier, 2013). Even if we allow for people to own more than one smartphone, the number remains impressive. Many use their private smartphones for accessing work emails or other cloud data (BYOD) and it has become crucial for managers to be connected and have access to decision-relevant information (Borges and Joia, 2012; Cosgrave, 1996), independent from time and location, but dependent on the device itself feeling the obligation to always remain switched on (Mazmanian et al, 2013). Accessing information anytime and anywhere can also lead to an even higher degree of asynchronicity in manager communication that might affect comprehension and the content of messages and reports (Borges and Joia, 2012).

In terms of cloud computing, the anytime-anywhere access to data and applications in the cloud is independent of platform or device; it is possible to access the same information from a Windows PC or an Apple Macbook. Given adequate bandwidth, devices like an Android-driven smartphone or an Apple iPad can access the same cloud data using simple web-based interfaces (e.g. AWS Management console; see Gupta et al, 2013; Marston et al, 2011). Mobile devices like tablets or smartphones do enable the cloud user to access information like accounting data on the go, but especially smaller handheld devices do have one major drawback: their small screen size. Where a computer screen is able to display a lot of decision-relevant information at once (or at least easy to navigate using mouse and keyboard), the smartphones with a few inches screen size³ are unable to present as much information for the sake of readability (Ziefle, 2010), comprehension (Jones et al, 1999), and navigation (Parush and Yuvuler-Gawish, 2004) might be tedious using fingers, tipping and wiping away at analytics and reports. The aim to provide access to the very same information to small screen and large screen users as well as to allow them performing the same tasks creates design challenges to developers (Parush and Yuvuler-Gawish, 2004) and management accountants as drivers and stakeholders of the information-provision process alike.

Why should this concern the management accounting function? The notion that managers are able to access potentially decision-relevant accounting information in the cloud, i.e. base a decision on potentially limited data (Cosgrave, 1996) they see on a small screen, outside the confines of their organisation, led us to the following question: Is there actually a risk of making wrong decisions due to the small screen size of mobile devices? In other words, does the loss of data due to condensed information (basing decisions on limited information; see Cosgrave, 1996) on a small screen counteract the otherwise beneficial anytime-anywhere access to decision-relevant accounting information?

An early study by Jones et al (1999) found evidence that small screen users were 50% less effective in completing information retrieval tasks than users on large computer screens. In their study, 80% of members in the small screen user group reported that the small size actually impeded their work (as opposed to 40% of users in the large screen group). Similar results were

³ For instance, the Samsung Galaxy S4 has a screen size of 5", the iPhone 5s provides 4" diagonally.

reported by Parush and Yuvuler-Gawish (2004) who looked at the impact of a broad navigation structure on task performance, including tasks that require making decisions. They found that a broad navigation structure (a larger number of navigation options on the same level) leads to less errors in decisions than a deep navigation structure (many hierarchical level of navigation options), as this decreases time spent on search, decisions and reaction on less navigation levels. This would also result in less confusion about where a particular piece of information can be found, avoiding disorientation, and keeping their mind on the task (Parush and Yuvuler-Gawish, 2004). This would support decision-making using small screen devices, as it would also increase position awareness regarding the level of (accounting) information they are in - especially important the more complex the task at hand is.

Navigation and position-awareness were also important factors in Ziefle's (2010) work on mobile devices and their usefulness to supporting older people. Focusing on the trade-off between visibility/readability and ease of orientation in handheld device menus, she found that the less information is displayed on the screen at any time, the more the user is forced to navigate to other functions and pieces of that information. This requires in-depth knowledge of - in our example - the accounting application displaying the data, its navigation and menu structure, potentially disorienting new users of the application. As a consequence (for all users), decision-relevant information might get omitted, overseen, misinterpreted, incorrectly analysed due to incomplete information, or difficult to compare to determine a trend or a tendency of what specific data insinuates.

Accessing the cloud also encourages collaboration between location-independent parties. Watters et al (2003) looked at the use of large tables on small displays, where collaboration happens across a variety of devices. They particularly focused on whether task performance is affected when some larger piece of information (in their case a table) is larger than the screen. An interesting aspect in Watters et al's (2003) analysis is what happens when collaboration across devices requires a shared view, but happens on different screen sizes. Watters et al (2003) found that the provision of contextual information improved user performance in general; an additional search function improved efficiency using large tables on small screens.

Now where is the management accounting function in all of this? For small screens, it seems that it is as important WHAT a particular report states, as HOW it looks like on a small display. In addition, the design question of how the information from the cloud can be navigated so the user is not missing out on crucial information is essential to remain “position aware” (Parush and Yuvuler-Gawish, 2004). With a suggested involvement of the management accountant in the design of the information system, the usability and usefulness of how decision-relevant accounting data is displayed on a variety of devices becomes evident for making decisions. This would potentially decrease the probability that condensed information viewed on a small screen would be blamed for erroneous decisions. It seems that search mechanisms, clearly navigable drill-down functions, breadth instead of depth in navigation hierarchies, and reduced scrolling would be essential in all design considerations (Parush and Yuvuler-Gawish, 2004; Watters et al, 2003; Jones et al, 1999), and thought put into how accounting information retrieved from the cloud needs to be displayed to keep design-induced incorrect decisions at bay.

We see the potential of future research on app design and impact on managerial decision-making in this area, especially using contemporary devices like smartphones and tablets; to our best knowledge, no such research has been done to date.

3.4. Research area 4: Impact on the role of the management accountant

The previous section on small-screen usability and navigability of accounting information from the cloud has also highlighted the idea that the MA function and the management accountant will need to get involved in more non-accounting related tasks. In this section, we want to expand this idea and discuss how the management accountant might take on a more strategic and IT-involved role, practically turning into a “grey eminence” or “jack-of-all-trades” inside the company.

The role of the management accountant has been the subject of many studies, especially in the area of accounting and organizational change. Some studies have found role changes which are perceived as positive to management accountants (Goretzki et al, 2013, Burns and Vaivio, 2001; Weber, 2011), while others note potentially less favourable changes (Otley, 2008; Scapens and Jazayeri, 2003). In particular, role changes suggesting a move towards a

business partner/ business advisor type role have been noted by many of academics in recent years (e.g. Goretzki et al., 2013; Weber, 2011; Baldvinsdottir et al., 2009; Byrne and Pierce, 2007; Jarvenpaa, 2007; Burns and Vaivio, 2001; Granlund and Lukka, 1998) as well as practitioners (Simons, 2012; Boettger, 2012).

As noted earlier, one major driving factor of this role change are developments in information technology (Scapens and Jazayeri, 2003). Especially since the late 1990s, fully-integrated ERP systems were said to be responsible for freeing the accountant of the previous bean-counting and routine work, and move their focus towards consulting or advising line managers (e.g. Goretzki et al., 2013; Weber, 2011; Scapens and Jazayeri, 2003). This is coherent with Otley's (2008) observation that "traditional management accounting is diminishing" (p.235), as management accountants seem to encounter the need to turn towards taking up additional roles, tasks and responsibilities (Weber, 2011) to gain (or re-gain) legitimacy. As noted by Burns and Baldvinsdottir (2005), moving the accountants closer to what happens in the business, to integrate them so they can proactively support management, lifts the management accountant into a highly prominent and influential role where they can add value (O'Mahony and Doran, 2008). Of course, this requires an altogether new set of skills and responsibilities that need to be developed (Weber, 2011), first and foremost going beyond the numbers, working cross-functional and lead as well as participate in a variety of teams and projects (O'Mahony and Doran, 2008). In contrast, Byrne and Pierce (2007) in a series of interviews with 36 financial and operating managers in medium and large Irish manufacturing firms found that the decision partnering aspect was not as prominent as in other studies, being more of a "recommender" or "suggestor" than a decision maker (p.482). However, this shift towards a deeper embedding in the business is not just an academic discussion. Considering the rhetoric of professional bodies such as the Chartered Institute of Management Accountants (CIMA), the role of the management accountant has also evolved from a mere provider of cost information to an 'in-house consultant' and business partner in all things operational and strategic (Simons, 2012; Bhimani and Bromwich, 2010). In these areas, the management accountant's skills "are able to add little value" (Otley, 2008, p. 235), and the role is also contested by other specialist functions like operational management or information systems.

Competition for the management accountant does not only stem from other roles in the organisation; as recipients of decision-relevant information, managers themselves are perfectly able and capable to gain direct knowledge of their costs, budgets and other information that is relevant to their decisions (Scapens and Jazayeri, 2003). The IT available to them enables them to create their own reports in any format they require in order to make decisions (Granlund and Malmi, 2002). Line managers and other non-accounting functions seem to be able to handle accounting information (Otley, 2008; Scapens and Jazayeri, 2003) as it moves out of the accounting function. This might detach management accountants not only from their core responsibilities, but also from the newer business partnership-role if they do not keep abreast of internal business processes. Accounting literacy is not necessarily exclusive to management accountants, as discussed above. El Sayed (2006) found evidence in Egyptian companies that information technology staff are well-versed in learning accounting knowledge (similar Caglio, 2003).

For the management accounting function, there is a need for greater involvement in business processes, requiring considerable enlargement of their roles (Byrne and Pierce, 2007), especially towards technology. With ERP introduced, implemented and running, a range of authors has clearly pointed towards the management accountant taking ownership of the process of implementation, configuration, maintenance, operation and system evaluation of IT systems and developments (Burns and Vaivio, 2001; Granlund and Malmi, 2002; Byrne and Pierce, 2007; Azan and Bollecker, 2011; Goretzki and Weber, 2011; Chen et al., 2012). This clearly suggests how essential in-depth IT expertise and skills for the management accountant has become.

If the implications of anytime-anywhere access to decision-relevant information by means of cloud computing technology are not actively incorporated in the role of management accountants, this may put a dampening effect on their influence on decision-making processes in general, and the suggested role of a “business partner” in particular. We suggest that management accountants might lose a certain amount of influence and relevance in an organisation adopting cloud technology unless they actively acquire the corresponding

knowledge, in other words, a “pro-active hybridisation” of their own role. This knowledge needs to enable the management accountant to be a leading instead of a lagging factor of the set-up and maintenance of information systems that leverage the processing power and data sets embodied in cloud technology - even if managers bypass their role in order to access it. In essence, a management accountant may need to be an “information controller and distributor” ensuring that accuracy and relevance of information disseminated by whatever technological means.

The management accountant could a) design and operating the information systems on a cloud platform (similar Weber, 2011), so he influences what kind of information is gathered, how reports can be generated, generally, how relevant information can come off the system; b) actively train and advise non-accounting personnel (similar Chen et al., 2012, for ERPs), fill a corporate teaching position and guide others towards correct use and interpretation of accounting information; and c) establish himself as the primary information hub that keeps on advising management. In other words, we suggest a “grey eminence” positioning by pro-actively taking on a hybrid position within the organisation. By doing that, the management accountant is able to re-legitimise his role along various paths of task development (Weber, 2011).

4. Research agenda

From the previous sections detailing the research area, we can identify and suggest potential research areas from management accounting researchers that are potentially worth investigating.

Research area 1: Impact on the basis for decision-relevant information (costs)

Future research will need to enable the management accounting function to understand the impact of new types of costs that arise with cloud technology, as well as deal with changes in the cost landscape. Those businesses that move their IT in the cloud will experience shifts from capital expenses to operating expenses, and the results of these shifts on the decision-usefulness of costs. We do not suggest that there will be an impact on management accounting instruments as such (similar Granlund et a, 2013), but we are hypothesizing that the changes in cost will not be as simple as the mere replacement of one group of cost items (IT investment costs) by a

simple pay-per-use fee. Also, knowledge of the TCO over the life cycle of a cloud will be instrumental to cost management, budgeting and control, all directly impacting the management accounting function and its responsibilities.

Research area 2: Impact on strategic IT decisions (outsourcing, insourcing), implementation and security issues

Future research from the management accounting function's point of view will need to look at two separate areas in decision-making: 1) Involvement of management accounting in strategic IT decisions, and changes in decision-making processes regarding cloud-related capital budgeting decisions (financial and non-financial factors); 2) Involvement of the management accounting function in cloud risk management to ensure data security, privacy and ultimately, integrity.

We feel that the management accountant's view on these issues has not been systematically researched by academic accounting researchers. From the discussion above, a clear management accounting research gap appears, as most contributions come from computer sciences and IT literature that - if at all - aim to include a business perspective. We think it beneficial to investigate these questions from the management accounting point of view.

Research area 3: Impact on the technical usability of management accounting information on mobile devices

From our discussion in this section, we conclude that the management accountant should get involved in how small screen devices impact decision-making. This would potentially include participation in app design, computer interfaces and issues of navigability and usability; to our best knowledge, no such research has been undertaken from the decision-making impact point of view. Management accounting is predestined to influence this discussion, investigate potential areas of risk to managerial decision-making, and ultimately aim to use reduce them by influencing end-user interface design.

Research area 4: Impact on the role of the management accountant

Many of the implications for this research area are somewhat linked to all four areas, as we are ultimately asking to involve the management accounting function and hence the management accountant to venture in areas that are not necessarily the traditional ones. As such, future

research might look at the actual skills that management accountants needed to develop and apply after the implementation of cloud technology (competencies, skills, knowledge, etc.), whether previous experience and knowledge from e.g. ERP implementations, knowledge of running systems in and from the cloud, how managers use these systems (e.g. is bypassing the management accountant a regular occurrence).

5. Concluding comments

From the above discussion and research agenda, it is evident that cloud technology is a potentially crucial change factor of the management accounting function and the role of the management accountant. As such, we claim that the management accounting function has indeed a very high interest in facing this technology head-on, getting involved in the decision to adopt the cloud, having knowledge of costs (and cost savings) included as well as their potential to change the information basis of some management accounting instruments (but not the instruments themselves). Further to that, questions of risk management (security, privacy, integrity) will need to enter the realm of management accounting, as the interest to protect what is potentially being moved outside the premises of the organisation should become evident. After all, the management accounting function aims to be the information hub of an organisation where all strands meet. Furthermore, the use of small devices (often owned by the person using it, BYOD) does not only impact questions of access and security, but also how the information displayed might influence decisions "on the go". And finally, how does cloud technology change the underlying mechanisms of management accountants' work and management accounting that build the basis for most of our MA theories today?

Cloud technology is still in its (albeit late) infancy, but the market is becoming more stable (Gartner, 2012), indicating that the technology is here to stay. As practice is pushing the cloud agenda forward, academic research needs to catch up and provide insights and ideas from an academic point of view, opening an exciting new field to management accounting research.

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