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Reflections on the Applicability of Business Analytics for Management Accounting – and Future Perspectives for the Accountant

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Abstract

Purpose – To identify, discuss and provide suggestions for how the phenomenon of Business Analytics and its elements may influence management accounting and the accountant.

Design/methodology/approach –This paper identifies a number of studies from both academic journals but also reports from professional consultancies and professional accounting bodies concerning future opportunities and implications for management accounting in combination with business analytics.

Findings – First, it was found that both academic articles but also professional accounting bodies suggest changes for management accounting. Second, it shows that topics such as, a holistic view, fact-based decisions, predictions, visualization, and specific hard core skills for the accountant are the most important mentioned. Finally, the paper demonstrates that there are different ambition levels for the

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management accountant, depending on if s(he) wants to be on a descriptive, on a predictive, or on a prescriptive level.

Originality/value – Even though the paper is general in nature, the paper discusses a phenomena that for some reason has been ignored by practitioners and researchers. The true value of the paper therefore lies in making practitioners and researchers, more aware of the possibilities of business analytics for management accounting and through that, making the management accountant a real value driver for the company.

Keywords: Management accounting, management accountant, business analytics, creativity, big data, decision making.

1 Introduction

In a commentary in Accounting Horizons (2012), Moser asks if accounting research is stagnant. His answer to this question is a qualified 'yes'. There are several reasons for this answer. One of them is that researchers within the field of accounting rarely collaborate with researchers who use different methods or with researchers outside the field of accounting. Researchers tend to work with researchers who use the same research methods. The result is that our research does not have much impact on society and on practice because no one outside the accounting research society cares about our results even though actual management accounting has evolved considerably over time (Birnberg, 2009; Hopwood, 2007; Kaplan, 2011; Zimmerman, 2001).

Over the years, the concept of change in management accounting research has been studied from many different angles using different theories, for example functionalist, behavioural relations, institutional theories, actor network theories, interpretive and critical perspectives together with a variety of different methodologies such as field studies, case methods, archival studies, and experimental studies (Berry et al., 2009). Frustration has been that few research results have ever been used in the practical world (Merchant, 2012) in spite of the fact that management accounting is an applied and practical field that constantly faces new challenges from the business world (CIMA, 2009; IMA, 2008a; Kaplan, 1998, 2012; Kasanen et al., 1993; Otley, 2001). For research to merely contribute new theories is not good enough; instead the researchers should try to advance the body of knowledge, i.e. to develop predictive theories that specify both the behaviour and the context required for achieving the specified outcome (Ahrens and Chapman, 2007). McAfee and Brynjolfsson (2012) also argue that 'all these can be done in areas that so far have been dominated by intuition rather than by data and rigor'.

The term 'business analytics (BA)' is being used within the information technology industry to refer to the use of computing to gain insight from data. The data may be obtained from a company's internal accounts and sources such as its enterprise resource planning application, from data warehouses, from a third party data provider, or from public sources. Companies seek to leverage the digitized data from transaction systems and automated business processes to support what is normally called 'fact-based' decision making. Therefore, the concept of business analytics is a category of computing rather than a specific method, application or product (Lustig et al., 2010). In many ways, the goal of business analytics is to make better business decisions rather than simply to automate standardized processes.

A citation from the CIMA Conference in London 2017 (Big Data and Business Analytics) also states:

'Discover how to use analytics to transform finance. Data analytics are becoming the most important means of identifying the business drivers of the organisation and therefore a major influence on its financial outcome'.

Even though the concept of big data or 'big data analytics' is often related to unstructured data (e.g., data from the internet such as data used by Amazon, Facebook, Twitter, and YouTube), there are also a number of interfaces to a company's performance area such as different dashboards (Eckerson, 2011; Giles, 2012 in The Economist). The three-fold challenge of big data is therefore: deciding which data to use, deploying analytics, and using its insights to transform operations (McKinsey, 2013). Using structured small-data (i.e. spreadsheet data in rows and columns) is also relevant (Davenport and Kim, 2013).

To shed light on the link between business analytics and management accounting, the purpose of this paper is to review some target related literature discussing this intersections. More specific, the paper first discuss the superior themes and their content from the business analytics literature that would be of interest for the management accounting

community, then the paper tries to evaluate these results compared to the management accountant's areas. Because the paper is seen more as an inspirational paper discussing these questions, the findings are based more personal opinion and interpretation than on specific research contributions.

To discuss these issues the paper first analyses the driving forces and elements in business analytics and combine these themes and issues with traditional areas within management accounting. Based on the findings a need for increasing the focus between business analytics for decision making seems to be strong. Finally, the paper discusses the demand for management accountants' analytical skills which is expected to soar in the future. The main conclusion is that if the management accountant want to excel to the highest decision level in the business analytics environment (i.e. the prescriptive level) the accountant must increase – not only the IT - but also their statistical and econometric skills. However, also soft skills such as intuition, creativity and communication skills specific originate from the analytics movement are most relevant (Davenport and Kim, 2013).

The paper is structured as follows. To get into the BA movement, section 2 synthesizes the relevant literature on business analytics and management accounting. Then section 3 discusses the implications of the business analytics for management accounting and section 4 finishes the paper with a conclusion, limitations, and ideas for future research.

2 Driving sources of business analytics[1]

The background information synthesis is that 'analytics' will also have a decisive impact on management accounting and the management accountant (MA). In order to compare and being able to say something about different ideas from the analytics literature on management accounting one can examine the driving forces behind the analytics movement from primary and secondary research perspectives and synthesize the literature by analysing important differences and similarities (Denyer and Tranfield, 2008; Hemingway, 2009). Primary literature search is based on reviewed articles from journals, whereas secondary literature is literature such as research reports and white papers from consultant companies or other documents not normally subject to editorial control and peer review. This classification is used below in order to give a more complete view of possible influences on management accounting from business analytics.

2.1 The analytics journey

The concept of business analytics originated in an HBR article by Davenport in 2006 entitled 'Competing on Analytics'. Since then, Davenport has written a number of books and a huge number of articles. Looking into the definition of 'business analytics' this is defined as:

> *'the use of data, information technology, statistical analysis, quantitative methods, and mathematical or computer- based models to help managers gain improved insight about their operations, and make better, fact-based decisions' (Davenport and Harris, 2007, p. 7).* They continue by saying: *'that analytics are a subset of what has come to be called 'business intelligence': a set of technologies and processes that use data to understand and analyse business performance.*

The analytics journey can best be described by Figure 1. The figure shows the different stages and questions related to the level of business intelligence and competitive advantage. BI encompasses a variety of tools, software

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[1]It is important to realize that several concepts within the 'analytics movement', for example business analytics, business intelligence, or data mining, may have different definition and different meaning for different people (e.g. data scientists vs. ordinary users). Finding a single unique definition may almost be impossible, also because the concepts have developed over time.

applications and methodologies that enable organizations to collect data from internal systems and external sources, prepare it for analysis, develop and run queries against the data, and create reports, dashboards and data visualizations to make the analytical results available to corporate decision makers as well as operational workers (Davenport and Kim, 2013).

Insert Figure 1: (Roadmap to proactive decisions) about here!

In order for a business to have a holistic view of the market and to able to compete efficiently within its markets requires a separation in three levels:

Descriptive Analytics (insight into the past): Also known as standard reporting and dashboards: What happened? How does it compare to our plan? What is happening now? Drill down and analysis: How many? How often? Where? Ad-hoc reporting: Where and what exactly is the problem? Alert: What actions are needed (Davenport & Kim, 2013; Lustig et al., 2010)?

This means using a set of technologies and processes that use data to understand and analyse business performance (e.g., by using charts, pivot tables, and graphs). The idea is to identify patterns by using simple statistical measures (e.g., the mean, correlation, range, and standard deviation) to make informed decisions (Evans and Lindner, 2012).

Predictive Analytics (Understanding the future): What is happening now? What could happen? What data is correlated with other data? What pattern recognition can we see? When should I take action to correct or adjust a process or piece of equipment? What if these trends continue? What will happen next if…? (Davenport & Kim, 2013; Lustig et al., 2010)?

Predictive analytics thus includes extensive use of data and statistical techniques to uncover explanatory and predictive models of business performance representing the inherent relationship between data inputs and outputs/outcomes. It is at this level that the term 'advanced analytics' is more aptly applied. Evaluating the predictive power of a model refers to a model's ability to generate accurate predictions of new observations from possible future values (cross-sectional) or by time-series data (Shmueli and Koppius, 2011). Predictive analytics also uses techniques such as clustering, expert rules, decision trees, simulation, and neural networks.

Prescriptive Analytics (Advise on possible outcomes): Prescriptive analytics is based on the concept of optimization, which can be divided into two areas: How can we address the best outcome, and how can we achieve the best outcome and including the effects of variability? (Davenport & Kim, 2013; Lustig et al., 2010)?

The field of prescriptive analytics allows the decision makers to 'prescribe' a number of different possible actions to and guide them towards a solution. Prescriptive analytics attempt to quantify the effect of future decisions in order to advise on possible outcomes before the decisions are actually made. At their best, prescriptive analytics predicts not only what will happen, but also why it will happen providing recommendations regarding actions that will take advantage of the predictions. In prescriptive analytics, it is time to think about what the best response or action will be given the limited resources of the company. Prescriptive analytics uses optimization to identify the best – and most likely – alternatives in order to minimize or maximize some objective.

Davenport and Harris (2007) also document a large number of case studies of companies that have gained benefits by using advanced analytics such as Procter & Gamble, Barclays Bank, Capital One, Boston Red Sox, and Harrah's Entertainment. Even though these companies may be characterized as relatively big companies, they used

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relatively simple models. Capital One, for example, was able to identify and serve market segments before its peers. The key to this ability was the company's closed loop of testing, learning, and acting on new opportunities (Davenport and Harris, 2007, p. 42).

According to a Gartner (2012) survey, organizations get $10.66 of value for every $1 invested in analytics and the survey predicts that adoption rates for analytics will go from 25%-35% today and will continue to accelerate beyond 2020.

2.2 Primary or reviewed accounting literature

A search of large scientific databases (ABI Inform, EBSCO, and Science Direct) for key words such as business analytics and management accounting/accountants was done. This gave a large number of hits, but only few relevant reviewed articles. However, this search produced a number of articles concerning different IT/ERP systems and management accounting which is not relevant here.

Kaplan was one of the first to mention a new environment for accounting. In an interview with Paul Sharman in Strategic Finance, March 2008, Kaplan also pointed to the importance of BA by saying:

'Management accounting analytics is no longer constrained by limited or complex access to companies' databases. But to excel at analytics, management accountants will require extensive training in modelling, multivariate statistics, and econometrics'.

Năstase and Stoica (2010) explore and discuss the relationship between the analytical capabilities in the planning, sourcing, making, and delivering areas of business performance using business analytics and business process orientation as moderators. The article lists a number of relevant areas within management accounting in which BA is being used or can be used, and it discusses a number of concepts (BI, data mining, data analysis, etc.) and their assumptions. The message is that because the world is changing and becoming increasingly instrumented, interconnected, and intelligent, new ways of using and presenting data hold the potential to supply actionable insights for decision makers at all levels of the organization such that performance can be optimized.

Schläfke *et al.* (2013) were among the first to discuss business analytics in a performance management system framework and to address the need for management accountants to develop a performance management analytics approach. They suggest a multilayer performance management framework that could help managers decide on the kind of analytics they should use when they want to test and map the causality-based couplings of context factors, inputs, processes, outputs, and outcomes in order to highlight their value creation. As pointed out by Schläfke *et al.* (2013) this will require new data analysis skills.

Cokins (2013) discusses seven trends in management accounting, where predictive accounting and business analytics embedded in ERP methods are two of them. He suggests that instead of focusing on historical cost or descriptive costs, researchers must now focus on predictive costs to close the gap between what management accountants report and what managers want in order to make relevant decisions. He also finds that business analytics is needed because this is the only sustainable long-term competitive advantage as the traditional generic strategies such as being the lowest-cost supplier are vulnerable to agile competitors who can quickly match a supplier's price or invade his customer base. In the end more relevant skills are needed if management accountants are to be able to fulfil their jobs.

Warren *et al.*, (2015) discuss the importance of big data on management and financial accounting basically from video, audio, and textual information made available via big data. Specifically, in managerial accounting, the authors

posit that big data will contribute to the development and evolution of effective management control systems and budgeting processes. For example, for the BSC big data can identify new behaviours that influence respective goal outcomes. For instance, web use while at work may be tied to learning and growth goals, internal emails may correlate with the effectiveness of internal business processes as well as customer service quality, and customer service quality may be related to vocalic cues mined from customer service calls, or the tone of emails and phone conversations made on company equipment could be indicators of employee morale or the number of emails sent by managers could be a proxy for productivity. The authors also mention the use of big data, including additional streams of data outside ERP systems (e.g., climate, satellite, census, labour, and macroeconomic data) could be used to enhance the beyond budgeting practices.

Finally, Brands and Holtzblatt (2015) discuss and analyse how management accountants can position themselves so as to play a key role in the implementation and application of business analytics in their organizations as they move beyond traditional, transaction based accounting to analytics. This trend will transform the way management accountants' analyse and interpret data for their companies in the future, not only in relation to financial accounting (e.g., accounts receivable, and payment monitoring) but specifically in relation to the visualization of data. The authors end with a roadmap for BA and the following statement:

> *'Management Accountants have a difficult task ahead of them. If they fail to leverage the opportunities provided by the digital information revolution, they could jeopardize their organization's operating performance and competitive advantage. Put simply, management accountants and other financial professionals must identify how they can use and analyse data' (p.10).*

2.3 Secondary literature research findings

To explore new research ideas or changes, academic literature may be scarce and in such cases secondary or the 'grey' literature may be included (Hemingway, 2009). In the following an outline is provided of the publications and reports issued by mainstream professional accounting bodies and large consulting companies on the influence of business analytics/big data on management accounting.

2.3.1 Professional accounting bodies

Because the influence and importance from professional accounting bodies seems to have increased over the years, it is important to include their ideas, topics, and research areas to see how these organizations envision the future for management accounting and accountants. Focus is on a few relevant reports from the American organization IMA (Institute of Management Accountants), the UK organization CIMA (Chartered Institute of Management Accountants), ACCA (Association of Chartered Certified Accountants), and CGMA (Chartered Global Management Accountant.

The synthesis can be formulated as: *what does empirical research conducted by these professional accounting bodies and consulting companies from 2013 and forward envision and suggest for the future as regards the interrelation between BA, big data, management accounting, and the management accountants?*

Because we are interested in the field evidence on the subject, only targeted empirical studies are used. The search has come up with the papers listed in table 1.

Insert Table 1: (Publications from professional accounting bodies.) about here!

Due to limit space and because of the repeated points made in many of the reports, only a few relevant points and findings from the latest CGMA (2016) report will be discussed below.

To be certain that the decision we take will eventually have the highest impact is rarely possible. We therefore need to make each decision based on the best possible information and shape it by the best possible judgment. This is the main topic in this report. Senior leaders around the globe are often struggling to make the right decisions. The large majority find themselves battling against bureaucratic decision making processes, siloed and short-term thinking, facing lack of trust and collaboration inside the organization and difficulties with translating ever expanding volumes of information into relevant knowledge. The solution lies in a holistic view:

> *'The solutions to many of the decision-making challenges we have identified can be achieved through more integrated thinking—cutting through silos to connect the relevant people and information from across the organisation. Joining the dots in this way enables leaders to see the big picture. It means that all of the relevant insight is available when making decisions. It enables the analysis of how the business is performing in its market and why, drawing on the business model as a powerful frame of reference. And it means encouraging behaviours that build a foundation of trust upon which information is shared and influence secured' (p. 4).*

The report uses the word 'VUCA' world - characterized by Volatility, Uncertainty, Complexity, and Ambiguity. It is becoming harder and harder to get it right. As discontinuity becomes the norm and the most established business models are challenged, organizations need to make good strategic decisions quickly and then deliver on their choices. In this VUCA world CFOs are important:

> *'Organisations need a powerful framework led by the CFO and their management accounting functions to help leaders take the best possible decisions and in so doing to implement practical solutions that address the challenges of decision making today—this will prevent the decision-making gap from growing further. All the relevant information needs to be brought together, organised on the basis of a shared understanding of the business model, focusing on key performance indicators, in order that resources can be best allocated and risk managed to maximise cash generation' (p. 5).*

The solution lies in what the report calls 'integrated thinkers':

> *While many are struggling to make headway in their decision-making capability, there is a group of organisations at the other end of the spectrum. These companies are using high-calibre decision making to drive performance and bottom-line results, as well as making their organisation an attractive and stimulating environment for talented people. We call these organisations 'Integrated Thinkers' and they are characterised by strong implementation of the Global Management Accounting Principles® that provide a foundation for effective decision making and the creation of value in large organisations. These principles are: Influence, Relevance, Analysis and Trust (p. 8).*

Integrated thinkers – or 25% of the respondents - enjoy a decision making advantage and are more effective in the key factors that affect decision making. Asking respondents how their organizations have performed over the past two years, compared to other organizations in their industry, 65% of integrated thinkers cited a better performance compared to their industry peers. About 55% of the executive teams see a need to improve active collaboration with fellow executives:

> *Clearly the days of the 'imperial' CEO are over. No one person has all the information necessary to make decisions. You need the people with the right experiences at the table who bring that knowledge, whether it be their business units or their functions (Mark Weinberger, Global Chairman and CEO of EY, p. 18).*

Another important topic for management accountants is how to define different time perspectives for decisions. Defining short, medium and long term objectives in companies seems to pose a real challenge:

> *Yet, in our survey, almost half (48%) of respondents say they are struggling to balance their short, medium and long-term objectives as they make key decisions about their organisations' futures (p. 20).*

This is also supported by problems related to different metrics in that 34% of the respondents report that they find it challenging to select the right combination of metrics to measure business performance over different time frames. However, 68% of the integrated thinkers say that they are highly effective in their understanding of how their business model needs to adapt over time in response to market trends. This 'time dimension' must be included in models and decisions:

> *The sophistication of information and its availability for real-time decision-making is in a different place from where it was a few years ago, says Mr. Henry of Royal Dutch Shell. Tapping into these information sources to react in tougher times is critical, and can be a major opportunity to create or protect value. At Yahoo, Mr. Goldman adds: Modelling can be very dynamic in today's world—the information is constantly changing in a climate or environment that is more volatile than in the past (p. 23).*

However, 80% point to at least one occasion during the last three years where their organization has made a strategic decision and subsequently discovered that it was based on flawed information, and although 37% of organizations say that big data has helped them to make better decisions, a worrying 32% say that it has actually made things worse.

The time dimension is specifically important in connection to forward looking and prediction. 'Only' 66% of the respondents say that their management information systems contain the right amount of forward-looking and predictive data.

One of the main conclusions made in the report is to invest in skills or else other will take over:

> *Demand is increasing for data scientists and finance executives with data expertise. Closer integration between data specialists and other functions can help to unlock new sources of information, delivering fresh insights about past outcomes as well as helping to predict the future environment. Related to this, only 27% of senior leaders in our survey rate themselves as being highly effective at interpreting new data sources and tools. Recognising the need for greater organisational support in this area, 40% say that data scientists should be given greater responsibility in the decision-making process (p. 27)*

Thus the pivotal questions are in what direction these professional accounting bodies go and how will it affect the future role of the management accountants? Implicitly, most of the statements and citations build upon a number of assumptions as regards the qualifications and skills needed by the accountant in the future. In the next section, a number of the most prestigious consulting companies and their ideas in relation to management accountants and BA are discussed.

2.3.2 Consulting companies' views on business analytics and decision making

The consulting companies used here are all on Forbes' list of the most prestigious consulting firms in the world[2].

Due to the extremely high number of research reports and recommendations produced by professional consultancies concerning analytics and big data, the research is limited to include only papers from 2013 and forward.

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[2] There is a number of different ways to classify consulting companies, e.g. financial management companies, top consulting firms, management consulting industries, or IT-consulting companies. Here the choice is on Forbes 2015 list over 'The Most Prestigious Consulting Firms In 2015', based on Vault.com. Vault's list comes from a survey of consultants who are asked to rank their peers and competitors. However, even though a consulting company is not rated as one of the most prestigious, it might be relevant for many other specific reasons related to BA (e.g. Ventana for using System Dynamics for BA, or Alteryx and Tableau for using Visual Management for BA).

In the same way as for the professional accounting bodies, the selection criteria has been statements - based on empirical data - that describe these companies resulting attitude for how BA may influence MA. This selection may be seen as a personal filter - and not as the only result and influence. However, the consulting companies belong to the largest and highest ranking consulting companies discussing business analytics, and big data the possible influence on management accounting. Often their statements and conclusions are the result over a long period of time where the same topic has been investigated.

Table 2 lists the selected companies together with the assumptions for their research and the important implications for management accounting and management accountants.

Insert Table 2: (Publications from major consulting and accounting companies.) about here!

Due to limit space and because of the repeated points made in many of the reports, only a few relevant points and findings from MITSloan Management Review will be discussed below.

The purpose of the MITSloan Management Review in collaboration with SAS Research Report (2016) study is to understand the challenges and opportunities associated with the use of business analytics and big data. In the report, the term 'analytics' refers to the use of data and related business insights developed through applied analytical disciplines (for example, statistical, contextual, quantitative, predictive, cognitive, and other models) to drive fact-based planning, decisions, execution, management, measurement, and learning. The survey was conducted to take the temperature of BA in the present business environment. The findings also show that despite the hype, the reality is that many companies still struggle to figure out how to use analytics to take advantage of their data:

> *It is hard work to understand what data a company has, to monitor the many processes necessary to make data sufficient (accurate, timely, complete, accessible, reliable, consistent, relevant, and detailed), and to improve managers' ability to use data. This unsexy side of analytics is where companies need to excel in order to maximize the value of their analytics initiatives, but it is also where many such efforts stall (p. 3).*

There are several reasons for not gaining the edge of analytics; 37% say that they have just begun to apply analytics; 29% say that they do not use analytics to drive strategic decisions; 29% say that they are not sure how to apply the analytical insights to their business; and 28% say that analytics is not a priority for senior management. As pointed out in the survey one problem seems to be the use of data management tools because since 2012, companies have not improved their data management capabilities. Data management is fundamentally important to achieve effective analytics, yet it remains one of the biggest challenges for many organizations. However, most feel optimistic about analytics and its implementation over the next few years (about 80% strongly agree and agree in this statement).

A number of case studies included in the report also show that formal analytics strategies tend to focus on at least three basic areas of activity: skills development, data management, and cultural norms for using data in decision making. Some of the most mature analytics organizations (the paper mentions Bank of England, General Electric, Xiaomi), along with those that are striving to use analytics more widely, forge a strong connection between their organizational strategy and a formal strategy for analytics.

Finally the survey shows that decision making is probably the most important topic within BA:

> *The main goal of a formal organizational strategy for data and analytics is typically to improve decision making with analytics in a wide realm of activities. These might include customer segmentation, pricing, identifying new markets, managing supply chain risk, fraud detection, creating efficiencies, and improving operational effectiveness (p. 10).*

However, analytics alone is not enough:

The perceived dichotomy between analytics and intuition is false for two reasons: Intuition has a critical role in developing analytics; and blending analytics with intuition in decision making can produce more effective results than either alone, especially when making strategic decisions(p. 14).

In summary, even though the reports and the literature above include many different elements and statements and several topics, the tendencies seem to be clear. The decision makers agree that business analytics, data analytics, and supported techniques are increasingly important.

Many decisions mentioned in this literature related to areas that are actually the main field of management accountants (compare, e.g. to Drury, 2004; Horngren, 2010; Seal *et al.*, 2015) and this is actually the main reason why management accounting and management accountants have to take the analytics movement very seriously.

3 Discussing the implications for decision making

Now we proceed by synthesizing the knowledge that we have gained on the business analytics literature discussed earlier. The idea is also to compare with the management accounting community also has discussed about these issues. Below five statements give the highlights from the literature above compared with existing management accounting literature.

> **Management accountants must focus on the holistic view in an analytics culture:** Performance management research has already been dominated by different holistic models for several years. Within strategy, holistic models such as the balanced scorecards, the pyramid model, and different business models have been dominant (Berry *et al.*, 2009; Ferreira and Otley, 2009; Flamholtz and Hua, 2003; Kaplan and Norton, 1996; Malmi and Granlund, 2009; Simons, 1995). Birnberg (2009) and Bromwich and Scapens (2016) also have suggested that the practical problems faced by management accountants be solved by transgressing the boundaries of management accounting and interacting with non-accountants by for example combining qualitative and different quantitative methods. In the analytics perspective, however, the holistic view is related to decisions and access to relevant data, meaning that the MAs must come up with new ideas and suggestions that create change in the organization through commercial insight and impact. The main idea is to treat the whole 'patient' rather than just the current complaint. Therefore, MAs must – in a much deeper way - interact with other operational areas to be able to identify impacts from these areas (e.g. supply-chain, customer engagement, human resources, and marketing). In an analytics culture, decision making norms, behaviours, values and outcomes are aligned to assure that analytical insights actually generate value - not merely promise the possibility.

> **Management accountants must focus on fact-based decisions that create value and impact:** Since the beginning of cost accounting and management accounting, a big part of theory and textbooks have always emphasis on solving real and relevant practical problems in order to secure the impact on students and society (Groot and Selto, 2013; Johnson and Kaplan, 1987; Kasanen *et al.*, 1993; Merchant, 2012). So, this is in fact not a new idea. In an analytics view, however, not only should decisions be based on facts, but they should also make impact and create value for the company. Experience has shown that this is hard work and assumes in fact a lot of talent and skills to be able to estimate these outcomes (Davenport and Harris, 2007; Silvestro,

2014). At the operational level this is often easier than at the strategic level (Fact based decisions; Tableau, 2012: 'Decisions follow facts'). Strategic decision making tends to be very different and much more complicated: too many variables (e.g. markets, customers, products, and processes), too little structure, and too much uncertainty. Two different types of research problems or start up within the analytics approach can be used (Simchi-Levi, 2014). These types are also relevant for the MA. In problem-driven research, the decision maker identifies a problem and uses models and data to develop insights and possibly improvements for the company. In data-driven research, data from the organization are gathered before any specific model is developed; it is the decision maker's careful analysis of the data that sheds light on possible opportunities to make improvements. Because the decision model in analytics may be characterized as holistic as mentioned earlier, all types of relevant data should be used (financial, non-financial, tangible, and intangible) if necessary. And as pointed out in the literature above, an important assumption is that associations and relations is that the relations are based on real cause and effect relationships derived by 'scientific methods' (as mentioned in PWC, 2013), which means statistics and econometrics techniques. However, data, mathematical models, and statistical techniques by themselves do not constitute information - only the human mind can provide purpose and hence relevance to the data. The next step, therefore, is to turn information into knowledge, where knowledge can be defined as 'information combined with experience, context, interpretation and reflection' (Davenport et al., 1998). Furthermore, no BA can provide knowledge or insight directly, meaning that information derived from business analytics is only 'attention directing' and, therefore, require further work. Even knowledge by itself may not enough. The decision maker and the MA must truly understand an issue to be able to act upon it wisely (also 'understanding' is not an easy concept to explain, see, e.g. Webster, 1989). Therefore, when exploring the data, the MAs must at first be able to find patterns to determine whether something is directionally or in in-directionally related, which matters more than total accuracy. Data-driven decisions also include intangible assets (e.g. customer satisfaction, employee engagement and retention). Therefore, the MA must be able to define different time perspectives for decisions, i.e. short-short, short, medium, long, and long-long term objectives, and to do so in the right combinations for key decisions and specifically for forecasts and predictions.

➢ **Management accountants must focus on predictions and forecasts:** Both subjects are emphasised several times in the analytics literature above as important 'new' topics for the MA. Some argue that the problems with classical budgeting stem from the way budgets are used (Horngren et al., 2004; Welsch et al. 1988) while others argue that budgeting processes are fundamentally flawed. Never the less, traditional budgeting has now become the subject of considerable criticism and debate with the purpose of promoting the idea of Beyond Budgeting, Rolling Budgets or Activity-Based Budgeting (Bogsnes, 2009; Hansen, 2011, Hope and Frazer, 2003). For the analytics accountant, however, the MAs must move to a more advanced predictive analytics level using statistical modelling and data mining to predict risk events to assess emerging threats. In the analytics environment, choosing and using the right KPIs as depending or independent variables presuppose that the data structure is aligned to the value drivers of the business and thus is able to facilitate effective decision making. The purpose of analytics forecast is to be able to track the expected performance of the business (using probability statements) so that timely decisions can be taken to address shortfalls against target or to maximize an emerging opportunity (Makridakis et al., 1998). Prediction, on the other hand, is a statement or a plain hunch of future events based on present circumstances (Moridge and Player, 2013) such as

using the present sales to predict how many customers will buy a new car and what the net profit will be (Davenport and Kim, 2013). This activity is normally executed in a holistic model setup to see, for example the effect on net profit for the whole company. To supplement a traditional budgeting and planning process with forecasts and predictions as prescribed in a BA environment requires in-depth knowledge of different advanced statistical techniques and their assumptions and limitations.

➢ **Management accountants must focus on a visualized reporting process:** Reporting and communication have always been important topics for the MA and is seen as the language of business (Bhimani *et al.*, 2012). In the analytics view, both concepts have been emphasized several times. Because many of the decision topics within BA are highly related to the MA's domain, for example pricing – and because the decision maker has to make impact (i.e. improvements) and value (i.e. for customers) for the company the ideas, effects and possibilities must be presented in an interesting, understandable and effective way. To do this, the MAs need to have the skills to do it, i.e. skills related to the outcome from analytics in the form of numbers, graphs, trends, etc. Often such presentations is used interactively, meaning that the presenter can show the full effect immediately when, for example, a change in a variable is done. Many supposed rules are based on personal opinion, aesthetic judgments, and incomplete or oversimplified studies. To figure out which is which, the MA has to keep asking a simple question: how do we know that? Visualizations help people understand their data through data storytelling (importance of understanding events from beginning to end) and to share the human impact of numbers (Davenport and Kim, 2013). To gain advanced insight, the MAs also need to use data blending tasks such as parsing XML data to find and analyse, for example, part failure trends or spatial analytics to find and analyse customer behaviour by store. An example of visual analytics is shown in figure 2.

Insert Figure 2: (An example from Facebook Performance Visual for Delivery Costs for Customers With permission from Alteryx: The Leading Platform for Self-Service Data Analytics.) about here!

The graph contain both hard core data (numbers, time series data) and soft qualitative information (definitions and explanations), but most importantly also the assumptions (e.g. the data management structure) underlying this information (it can be checked by double clicking on a specific piece of information in the outcome). They build on DataVIZ (that is able to drill down into the source data to change the analysis parameters and make business analytics a game changer). Intuition and creativeness are not only related to building models in BA, but are also related to the explanation in the visualization view. In an analytics setup, the data-driven is interpreted and communicated through different interactive smart tools. Therefore, the MAs have a pivotal role to play in helping the business translate new data insights to company value by using different visualization techniques. Rather than just presenting financial data, the role of the MAs could, for example be to identify the options available to decision makers by analysing different datasets and scenarios, for example for customer segmentation, pricing, and product costing.

➢ **Management accountants must have explicit relevant skills for business analytics:** Skills and education subjects have been discussed over a long period within the management community. So what's new? A general statement often used is 'they need the same skills but in more depth now'. However, the demand for new skills are

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also mentioned and discussed in most of the papers above, without, being specifically clear. Looking into the often mentioned subjects, more depth is needed within IT, business intelligence, data mining, programming, and data management. Within statistics and econometrics, correlation and multiple regression have been mentioned as the most popular techniques. However, there is no doubt that if MAs want to be on a high analytical level, they must also be able to handle more advanced statistical techniques (for example, time-series analysis, ARIMA models, structural equation modelling, panel data models). So, if the MAs want to be part of the future for 'advanced analytics' (see, e.g. Hair et al. 1998, for advanced data analysis) and secure their jobs for the future, they need to shape their professional identity and focus on developing the necessary skills or they run the risk of other professional groups to take over (e.g., those data scientists who are strong in business, ROI optimization, dashboards design, metric mix selection - named Business Analyst). Hiring the best people has increasingly been recognized as a key to an organization's successful analytics deployment (Davenport et al., 2010). Or as said by Davenport and Kim (2013, p. 1) 'everyone needs analytics skills'. Simulation and optimization on the prescriptive level will provide a powerful methodology for complex behaviours and decisions, but will also require relevant insight for building relevant models based on data as mentioned by Simchi-Levi (2014). Findings also show that the functions of management accounting can be strengthened by the use of data mining and therefore the organization's decision making capabilities can be improved (Wang and Wang, 2015). However, for the MAs who want to work with decision making on the advanced analytics level, more advanced IT and econometrics skills are a 'must' because the biggest competitive advantage that companies can realize for their customers is when math is applied in new ways to solve specific challenges or opportunities within their business (Lustig et al., 2010).

These five syntheses tell us what the literature above has told us about the implications for management accounting/accountants in the analytics movement. It is evident from the discussion above that the analytics movement could have profound impact on MA and their work, depending on what level the accountant operates. Figure 3 represents the five spaces relevant for MA in a BA environment.

Insert Figure 3: (The figure depicts the five key implications for management accounting in Business Analytics) about here!

Even though these key implications are separated in figure 3, they are all interrelated and depending on each other through different levels of IT-systems and software applications. This means that changes and decisions can be made or changed at a high speed, if necessary. The traditional sequences for a decision within management accounting normally goes from goal formulation, implementation, evaluation and feedback (see e.g., Drury 2004, p. 9 or Groot and Selto, 2013, p. 78ff). These time delays will probably be reduced or disappear because the decision process may be a continuously and interactively process made in holistic models.

4 Conclusion, implications and limitations

What has been advocated in this article is not a revolution, but rather an evolution or adjustment and an extended answer to Moser's question in the beginning of the paper. Inspired by trends in other business areas such as logistics

and finance, it is argued that MAs and management accounting research should exploit the opportunities that the analytics movement offers and start developing theories and suggestions for fact-based decisions with a high external validity, i.e., research that will make our effort relevant for practice as proposed by many accounting researchers.

In the future, business analytics with its variety of techniques to handle large quantities of data will pervade most traditional accounting fields and decisions such as e.g., product mix, make-or-buy, profitability, and pricing at the operational as well as at the strategic level. In business analytics, data will be an intangible asset on an equal footing with personnel, machinery and buildings (Davenport and Harris, 2007).

The important point is that we have to focus on giving management accounting students and professionals the right skills in order to convince the companies that they can add value to the business; if not, other groups of professionals are ready to take over.

In today's highly connected business environment, the pace of change is rapid and the pressure to keep up is quite overwhelming. Practical business is about the ability to change course fluidly and to react to changes in all areas of the business. Faster cycles of scrutiny of performance against expectations are increasingly demanded across all levels; from tactical to operational to the strategic level. Simple modelling approaches of yesterday will be replaced by holistic models based on advanced statistical techniques which will enable the decision maker to test even small changes to see changes in outcome. The MA must during all BA steps constantly remind him/her selves on what is the purpose, the context, possible alternative interpretations from alternative techniques, assumptions, experience and so on.

Not only will big data and business analytics have impact on practice as discussed above, but it should also have impact on research. For example, predictive analytics could be useful for generating new theory, comparing competing theories, improving existing theories, assessing the relevance of theories, or assessing the predictability of empirical phenomena (Schmueli and Koppius, 2011). The idea is to produce new and interesting solutions for accounting decisions – now with a data-related and holistic view as the starting point. For practice, such fact-based research would also be of high interest. The gap between research theory and practice that has been discussed since the 80s could be reduced by taking a business analytics approach.

There are several limitations of this paper that need to be addressed. First, a BA model is just one model of reality – not reality itself. This means that we must consequently constantly seek to understand reality more fully – for example via soft skill techniques – so the models become more meaningful. Second, the literature and conclusions are primarily based on a few primary research studies and on secondary empirical studies from professional consultancies. From the methodology point of view, more empirical and specific studies are therefore needed in order to go deeper into the new analytics environment for the decision field of the management accountants, for example for building performance maps and models. Third, the impact of business analytics, business intelligence, data mining, and big data technologies on management accounting is illustrated mainly using simple business and technology points of view meaning that the influence on the organisation – and how the structure of the organisation is designed – is not discussed here (e.g. contingency and cognitive factors). With business analytics, for example, it could be assumed that the managements' operational tasks will be minimized or that the management style will be more 'diagnostic control' (Simons, 1995) and that the analysts will be a technocratic power group within the company.

A field of particular interest for MAs is what is now called 'visualization research' (see, e.g. Schneider *et al.,* 2015). This denotes the process of representing data graphically and the interaction with these representations in order to gain insight into the data structure and associations of groups of data. Modern visualization research addresses the problem of converting data into compelling, revealing, and interactive graphics that suit users' and decision makers' needs. Because the MA is an important decision maker in companies, the DataVIZ enable the MA to drill down into the

source data to change the analysis parameters and make business analytics experimentations by asking simple questions such as: how do we know that and what influence on net profit does this decision make? This subjects could also be interesting subjects for future research.

All in all, management accountants are facing not only big challenges, but also a great opportunity to be part of an improvement of the decision environment in the 21st century.

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Organization	Title	Research assumptions	Statements related to Management Accountants
CGMA (2013)	*FROM INSIGHT TO IMPACT* *Unlocking opportunities in big data*	The report is based on a survey of 2,093 CFOs and other finance professionals, working in a broad range of business sectors across more than 80 countries. It also makes use of a program of interviews with senior finance executives.	MA should focus on all types of data (unstructured but also on the potentials of structured data), on new analytics techniques and tools on daily metrics and on finding patterns and correlations. Concepts such as BI, data mining, predictive analytics, communication and presentation skills are important for MA.
IMA & ACCA (2013)	*Big data: its power and perils*	Based on literature on big data together with three roundtable meetings with leading accountancy and finance professionals (in total 36) to consider the future implications of big data for the profession, supplemented by a series of expert interviews with big data practitioners.	MA must focus on new skills and new ways of thinking and on using big data and analytics for performance and decisions (in real time) to identify new options and using different datasets for risk forecasting. New skills and new ways of using data are important. Only this can retain their influence. They also need to know about statistical modelling, data mining, advanced predictive analytics, and risk forecasting techniques.
CGMA & Oracle (2015)	*The Digital Finance Imperative: Measure and Manage What Matters Next*	The survey is based on 744 respondents in 34 countries, EMEA (Europe, Middle East and Africa), USA and Canada, BRIC countries (Brazil, Russia, India and China), UK, APAC (Asia-Pacific) countries, and Latin America, excluding Brazil supplemented by interviews with senior finance and management professionals across the globe.	The digital age has redefined the role of the CFOs – specifically related to intangible assets and data-driven decision making. They will be asked to define and implement new, digitally-enabled business models. MA must be able to develop new KPIs (e.g. for customers) to track the progress based on causal relationships and correlations also within supply-chains, sales and customer areas. The role of the CFOs has broadened regarding specific IT and data management. MA must work together with data scientists to improve performance.
CGMA (2016)	*JOINING THE DOTS - DECISION MAKING FOR A NEW ERA*	The report is based on a survey conducted on 300 C-level executives (C stands for Chief) in large organizations from 16 countries around the world. The survey was supplemented by in-depth interviews for deeper insight with nine CFOs in big companies.	Relevant decision making for 'Integrated Thinkers' is based on integrated and holistic thinking (the business model as a frame), i.e., cutting through silos to find the relevant information across the organization to see the big picture. VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) and defining short, medium, and long terms time dimensions makes this difficult. Real-time decision making is very important for forward looking and predictions. Sixty five percent of Integrated Thinkers perform better than their industry peers. Therefore, the conclusion is to invest in increased skills for the decision maker.

Table 1: Publications from professional accounting bodies.

Consulting Companies	Title	Research assumptions	Statements related to Management Accountants
Gartner (2013)	*The CFO's Six Technology Imperatives*	The survey is based on 237 financial executives, with 55% of respondents from global or multinational companies and with 27 percent of the respondents from publicly traded firms, 62 percent were from private for-profit, and 11 percent were from not-for-profit organizations.	CFOs are deeply involved in deployment and implementation of BA, IT decisions and performance management based on BA. The CFOs prioritize BI and business applications more than the CIOs do. The study also shows that the CFOs are often more concerned about the deployment of newer technologies. Topics such as scorecards, budgeting and forecast and customer profitability are the most important areas, but also predictive modelling and statistical analysis are mentioned.
PWC (2013)	*Closing the gap in performance management*	The results are based on 893 global members of the Chartered Institute of Management Accountants with nearly three-quarters of the respondents based in the UK and with the rest distributed across the globe.	CFOs should be able to link KPIs to strategic objectives and define KPIs by using a mapping approach and to use more scientific methods for cost allocations including finding relevant and real cause and effect relationships. CFOs must also be able to improve the budgeting, planning and forecast areas including capacity and pricing. This will require knowledge of data management, BI and model scenarios with variance analysis.
MITSloan Management Review in collaboration with SAS Research Report (2014)	*The Analytics Mandate*	The results are based on a survey of 2,037 professional managers and executives and interviews with more than 30 executives from organizations located around the world.	Several factors are needed to build an analytics culture that works. To be in front, MA must be more dedicated to analytics and data-driven models and be able to add value through different disciplines (e.g. statistical, contextual, quantitative, predictive, cognitive, and other techniques) and thus be 'analytics innovators'. Data is both internal and external data. Asking the right question becomes very important in an analytics culture. To fulfil their analytics mandate, companies need graduates with the right skills within analytics.
Accenture & MIT (2015)	*Winning with Analytics*	Is based on data from a survey of 864 respondents from nine countries and eight industries and companies in nine countries and eight industries and covers the countries of Brazil, Canada, China, France, Germany, India, Japan, the United Kingdom, and the United States.	MA is involved in both 'low performers' and 'high performers' with focus on growth, profitability and performance. People with analytics talent are needed. High performers use more data sources and more advanced tools and techniques (and have a much higher outcome). If the MAs want to be part of this talent group, they have to be able to handle advanced tools and techniques (e.g. optimization and simulation).
KPMG and ACCA (2015)	*Planning, Budgeting and Forecast - An eye on the future*	The survey is based on over 900 finance professionals from more than 50 countries (from Senior Finance Managers to Internal Auditors, Treasury Analysts and Consultants).	Because MAs are normally deeply involved in PBF (planning, budgeting, and forecasts), it is important to be aware of how big data, risk measurement and different techniques can be used to improve performance. CFOs must deploy techniques such as rolling forecasting with moving targets (that reflect real-time changes in external factors) in combination with tools within predictive and prescriptive analytics if they should make empowered decisions.
MITSloan Management Review in collaboration with SAS Research Report (2016)	*Beyond the Hype: The Hard Work Behind Analytics Success*	A survey based on 2,192 respondents across the world, supported by interviews and case studies from a wide variety of industries and from organizations of all sizes.	As analytics also includes cognitive models and learning, the MA has to be part of the team that can make data sufficient (accurate, timely, complete, accessible, reliable, consistent, relevant, and detailed). However, data management tools have not been used sufficiently in analytics. Decision making is the most important topic in analytics which again assumes much attention on data and analytics skills with focus on prediction and prescription. Integrating the analytics strategy with the organizational strategy is important. Intuition has a critical role in developing analytics and in strategic decision making.

Table 2: Publications from major consulting and accounting companies.