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Integrating big data with traditional data

Looking to museums for empirical evidence

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Contents

Key conclusions

- Big data is highly valued as a support in decision making.
- Management accountants are generally associated with hard financial data and therefore may lack the skills required to be involved in and lead data integration.
- Analytical, technological and digital skills are fundamental for management accountants.
- Continuous interaction between all areas of an organisation is required for big data interaction and management accountants have an opportunity to lead this process.
- Management accountants can add value to existing big data services on the market when used by their organisation.

Introduction

Big data is everywhere. The term has become today's "it" word that turns up in many expected and unexpected fields, from management accounting and strategy to information technology, mathematics, urban management and public policies (Simons, and Masamvu, 2014; Agostino and Sidorova, 2017). Big data has also found its way into many organisations, businesses, governments and the not-for-profit sector.

The enthusiasm generated around big data has driven development in advanced analytical techniques (Agostino and Sidorova, 2016) and is behind new professional roles built on analytic skills (Peppard, 2016). Both focus on gaining insights from big data, while all the time forgetting about possible interconnections with traditional data (Arnaboldi, 2018). This has given rise to a silos structure and big data and traditional data are often treated as separate matters and used in different spheres. Traditional data are the preserve of accounting whereas big data have become the realm of data analysis experts external to the company or internal managers in functions other than accounting.

Even so, big data can add value to management accounting and used to craft information that is 'more': more varied, more precise, more reliable and timelier (Taoh, 2018). Importantly, big data can also be a source of competitive advantage (Simons et al., 2013).

The objective of this research is to expand our current understanding of the potential and risks of big data by investigating how big data can be integrated with traditional data.

Objectives

This study aims to examine whether big data can be integrated with traditional data and the associated implications for management accounting.

More specifically, research is organised around the following research questions:

- What types of big data are available to museums?
- What are the expected benefits of integrating big data with traditional data?
- How does big data integration take place?
- What is the role of management accountants in managing big data integration?

Research methodology

This study was carried out in two main phases, consisting firstly of a preliminary multiple case study involving 25 Italian museums and secondly four in-depth case studies on four museums selected from among the original 25. The central government in Italy has been strongly encouraging Italian museums to introduce online technologies and become 'digital museums'. This background indicates why the Italian museum context was taken as the empirical setting for this investigation. To extract our sample from the almost 5,000 museums in Italy, we used a national survey on museums conducted by ISTAT (Italian National Institute of Statistics), which had a section asking museums about their use of digital technology. We first detected the museums that were most advanced technologically and were using several digital technologies. From this smaller group, we selected a sample of 25 that included a mix in terms of size (determined based on visitor and staff numbers), geographic location, private and public status and collections (archaeology, science and the natural world, modern art).

The purpose of this multiple case study was to gain a preliminary understanding of the types of big data being collected and the reasons for integrating big data with other data.

For the second phase, the results from these 25 museums helped in the selection of the four museums with greatest variety in terms of big data sources, use of big data and big data reporting tools. The most senior people in each museum — museum director, marketing and communication manager (and digital manager, where present), administrative and finance manager, curator and facilities manager — were interviewed following an open-ended format (see the Appendix for the set of questions). The museums gave us access to their traditional financial and non-financial reports, big data reports and strategic documentation on their big data strategy (when present). This second phase was particularly useful in terms of understanding the process of integrating big data with traditional data, and provided an insight into how the process takes place, the technologies adopted and the organisational roles involved.

Main findings and their implications for practice

The findings presented below draw upon the evidence gleaned from the set of questions and interviews with Italian museum staff. The findings are ordered by research question.

What types of big data are available to museums?

Museums deal with two categories of big data, determined according to "where" data were generated.

- Big data generated online through devices that are not physically in the museum. This category includes data from websites, online galleries, online ticketing, social media, videogaming and Apps. Museums were found to collect data most frequently from websites and social media, followed by online ticketing data, which are used in profiling users.
- Big data generated on-site through devices that are physically in the museum. Data comes from AR (Augmented Reality), VR (Virtual Reality), QR codes and smart IoT (Internet of Things) devices and can give the visitor's museum geo-location.

Museums need to know whether they are dealing with online or on-site data, as the former is connected to a generic audience that may or may not be in the museum, while the latter is linked to people visiting the museum at that time.

Surprisingly, from the interviews, it became clear that data relating to cultural heritage assets, mainly descriptions and history of artwork, are not in the big data format but are generally held in Excel files or other museum databases and there is no generation of data in real time.

Table 1 shows that the reporting frequency for museum online and on-site generated data is heterogeneous, and can be in real time, and/or periodically and/or occasionally.

Table 1: How often do you report on big data generated through these means? (% of respondents — total museums: 25)

	Frequency		
Big data source	**Real time**	**Regularly (weekly, monthly, quarterly)**	**Occasionally**
Online — Website data	20%	60%	20%
Online — Social Media data	12%	63%	25%
Online E — Ticketing data	52%	29%	19%
On-site — Museum Apps	17%	33%	50%
On-site technology	33%	50%	17%
Average	**27%**	**47%**	**26%**

There seems to be a contradiction between the frequency in reporting and the fact that big data are generated in real time. Of the museums that generate big data in real time, just under one in three (27%) reports on these data in real time. In nearly half (47%), big data are reported as traditional financial or non-financial data in weekly, monthly or quarterly reports. The remaining 26% said that they rarely report this data (for strategic plans, social reports).

What are the expected benefits of integrating big data with traditional data?

Three main reasons emerged from the interviews with museum directors:

1. To draw a more complete profile of actual and potential visitors

'We run a post-visit customer satisfaction survey three times a year, we have online ticketing data, data from Facebook, Instagram and Tripadvisor, from our financial statements and on-site ticketing. I would like to put all this together and create a single profile per visitor. If I know a visitor's gender, nationality, education, age, how they respond to my social media posts, when they buy tickets and where they go in the museum, then I can tailor my services and promotions to that user. In the long-term, this allows us to engage more closely and lastingly with our visitors'.

2. To get data without asking visitors for feedback

'One of our greatest problems is to convince our visitors that their feedback is precious! We monitor online reviews on Google Maps and Tripadvisor to get genuine feedback without having to ask'.

3. To catch early signs that are then detected from traditional data

'Big data is a benefit in terms of timing. We get data generated from online sources and on-site devices before traditional financial data. Early data means making decisions and solving problems sooner. We had problems with our online ticketing system and customers complained on social media, so we knew about the problem and could react immediately'.

While the expected benefits varied, from all these quotes, it is clear that the centrality of visitor relationships is a major plus point for data integration. Museums want to learn more about their visitors' needs, expectations and reactions and can do so through big data combined with traditional data that they have already collected. In the long term, knowing their customers better will lead to personalised offers and services, customer loyalty and a strengthened relationship.

How does big data integration take place?

The interviews revealed two main types of big data integration with traditional data.

- **Functional integration** — When the process of integrating data is restricted to a single organisational function in charge of collecting and validating big data generated within that function and integrating them with traditional data also generated within the same function. Functional integration is typically the preserve of marketing and communications. Big data generated digitally by customers are integrated with traditional data available to that function, such as customer satisfaction data. Data collection, validation, integration, reporting and analysis are used for decision-making within that function.

  Key aspect for management accountants — Function managers typically manage this area and accountants are not directly involved in the big data integration process and neither are they informed because they are generally associated with "hard financial data" (interviewee's words).

- **Organisational integration** — This happens when the process to integrate data integration is organisation-wide. Big data and traditional data collected by each function are collected in a single "hub" responsible for validating and integrating data, calculating KPIs and reporting to senior management. Data gathered by marketing and communications are integrated with data from curators, ICT and security. Unlike previously, all big data generated are integrated.

  Key aspect for management accountants — Accountants can manage this process when the museum director involves them directly. We found that accountants acted as data validators and collectors (in charge of creating dashboard linking data received by the different functions).

In both cases, big data integration follows these steps (which can be extended to areas other than the museum industry):

- Data collected from big data and traditional sources, typically the area that owns/generates the data
- Data validation and data cleaning
- KPI calculation
- Data interpretation
- Data reported via dashboards and scorecards.

What is the role of management accountants in managing big data integration?

The four management accountant roles gleaned from the interviews are the following:

1. Marginalised accountant

At the margins of the data integration process, delivers financial data to another party in charge of big data integration, typically ICT.

2. Accountant acting as collector

Only involved in the early stages of the data integration process (collecting/validating data). Receives data from other parts of the organisation, validates and forwards to an external analytics provider or an internal function (typically ICT) who will calculate the KPIs and prepare dashboards and scorecards.

3. Data analytics-driven accountant

Involved throughout the process, without making decisions about type of data to collect, KPIs to calculate or type of data to report. These choices are included in the museums' big data analytics software, which collects big data automatically, while the accountant provides validated traditional data. Algorithms filter and clean big data, calculate KPIs and set up reporting. Management accountants supervise but do not lead the process.

4. Decision-making accountant

Actively involved throughout, identifying priorities for data collection, requests/validates data, selects KPIs according to organisational priorities, interprets KPIs according to the museum's strategy, forwards to senior management through ad hoc dashboards.

Common trends in data integration are:

- No dedicated 'big data manager' — None of the museums studied had a "big data manager" or equivalent. The work is often seen as purely an add-on carried out by whoever collects and generates data, typically not the management accountant.
- Management accountants are generally associated with hard financial data and not digital data. Management accountants were never mentioned in connection with online/on-site digital data or data analytics. Technical people are more likely to be linked to the notion of big data.
- Lack of dedicated big data management skills. Whoever is in charge of managing big data integration does not have specialised data analytics skills. The people managing the data sources are the same parties involved in data collection, reporting and analysis. Communications are responsible for websites and social media data analysis. Services are in charge of ticketing data. The digital or curatorship areas collect and analyse data from offsite technologies. Data collection and data analysis are often led by good sense (informants' words). Some museums may use real-time analytics from social media platforms.
- Increase in software for big data integration, often seen as a "dream" for museum directors. Software already available on the market has predefined KPIs and reporting tools, with limited scope for customisation and pre-determined types of data to collect, frequency of collection and reporting and KPI metrics. For museums, they provide the way around no internal data analytics skills. The software vendor determines how and if traditional financial and non-financial data are integrated within big data, potentially providing tools for preparing dashboards that connect big data with data on revenue, customer satisfaction or other traditional data. Others restrict users to a predefined set of big data sources (web, ticketing and social media data).

Conclusions, lessons learned from the research

Big data is highly valued as a support in decision-making, especially when integrated with traditional data. Although the empirical setting is museum specific, some common trends can be beneficial for management accountants in other fields:

Digital and analytical skills for management accountants in the big data era. Big data is closely linked to digital technologies and analytical skills. For management accountants to be actively engaged in and/or lead big data integration, their analytical and technological/digital skills are fundamental, and even more so when big data must be reported through real-time dashboards. From our interviews, it emerged that accountants are associated with hard financial skills rather than with any digital or analytical expertise.

Relational skills for management accountant. Big data integration requires continuous interaction between all organisational areas for data to be collected. Management accountants leading this process must know how to interact positively with all other areas, and this interaction function should be reflected in the organisational chart.

Filtering and interpreting big data information. The diffusion of big data analytics software emerged as a major issue from the interviews. Big data analytics cannot remove the need for:

- Filtering big data to be collected — Big data are generated in real time and it is important to determine which big data attributes (e.g., geo-localisation, user ID, timing of data generation) are downloaded and collected.
- Interpret big data properly — Big data does not give a monetary value, but it often generates word clouds and lists of places or timings. A useful skill is to know how to read the resulting KPIs in line with organisational strategies and priorities.

Software can include filtering and interpreting functions based on predefined settings. Management accountants can make a difference in these filtering and interpreting operations, bringing added value to big data software services on the market.

References and further reading

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Appendix 1 — Draft list of questions for interviews

Part 1 — Personal information

- Role in organisation
- Experience and competences

Part 2 — Engagement with big data

- Do you have/are you aware of a big data strategy?
- What are the sources for your big data?
- Do you collect big data? If yes,
  - What type of data do you collect?
  - How often do you collect data?
  - How do you collect data?
  - Why? Can you give an example?
  - Who is in charge of collecting, analysing and reporting on the data?
  - Who is receiving reports?

Part 3 — Approach to big data integration

- Do you link big data with other data? If yes,
  - What type of "other" data do you collect?
  - Which kind of KPIs do you calculate?
  - How often do you collect data?
  - How do you collect data? Any software?
  - Why? Can you give an example?
  - Who is in charge of collecting, analysing and reporting on the data?
  - Who is receiving reports?
- What are the main benefits of integrating big data with other data?
- What are the main problems/future development connected with big data integration?

Appendix 2 — Case study on big data integration: the central role of the decision-maker

The director of one of the involved museums explained how she faced the big data integration challenge:

'We were interested in understanding the perception of our visitors on their experience at the museum, but also about their perception of our brand. We collected data from different data sources: an on-site customer satisfaction survey, a real-time social media monitoring, a website navigation data and an online ticketing dataset about our customers. The customer service area worked on data collection, data integration and data analysis since they are in charge of managing the relationships and activities with our customers. We had four different datasets in Excel file, each of them with different types of attributes and information about visitors and a different timing and time horizon.

'The first challenge was the selection of the type of data we were interested in. I manage personally this phase and my priority to understand the perception by customers lead me to focus on textual data rather than on transactional data. This step was useful in cleaning data and reducing the dataset.

'The second challenge was on offering a unified view of these different datasets. This was achieved through simple software on data integration that was precious in supporting the linkage between the different excel files. The main difficulty was not the software, but the filtering and identification of data object of analysis (an activity driven by our strategic objective). The software offered a visual representation of the analysed data, which was shared with the involved organisational units'.

This quote underlines three practical insights for management accountants:

- The need for filtering the information to be integrated and analysed starting from strategic priorities and objectives;
- The instrumental role of software, which was precious in supporting data analysis and visualisation, but it does not have a central position in the data integration process;
- The presence of a leading manager for data integration. This underlined the centrality of the decision-maker in leading the big data integration process.

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