

# On the relevance of self-service business intelligence to university management

Self-service  
business  
intelligence

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## Abstract

**Purpose** – Nearly 40 years since they first appeared, there is renewed interest in dashboards, engendered by the diffusion of business intelligence (BI) desktop software, such as Power BI, QlikView and Tableau, denoted collectively as “self-service” BI. Using these commodity software tools, the work to construct dashboards apparently becomes easier and more manageable and no longer requires the intervention of specialists. This paper aims to analyse the implementation of this kind of commodity dashboard in a university, exploring its role in performance management processes and investigating whether the dashboard affects the organisation (or not).

**Design/methodology/approach** – This paper focusses on an action research project developed by the authors, where the objective was to design and implement a dynamic performance measurement tool fitting the needs of department directors. The three authors were all involved in the project, respectively, as project manager, dashboard implementation manager and accounting manager of the studied organisation.

**Findings** – The results reveal a specific but complex change to the procedures and outcomes in the organisation studied, where the dashboard becomes a boundary infrastructure, thereby reviving technical and organisational problems that had been latent for years.

**Originality/value** – In this paper, the authors contribute to the debate on the digital age and the role of accounting with their exploration into the “revolution” of self-service BI tools. The democratisation and flexibility of these instruments put into discussion two core and somewhat controversial functions of accounting: data integration and personalised reporting.

**Keywords** Dashboard, Business intelligence, Performance management, Boundary object, Performance management

**Paper type** Research paper

## 1. Introduction

This study explores a subtle revolution taking place within accounting in the age of analytics and big data, which is making considerable changes to organisational life. To achieve its purpose, the research examines how an Italian university addressed this experience. The revolution in question concerns the diffusion of business intelligence (BI)



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desktop tools, such as Power BI, QlikView and Tableau, which allow non-specialist users to combine and integrate data and build interactive dashboards on their own personal computers or laptops. BI is changing the way organisations function, moving from an accounting and information and communications technology (ICT)-centric process to one that is decentralised and apparently owned by the users themselves (Meulen and Rivera, 2015; Sharda *et al.*, 2015; Stodder, 2015). This phenomenon is also referred to as “self-service” BI (Swabey, 2013; Netz, 2018) and is defined by two key distinctive features. These tools are commodity software and allow an easy integration of data coming from different sources. According to their promoters, the above two features can solve issues at the intersection of accounting and ICT (Hunton, 2002; Hyvönen *et al.*, 2009), whereby information must meet the user’s needs, entailing individual, self-managed personalisation and also it must be possible to integrate data without resorting to complex data warehousing and professional intervention.

Now as in the past (Yazdifar and Tsamenyi, 2005; Byrne and Pierce, 2007), accountants find themselves in the middle of a change that affects their function and role (Zoni and Pippo, 2017; Quattrone, 2016). It has been shown, however, that accountants are slow or reluctant to act upon the abundance of digital opportunities in the digital age (Arnaboldi *et al.*, 2017b; McKinney *et al.*, 2017) and they often leave the ownership of new developments to other organisational actors or areas, such as marketing or innovation in the case of social media analysis (Arnaboldi *et al.*, 2017a; Agostino, 2018). In these situations, it was found that accountants not only fail to grasp the organisational opportunities for innovation, but in fact fall back on their traditional operations, meaning that their sphere of influence and command over these areas appears unaffected, at least in the short term. In the case of self-service BI, instead, by not mastering an innovation, the accountant’s control is challenged more directly, as accountants historically own dashboards and all connected data (Clinton and White, 2012). Furthermore, the democratic, bottom-up processes involved in generating dashboards may create problems of data integrity and governance and these sooner or later find their way into the sphere of accountants (Riggins and Klamm, 2017). Despite these questions, the critical studies on the implementation of self-service BI are scarce and generally at the conceptual level (Janvrin and Watson, 2017; Riggins and Klamm, 2017). While empirical studies are increasing, they concentrate primarily on the benefits or technical aspects (Shivakumar and Pradeepkumar, 2019; Nair *et al.*, 2020).

In this paper, our aim is to provide a more critical perspective on the implementation of a self-service BI tool. To achieve this purpose, firstly, we explored how self-service BI reveals tensions at the intersection of accounting and ICT that have been latent for years and which concern data integration (Hunton, 2002; Hyvönen *et al.*, 2009). Secondly, we analysed whether accountants take on or not a new role during this change, contributing to the studies on changes to the accounting role (Yazdifar and Tsamenyi, 2005; Byrne and Pierce, 2007).

The study is based on an action research project carried out over an 18-month period in 2018 and 2019 in an Italian university, a setting of specific interest to public sector and accounting scholars (Modell, 2003, 2005; Turri, 2014). The university sector has recently drawn considerable attention in the face of weakened public funding, especially in some countries (Khalifa *et al.*, 2018; Williamson, 2018; Dobija *et al.*, 2019; Du and Lapsley, 2019), and measuring performance may be controversial under these conditions. Although performance information is potentially useful in decision-making, the proliferation of metrics may create tension and even more confused decisional settings (Du and Lapsley, 2019). The university setting is also particularly interesting for enhancing studies in accounting in the age of big data, because of the heterogeneity of data, both internal and external, required to oversee the many different processes taking place in universities, from teaching and research to external engagement and support services (Williamson, 2018).

To describe this trajectory more clearly, we have drawn on the concept of “boundary objects” developed by Leigh Star and colleagues to explain the nature of cooperative work among heterogeneous groups in the absence of consensus (Star and Griesemer, 1989; Bowler and Star, 1999; Leigh Star, 2010). From this perspective, dashboards are viewed as changing boundary objects, which have a material nature (materiality), and are places where actors can operate and be creative, but they are not without their limits.

To set out our argument, the paper is organised as follows: Section 2 presents previous studies relevant to the research (both university research and studies on big data). Section 3 contains an explanation of our conceptual perspective. Section 4 lays out the methodology together with the findings/results in Section 5, followed by the concluding remarks in Section 6.

The results reveal a specific but complex change in procedures and outcomes within the organisation studied, where the dashboard has become a boundary infrastructure, re-awakening technical and organisational problems in accounting that had been latent for years and had to be dealt with.

## 2. Self-service business intelligence and accounting in the digital age

Dataflows in Power BI is a new extensive capability [...]. It handles the most complex data preparation challenges for users through its revolutionary model-driven calculation engine, *cutting the cost, time and expertise* required for such activities to a fraction of what they otherwise would be (Netz, 2018 – Microsoft – emphasis inserted).

Self-service BI is depicted by its promoters, such as consultancy firms and technology providers, as the new panacea that will revolutionise data supply. The “democratisation” in constructing a dashboard is a novel element, and one that enters the debate on how the new digital age is affecting the sphere of accounting (Arnaboldi *et al.*, 2017b; Agostino, 2018; Dagilienė and Klovienė, 2019; Moll and Yigitbasioglu, 2019; Bhimani, 2020). Despite lagging behind calls from other sectors and professional bodies (Strauss *et al.*, 2015; Cooper, 2017), accounting scholars have activated discussion and research into the role and impact of emerging digital technologies on accounting. Since the start of the academic debate on big data, academic contributions in the accounting field have put the spotlight on accountants and how their work is affected by new technologies and professional figures (Bhimani and Willcocks, 2014; Suddaby *et al.*, 2015; Quattrone, 2016). These studies highlight the reluctance of accountants to enter the digital age, and even unwillingness to accept that the choice is not theirs to make, not least because of their commitment to firmly established tasks and their habit of looking within for data (Arnaboldi *et al.*, 2017b). One of the major changes investigated relates to the internet world, as testified in a recent review of contributions (Moll and Yigitbasioglu, 2019), which examined four topical areas: the cloud, big data, block chains and artificial intelligence. The authors reviewed studies dealing with these four areas in several fields, coming to a blunt conclusion regarding the early stages of accounting research:

This paper has demonstrated that empirical studies of Internet-related technologies are lacking in the accounting literature. This oversight is surprising given how interrelated these technologies are with the work of accountants (Moll and Yigitbasioglu, 2019, p. 15).

This closing remark reaffirmed the conclusions of other studies (Bhimani and Willcocks, 2014; Suddaby *et al.*, 2015; Quattrone, 2016; Arnaboldi *et al.*, 2017b; Agostino, 2018). Firstly, there is the need for more empirical investigation, moving from discussion and theoretical papers to a more specific analysis of changes. To do this, an accounting-based framing is desired to capture the impact of change and innovation on decision-making and value for accounting users, as well as their impact on working processes. Digital technologies, as in

our case, are often depicted as beneficial in terms of more efficient processes, yet their implementation can create additional work.

BI tools are promoted as a way to achieve long-awaited data integration without bulky and lengthy information technology (IT) projects. These features are emphasised in the consultancy sector (Logi Analytics, 2015; Netz, 2018), where these tools are portrayed as a revolution both for decision-makers, who benefit from integrated and easy-to-use dashboards, and for analysts, who no longer need specialists to design it.

Academic research also supports this over-positive representation. Contributions on self-service BI are mainly technical, concentrating on the specific benefits or features (Elbashir *et al.*, 2008; Dilla, 2013; Kowalczyk, 2015; Schlesinger and Rahman, 2016; Daradkeh and Moh'd Al-Dwairi, 2018; Daradkeh, 2019). This lack of research and narrow vision is highlighted by Rikhardsson and Yigitbasioğlu (2018), who, in discussing future open issues, pointed to the need for more critical studies where technical issues linked to information systems are coupled to an organisational perspective.

In this paper, our aim is to provide a more critical and organisational perspective where we focus on the impact of self-service BI on accounting. It also brings into the discussion two functions whereby accounts act as intermediaries. The first is their expected, but not unchallenged, business-advisory role, with their aspiration to support decision-makers in operational or strategic matters, by selecting and presenting the right information at the right time (Ahrens, 1997; Ahrens and Chapman, 2002; Burns and Baldvinsdóttir, 2005; Järvenpää, 2007; Morales and Lambert, 2013). The second function brought into discussion is the accountants' role as intermediaries and moderators between their function and duties and ICT. The emphasis put by BI providers on simplification gives the illusion that the ICT expertise which accountants have struggled to acquire (El Sayed, 2006; Jean-Baptiste, 2009; Harris, 2014) has become superfluous (Netz, 2018). While evidence of the fallacy of this view have started to emerge (Riggins and Klamm, 2017), it is only the tip of the iceberg.

### 3. Conceptual perspectives

Susan Leigh Star and colleagues developed the concept of boundary object to explain the nature of cooperative work among heterogeneous groups in the absence of consensus (Star, 1989; Star and Griesemer, 1989; Bowker and Star, 1999; Barrett and Oborn, 2010; Leigh Star, 2010). In their seminal article, Star and Griesemer (1989) showed how diverse groups of actors – among whom researchers from different disciplines, amateurs and professionals, humans and animals, farmers and townspeople – all contributed to the development of Berkeley's Museum of Vertebrate Zoology. Cooperation was enabled by "boundary objects", that is, objects that were "plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites". Boundary objects link the different actors together because they are common to multiple social worlds but can take on different meanings within each social world. Examples of boundary objects are diagrams and descriptions that are vague enough to become a means of communication for different distinct groups; piles of objects that are indexed in a standardised fashion and can be individually removed without changing the structure of a whole (i.e. a library); and standardised forms and labels that can be used as methods of communication common across dispersed work groups.

The use of boundary objects in accounting studies has grown in recent years (Briers and Chua, 2001; Laine *et al.*, 2016; Arena *et al.*, 2017; Arnaboldi *et al.*, 2017a; Wouters and Sandholzer, 2018). When interpreting the changing role of accountants in the context of self-service BI implementation, two streams dealing with the concepts of boundary infrastructure and of boundary spanning are particularly relevant. The following two subsections elaborate on them.

### 3.1 Boundary infrastructure

A boundary infrastructure consists of heterogeneous elements which together form a seemingly stable and coherent framework in which players can cooperate and act (Star and Ruhleder, 1996; Star, 1999). Studies into self-service BI indicate that it recalls boundary infrastructure, where diverse elements converge so that different players can act collectively. Several features distinctive to boundary infrastructure (Star and Ruhleder, 1996; Bowker and Star, 1999; Star, 1999, 2010; Arena *et al.*, 2017) emerge in the self-service BI “revolution”. A first property is its potential to change the roles and properties of the constitutive components. Desktop BI enables users to become analysts and designers, apparently pushing ICT into the background. Furthermore, the properties of performance measurement and accounting are also under threat: the decentralised process of building dashboards on the basis of desktop data means that data quality becomes secondary to timeliness for decision-makers. A second distinctive element of boundary infrastructure is its reliance on standards. BI tools are standardised software tools where open tutorials guide the process of constructing the visualisations, thereby indirectly setting the standards for dashboarding data, and hence imposing a standard for the decision-maker’s visualisation output. Other properties of boundary infrastructures include linking and joining objects at a distance, a function that self-service BI performs well. Self-service BI provides the means to share dashboards and allocate rights of use or not to other users.

### 3.2 Boundary spanning

As previous studies have however highlighted, the impact of boundary infrastructure on an organisation does not only depend on the technical instruments in play but also on the network of actors who influence the pattern of action (Llewellyn, 1994; Arena *et al.*, 2017). By bringing the theory of agency into our discussion, we are introducing our second conceptual element, that of boundary spanning. Boundary spanners are individuals who cross intra- or inter-organisational boundaries in the attempt to make things work (Llewellyn, 1994; Marchington *et al.*, 2004; Dekker, 2016). Previous studies in accounting have endorsed the concept of boundary spanning, in relation to the continuous evolution and hybridisation of the traditional role of accountants and their role as intermediaries (Briers and Chua, 2001; Caglio, 2003; Dechow and Mouritsen, 2005; Millo and MacKenzie, 2007; Dekker, 2016; Arena *et al.*, 2017; Arnaboldi *et al.*, 2017a; Tambar, 2019).

In this process of adaptation, as seminally set forth by Llewellyn (1994), accountants play a key role as agents in their boundary management. In this paper, we include an analysis of the actors involved in the process of implementing self-service BI, who are primarily accountants, ICT managers, as well as users and other managers who find that they can use the new commodity software to build dashboards. All these people span their professional and organisational boundaries and the agents’ work can transform technical infrastructure into either a source of conflict or a collaborative space. In observing this process of construction, for accountants, boundaries relate to both the professional sphere and also to boundaries of a more operational kind. Llewellyn (1994) drew attention to boundaries as “thresholds” when linked primarily to the work of financial accountants and boundaries as “binding structures”, when they refer to the work of management accountants:

The process of organizing happens at organizational boundaries, as agents or “gatekeepers” manage the exigencies of inclusion and exclusion in the production and reproduction of organizational realities (Llewellyn, 1994, p. 20).

This evolving process of inclusion and exclusion is recurrent in accounting studies (Dekker, 2016; Arena *et al.*, 2017; Arnaboldi *et al.*, 2017a) and it is worthy of study in the digital age,

where the production and reproduction of data and artefacts is apparently easier. The digital focus of our study contributes towards inserting this element into the broader literature on boundary objects. We have focused on conceptual elements that have been used to study many different phenomena, including new product development, team work and project management (Henderson, 1991; Carlile, 2002, 2004; Yakura, 2002; Bhecky, 2003; Barrett and Oborn, 2010), medical research (Fujimura, 1992) and strategy tools (Jarzabkowski and Paul Spee, 2009).

#### 4. Methodology

This study is an action research project. The adopted research approach investigates the dynamics relating to the process of designing a dashboard for, and its use by, the directors of several university departments. Interest in action research developed from social sciences and found a new impulse in the 1980s, including studies into higher education (Cohen and Manion, 1980; Suojanen, 1999). Since its origins, action research has met with growing recognition for its contribution towards understanding management practices and its theoretical insights. The central issue of this approach is the interplay between science and practice, which simultaneously influences the theoretical concepts and practical rules of the phenomena under study (Argyris *et al.*, 1985).

The study focuses on a project developed by the authors, where the objective was to design and implement a dynamic performance measurement tool fitting the needs of department directors. The research was carried out in four phases:

- (1) needs analysis;
- (2) dashboard design;
- (3) testing and implementation; and
- (4) consolidation.

The three authors of this paper were all involved in the study, each with his or her specific role. One author acted as senior researcher and project manager, having a key role in phases 1 and 3, while acting as an observer in phase 2. The second author was responsible for the technical implementation of the dashboard and the research team's interaction with ICT personnel and the data owner. The third author is part of the university management structure, i.e. the head of accounting, and joined the study at phase 2.

Phase 1 (needs analysis) was based on face-to-face interviews with the 12 department directors, the rector and the general director. The panel of people interviewed was enlarged during the needs analysis to include four senior managers and three officers in charge of processes relevant to the dashboard (e.g. teaching support services). Phase 2 involved designing the dashboard using a BI tool. During the first two phases, interaction with the ICT unit and the data owners was central, with 12 interviews being conducted to analyse and collect the proper data. Phase 3 involved the gradual release of the dashboard prototype. The tool was first presented to a small group of people (the rector and three department directors) and then was tested by all the directors and managers involved in the previous phases. Phase 4 consisted of two parts, the first of updating the dashboard continuously with information needed by users and the second of automating the process to collect data transmitted both ways between accounting and ICT. This fourth phase was particularly important for observing the boundary-spanning work of the accountants who were previously designated as dashboard owners.

Lastly, it is important to highlight that the authors were fully aware of the pros and cons of interventionist research, particularly in accounting (Jönsson and Lukka, 2007; van Helden

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*et al.*, 2010; van Helden and Northcott, 2010; Arnaboldi, 2013). The key concern is whether “objectivity” is such as to withstand any undermining of the quality of results. The authors have adopted several strategies to reduce this risk, which are common to qualitative research, where trustworthiness, rather than objectivity, is the guiding principle (Lincoln and Guba, 2006; Cao, 2007). During the data collection process, one of the authors was always on observation only, in order not to become distracted or over-involved in the discussion. Data were analysed against the framework, first by the authors separately to identify competing interpretations. The final data analysis used pattern matching in a reiterated procedure to determine the study’s practical and theoretical contribution.

The specific setting for the research is the Italian higher education system. The Italian university system is relatively “stable” following reform no. 240/2010, which modified the system’s mode of governance and clearly defined the organisation and functions of the academic senate, board of directors, departments and schools. The reform also separated the two roles of political governance and administrative management, while providing for their continuing close interaction. In universities, management systems across the board were affected by the introduction of the national accreditation system conducted periodically by ANVUR, the Italian National Agency for the Evaluation of Universities and Research Institutes (Turri, 2014), which determines the quality of teaching and research, together with legislation concerned with matters of anti-bribery, transparency and performance management. These measures acted as a driving force for innovation and placed focus on service end users but also created a more burdensome bureaucracy, with universities struggling to cope with their administrative management.

A sweeping glance across Europe reveals that Italy’s higher education system still lags behind the more advanced European countries, despite continuing to improve on the past, especially in terms of average level of education and public spending on education. The most recent data published in the report by the Organisation for Economic Co-operation and Development (OECD) on “Education at a Glance 2019” show that nearly 30% of Italians in the 25–34 age group had a degree in 2018 (up by 3% in 2017 but, even so, 10 percentage points below the average of 39% for OECD countries). Italy’s spending on education in 2018 was 3.5% of GDP, against an average of 5% for OECD countries, thus settling towards the bottom end of the ranking.

In 2019, the Ministry for Education, Universities and Research allocated around €7.27bn for ordinary funding to universities, slightly above recent years, but still below the levels of 10 years or so ago (about €7.5bn). Meantime, there has been a rise in funds “locked-in” for specific purposes (6.91% in 2017, 12.23% in 2018 and 13.54% in 2019) or for directing central policies. These measures have led to a decrease in the amounts in the universities’ financial statements that can actually be used to meet their spending policies. Looking at the criteria for specific categories of items, new criteria have recently been introduced, especially for what is known as the “reward bonus”. Such bonuses are paid on the basis of where universities are positioned against a series of performance indicators (for teaching and graduate training, research, third mission, internationalisation and quality of staff/academic recruitment). Compared to the past, with this evolution, universities need to field a greater capacity for measuring, controlling and updating a much larger volume of data, a fact that is inducing them to improve their accounting systems and develop dashboards to share and control data rapidly and effectively. At the same time, the new requirements have stimulated universities into activating a series of measures to improve their position against these specific criteria and so increase their incomings from the available financial resources. Starting from the intention of guiding the government’s action, data analytics and

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inferential statistics systems are now springing up within the most advanced contexts, where sophisticated data analyses are used to interpret major dynamics of behaviour.

## 5. Results

This section on the results consists of three parts that track the stages of the project, the transformation of the BI tool and its newly established centrality. The first part illustrates how the BI tool became a “dream” device for users, relegating accounting and ICT skills into the background. The second part (Section 5.2) illustrates how accountants re-established their place, this time as mediators, starting to shape the boundary infrastructure. The third part (Section 5.3) then analyses the search for a more stable framework where there must still be room for flexibility.

### *5.1 From a tool to a boundary object: business intelligence becoming central*

The BI dashboard implementation process followed an approach common to that of constructing an accounting tool by starting with the analysis of the users’ needs. During this phase, the department directors demonstrated their extensive knowledge of the processes they manage and their clear ideas about the data required and the various priorities. A common priority for all was to obtain a picture of the current situation and the trend of resources to be used to recruit new personnel, as well as the composition of the faculty. The directors already had these data on Excel files, but the files needed to be elaborated every month to reconnect with the past. Similarly, the directors wanted to organise the data on self-financing income received through research projects, highlighting the total amount, each department’s individual share and setting up a comparison with other departments over time. Alongside the need to put order among the “old data”, seven of the directors pointed out that they also required new data about single faculty members and their performance in teaching, research and participation in department activities.

The watershed moment came when the research team showed the first release of the dashboard to the directors. The directors at the meeting were able to navigate through the dashboard using BI tools. At that moment, the BI tools started to become boundary objects (Star and Ruhleder, 1996; Star, 1999), when the directors immediately saw that visualisations could be changed, data filtered in different ways and be integrated with other data. This early transformation of the BI tools into a boundary object was also linked to a first threat on traditional professional roles. The directors started to comment on the decreased relevance of ICT people and accountants in the data integration and visualisation processes:

So, you’re saying I can combine data from lots of different sources in this one place? I’ve been hearing about integrated data warehousing for more than 10 years, but it’s never happened. We’re fed up with wasting time matching up Excel files from Accounting and fighting with ICT to give us integrated data. This system is great (Department director).

The director’s comment clearly brought to light some latent problems concerning data integration (Hunton, 2002; Hyvönen *et al.*, 2009), as well as delight in seeing the much decreased need to rely on other people for integrated data sets.

The use of self-service BI meant that the time between the gathering of user requirements and the visualising of data was reduced, and this prompted a general commitment to improve the tools. As it is possible to change the visualisation setting in real time, this in turn led to a better understanding of performance data, alongside encouraging rapid improvements to the shared dashboard. In this altered relational process, the tool and the



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designer were both crucial and both acted as boundary objects, establishing a bond between the directors' needs and the data.

Flexibility is another key element of boundary objects (Briers and Chua, 2001; Laine *et al.*, 2016; Arnaboldi *et al.*, 2017a; Wouters and Sandholzer, 2018), enabling them to become “tools” central to the directors' work and put under discussion the role of specialised professionals, in this case primarily, the accountants. When the directors found that they could easily adapt the dashboard visualisations to meet their own requirements, it became clear that the business-advisory role of accounting had lost value in their eyes:

We are sent reports and excel files on these matters, but we always need to work on them to get information we can use in our meetings and decisions. This dashboard is fantastic, I can change, add and personalise information for department committees. You have no idea how difficult it sometimes is to discuss options, and decisions must be based on facts. This tool will give us massive help (Department director).

The dashboard was positively welcomed not only by the users, but also by the administrative staff – who had attempted to build dashboards several times in the past, before coming up against initial IT obstacles – as the following comment highlights:

For years we tried to build a dashboard for the university, but every project came to a halt when we faced the problem of collecting and integrating data. It was considered just too difficult and not a priority, meaning that we put it aside and went on using our scattered excel files (Head of quality assurance).

### *5.2 Towards infrastructure: accountants as boundary spanners*

This positive and flexible picture dimmed when the team started questioning the ICT unit about how to feed the dashboard in an automatic way. During the design and testing of the dashboard, the problems of data collection and automation were clearly addressed by the research team, involving ICT in all phases. ICT, however, started to raise objections, and they tried to slow the project down when they realised how significant the dashboard was becoming and that the directors wanted it as a routine tool. Two main concerns were raised. The first was the old unresolved bone of contention between accounting and ICT, in the form of data integration (Hunton, 2002; Hyvönen *et al.*, 2009). The self-service BI tool created an intermediate flexible layer held in the cloud where data from different sources and formats were uploaded (e.g. Access, Excel sheets and internal data warehouse). The directors considered this ease of data integration to be manna from heaven, as did the accountants, because it allowed them all to bypass the ICT unit and its data integration output, denounced as unsuccessful by the informants.

On its side, ICT questioned the BI integration solution, fielding the problem of information security, which had been overlooked, as highlighted by the head of ICT:

The solution to integrate data within the BI application is not acceptable security-wise. It means that the integrated dataset is available at desktop level and stored in the cloud, and this does not comply with our policies of ensuring more than just privacy.

The ICT unit considered the connection between this layer and the internal data warehouse to be insufficiently secure, and hence put forward the need to build a “reliable mirror database” (informant's words) as an essential step for the dashboard to be retained as an instrument.

In the past, ICT was able to terminate dashboard projects, citing these security requirements, together with the difficulty in automating data. This time, the situation was different because the visible usefulness of the output, having already been shown to the

directors, was a sort of “point of no return”. An alliance started to form between the BI tool and the accountants, who in this joined ranks with the users. On its own, the BI tool was by and large a boundary object, but it started to transform into a boundary infrastructure consisting of heterogeneous elements, although without a seemingly stable or coherent framework (Star and Ruhleder, 1996; Star, 1999).

Leveraging on the department directors’ positive reactions, the head of accounting decided that the moment was right to bring in two other pivotal actors, the rector and the general director. The department directors wielded considerable power within the university, and their opinion and support meant much; additionally, the rector and the general director really wanted department directors to have use of better data. There was another watershed moment, at a meeting called by the general director and attended by the rector, the head of ICT and the head of accounting, when it was decided to take a firm position: the dashboard was to be activated by January 2019.

At that moment, the accountants started to take on an ICT-user boundary spanning role. ICT had no say in avoiding the decision, but they started to propose specific technical details that could undermine the dashboard friendliness. For example, the ICT unit proposed that, for security reasons, the dashboard should be accessed through a longer path from the university login page. The department directors demurred, but the accountants came up with an acceptable compromise.

The existing accountants were expected to acquire new competences as fast as possible, to truly understand what was possible or not, and what was secure or not. It soon became clear that, while the BI tool was portrayed as an easy device to manage, there were also hidden costs associated with developing and managing the dashboard, and this turned into another source of problems, landing on the laps of the accountants in their role of mediators.

In this case, mediation was even more critical, given that the head of accounting needed to negotiate resources for their department and also for ICT. ICT, in turn, had to acquire the software licences and allocate personnel to the project; a task that took them away from other university ICT-related services. ICT staff was employed in designing the database (two persons at 50% of their time for six months) and accounting staff in managing and updating the dashboard (one person at 20% of their time for six months), plus one person was brought in from outside the department (who went from 50% part-time work on the project to full-time over the same period). The head of accounting also needed an additional person with the right management skills and expertise in data analysis and soft IT skills, who would join the project from outside the university. To manage and develop the dashboard, this person had to know how to design data and information systems using business analytics and BI solutions, have some kind of background in performance measurement/planning and control and also be capable of interacting with the department directors, the various data owners and the ICT personnel. This request created problems with human resources, and the general director was asked to intervene.

### *5.3 Search for coherence and stability*

Boundary infrastructures have the two distinctive features of stability and coherence (Star and Ruhleder, 1996; Bowker and Star, 1999; Star, 1999, 2010; Arena *et al.*, 2017). In developing the project, the accountants were faced with a major challenge relating to the users’ requests. In terms of use, the dashboard was a success, as the directors consulted, browsed through and made use of data. Their work, however, caused several problems, both old and new, to emerge.

The first problem concerned the correctness of the data. From the discussions between the department directors and accounting department – in charge of managing and updating

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the dashboard – it emerged that some data were incorrect, incongruent or incomplete. From the analyses, it became clear that the main causes of error related to incorrect or partial data keyed into native management systems in the various university units and departments. The need to correct this information led to a degree of friction and the need for mediation between accounting department – which was responsible for the data displayed on the dashboard – and the various university units expected to correct, complete and certify the data input. In more detail, because the information in the master databases was managed directly by the ICT division, this meant that the various units were faced with additional work to correct the mistakes in these records, on top of their previous work to revise the flows of information.

A second area requiring user mediation involved data visualisation and data update/refresh frequency. The department directors made several requests about modifying the layout of the data displayed and altering and/or replacing the views and detailed analyses, and they also asked accounting department to carry out further design and implementation work. The department directors also required a much higher refresh rate than that planned initially (if possible, in real time for some types of data), and this meant that accounting department and ICT had to oversee the operations much more closely. In the end, they agreed on a frequent refresh rate (in real time and/or every two weeks and/or every month) for the data and indicators extracted from the internal information systems, while it was to be less frequent for data that had to be collected from external software, controlled and/or which required manual post elaboration.

The final element of user mediation involved information flow management. After implementing the dashboard, it became clear that the various units involved in the project had different priorities and objectives while, at the same time, they were expected to work together to define the best information flow. Accounting department wanted to automate the retrieval of data generated through the management systems which had been created internally (this was simpler) as well as for data collected from external systems (this was more complex, as the various criteria and methods had to be agreed with the suppliers, and their feasibility verified in terms of the various rights over external databases). The aim of this exercise was to ensure greater reliability of data and minimum times in terms of elaborating the various releases. On the contrary, ICT would have preferred working on creating a well-designed and non-redundant database to manage the dashboard, with short process and elaboration times and, at least initially, fed with external data (because extracting data automatically would have required considerable time, distracting ICT personnel from other work). Also in this case, compromise was reached with the decision to extract data automatically from the beginning for data stored on internal databases, and subsequently for the data on databases managed by third-party software. Another critical factor was linked to the management of personal data for some information requested by the department directors. This involved careful analysis, including in connection with how to manage the information flows and, in some cases, involved carrying out accumulated re-elaborations. These extra elaborations resulted, on the one hand, in more work for the ICT division and accounting department, and on the other, it did not satisfy the department directors completely in terms of their requests for analytical information.

The accountants' work of mediation can be interpreted as continuous boundary spanning, where they were trying to maintain the flexibility crucial for users, and also retain the stability necessary for operational sustainability. The results presented suggest that the two properties, flexibility and stability, were evolving in the search for compromise between the two. Stability is the hardest to maintain when users understand and are able to master changes to their technological tools; what emerged was a "paced" revision of the dashboard.

The term “paced” is not intended to be programmatic, because, in a dynamic context, it is difficult to impose rigidity when implementing and revising technological tools, but they did agree on adding “data and features continuously to keep the dashboard vital” (in the words of the head of accounting). This concept of vitality brought about the second evolution to the features of the boundary infrastructure, with users ultimately signalling that they did not want total flexibility, but rather an instrument that was up-to-date and useful for the decisions that they had to make. The accountants’ use of “vitality” is seen in the following comment:

I’d say that another thing we learnt is that these “objects” must keep their vitality and dynamism over time, so requests must be kept in check, but the inevitable evolutions must be welcomed. This is why today many directors consider them as vital.

In brief, a new property emerged as essential in the boundary digital infrastructure, which we have called *paced vitality*. In practice, paced vitality is a fragile property and must be constantly monitored, especially when tools are a commodity and when some users are more advanced than others:

Many “advanced” users would like to lay their hands on source data as well as the summary data and build their dashboards and reports on their own. Of course, this is perfectly understandable as the tool is meant for a series of different needs, so, while it is an evolved analytical tool, it cannot answer specific requests. But nothing can latch into the automated flow of verified and certified data unless it goes through the main flow (Accountant).

## 6. Conclusions

Despite with delays, analytics and the new digital age have entered the domain of accounting and accounting studies (Janvrin and Watson, 2017; Rikhardsson and Yigitbasioglu, 2018; Moll and Yigitbasioglu, 2019). Previous studies have presented the role and proactivity of accountants as critical to this evolution, putting the spotlight on their reluctance to change and tendency to retain their current operations without expanding their sphere of influence and control (Briers and Chua, 2001). In this paper, we have contributed to the debate on the digital age and the role of accounting with our exploration into the subtle “revolution” of self-service BI tools. These tools have the distinctive feature of being a commodity for the users’ end purposes, as users can potentially build interactive dashboards and integrate data according to different formats, in an (apparently) easy way, hence without ICT support.

Previous studies on this topic are mainly technical and acritical, and overemphasise the instrument’s benefits (Elbashir *et al.*, 2008; Dilla, 2013; Kowalczyk, 2015; Schlesinger and Rahman, 2016; Daradkeh and Moh’d Al-Dwairi, 2017; Daradkeh, 2019). Furthermore, they are not framed within an accounting perspective, thereby the broader organisational impact of the adoption is widely overlooked, and indeed this angle is only now being glanced at in a few studies (Riggins and Klamm, 2017; Moll and Yigitbasioglu, 2019).

The specific objectives of our study have been informed by the concept of boundary objects (Star, 1989; Star and Griesemer, 1989; Bowker and Star, 1999; Leigh Star, 2010) and the two key elements of boundary infrastructure (Star and Ruhleder, 1996; Bowker and Star, 1999; Star, 1999, 2010; Arena *et al.*, 2017) and boundary spanning (Llewellyn, 1994; Briers and Chua, 2001; Caglio, 2003; Dechow and Mouritsen, 2005; Millo and MacKenzie, 2007; Dekker, 2016; Arnaboldi *et al.*, 2017a; Tambar, 2019). Our purpose was, therefore, to explore how self-service BI unveils tensions concerning data integration that have been latent for years (Hunton, 2002; Hyvönen *et al.*, 2009). In addition, we wanted to analyse whether

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accountants acquired a new role or not, thereby contributing to studies on the changing role of accountants (Yazdifar and Tsamenyi, 2005; Byrne and Pierce, 2007).

Regarding our first quest, our research revealed a complex and nuanced situation that became activated by the BI tool, highlighting how introducing new technology can cause organisational shock, by empowering the users. This extent of the implications was overlooked and they were found to be linked to user enthusiasm about data. The users' greater interest in data is a factor that can be considered as crucial to the relevance of accountants (Imhoff and White, 2011). This study revealed that the new digital tool was capable of attracting substantial interest because it brings together two features associated to boundary objects: flexibility and materiality (Star, 1999; Leigh Star, 2010). From its first release, the BI instrument was able to present an interactive dashboard, allowing users to browse through its content and set up filters to extrapolate data in different ways, shaping their own data views. Physical interaction on personal computers can be defined as the *materiality of objects in the digital age*. This material nature means that the BI tool takes on a central role, threatening the position of accountants as providers of reports, which were however seen as unsatisfactory. Having made this point, it was the tool's flexibility in being able to combine data from different sources that produced the greatest organisational shock, raising the possibility of accounting and ICT professionals no longer being relevant in data integration, an unsolved problem in this specific case and a recurring issue in accounting (Hunton, 2002; Hyvönen *et al.*, 2009).

The risk of flexibility was to create mayhem, with users creating their own dashboards and requesting further data directly from other organisational units (e.g. contract management or personnel). This was the entry point for our second research question, that of observing if and how accounting could find a new role. Similarly to previous studies, our research confirmed that mediation is central in gaining a role (Briers and Chua, 2001; Caglio, 2003; Dechow and Mouritsen, 2005; Millo and MacKenzie, 2007; Dekker, 2016; Arena *et al.*, 2017; Arnaboldi *et al.*, 2017a; Tambar, 2019) and that this became possible by spanning boundaries (Lewellyn, 1994). Boundary spanning, in turn, started to transform the BI tool, which joined a wider boundary infrastructure. By entering into the detail of the implementation, we were able to determine how accountants established a new role. Firstly, they found a role in governing the BI tool flexibility by giving it the *stability* that is part of the boundary infrastructure (Arena *et al.*, 2017). In so doing, there was however the risk of lowering user interest or opening the door to individual dashboard implementations, outside the "official" dashboard. The agency of the accountants brought out a new feature, that of *paced vitality*. *Paced vitality* is flexibility governed by agents and embedded in a more stable infrastructure. In this study, the accountants made use of paced vitality to retain user attention, keeping alive their role of data intermediaries in reporting (Yazdifar and Tsamenyi, 2005; Byrne and Pierce, 2007). The concept of paced vitality was also used to find a compromise with the ICT division, by agreeing to release further functions, but in a progressive way.

To summarise, our study enhances previous research into accounting in the digital age (Quattrone, 2016; Agostino, 2018; Rikhardsson and Yigitbasioglu, 2018; Bhimani, 2020), focusing on a new instrument, which is distinctive because it is more democratic in its ends for final users. This democratisation and flexibility put into discussion two core functions of accounting that are somewhat controversial (Hunton, 2002; Hyvönen *et al.*, 2009): data integration and personalised reporting (Abelló *et al.*, 2013; Daradkeh and Moh'd Al-Dwairi, 2018). Accountants were able to use boundary spanning to regain a valid role, finding in paced vitality the key for compromise.

Paced vitality is a concept that contributes to wider reflections on boundary object literature (Star and Griesemer, 1989; Bowler and Star, 1999; Leigh Star, 2010) and its specific application to accounting (Briers and Chua, 2001; Laine *et al.*, 2016; Arena *et al.*, 2017; Arnaboldi *et al.*, 2017a; Wouters, and Sandholzer, 2018). Paced vitality can be seen as a new feature of boundary infrastructure in the digital age, where continuous updating and object vitality are critical matters. Thinking, for example, of one of the most studied technologies, social media, the same concept can be applied to study how organisations can find a balance between social media openness and the regaining of an authoritative voice. This is a critical element in social media management, independently of whether social media is directed internally at employees or externally at outside users (Etter *et al.*, 2019). Finally, it is important to highlight the limitations of this study, which is that our results are specific to one organisation. Boundary literature allows for theoretical abstractions, but our study cannot be considered as a generalisation, stimulating the need to open new research.

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