

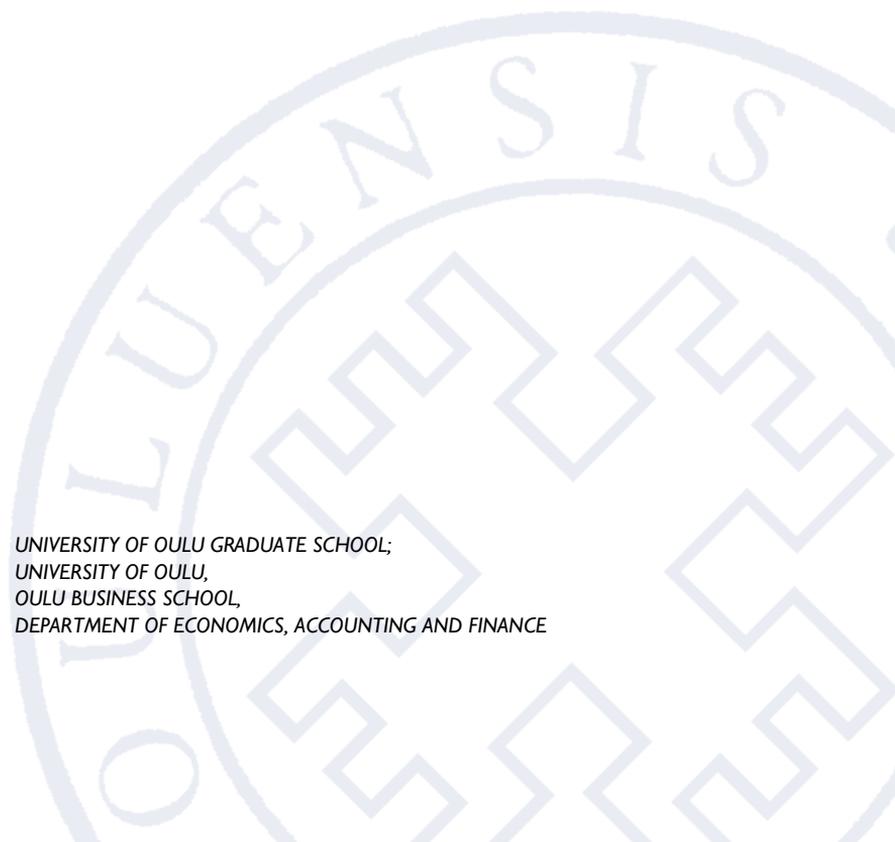
Erkki Lassila

BIG DATA IN THE MARGINS OF ACCOUNTING

*THE MEDIATING ROLE OF CALCULATIVE PRACTICES
IN A DIGITAL ENVIRONMENT*

UNIVERSITY OF OULU GRADUATE SCHOOL;
UNIVERSITY OF OULU,
OULU BUSINESS SCHOOL,
DEPARTMENT OF ECONOMICS, ACCOUNTING AND FINANCE

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ERKKI LASSILA

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ACCOUNTING**

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environment

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Abstract

This dissertation concerns the implications of the digitalization and related big data technologies for management accounting. It increases understanding of how these new means of quantification and calculation are intertwined with the management accounting expertise that has traditionally generated and linked calculable spaces and calculable selves for liberal programs of government. By highlighting the performative characteristics of digital space, the dissertation provides a fresh way to approach “the digital” from the management accounting perspective.

An increasing amount of literature has examined the disruptive digital transformation. However, there is still very little empirical and critically tuned research on the potential implications of this transformation for management accounting in its organizational and social contexts. This dissertation adopts an interdisciplinary perspective on accounting and problematizes the simplistic technical view of digitalization and big data technologies by taking a more holistic approach to the subject.

This dissertation is composed of three interrelated essays, which together bring forward the mediating and transformative role of calculative practices of accounting in the digital environment. The empirical findings show, first, how data analytics acts as a performative engine that generates coordination and control in creative digital development organizations. Second, the findings show how the governing of individuals’ everyday lives takes place in “free” digital application markets. Third, the findings show how specific characteristics that can be attributed to the digital calculable space have implications for the calculative expertise of management accounting.

This dissertation argues that the “uniqueness” of big data technologies comes mainly from their potential to economize and govern new territories of individuals’ private domains. However, it seems that these calculative technologies are, at least at present, still located in the margins of accounting.

Keywords: big data, calculative practices, data analytics, digital space, governmentality, management control, margins of accounting

Lassila, Erkki, Big Data laskentatoimen marginaalissa. Laskennallisten käytäntöjen välittävä ja muokkaava rooli digitaalisessa ympäristössä

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Tiivistelmä

Tämä väitöskirja käsittelee digitalisaation ja siihen liittyvien big data -teknologioiden vaikutuksia johdon laskentatoimeen. Sen tarkoitus on lisätä ymmärrystä siitä, kuinka nämä uudet määrällistämisen ja laskennan keinot kietoutuvat johdon laskentatoimen asiantuntemukseen, joka on perinteisesti luonut ja yhdistänyt laskennallisia tiloja ja laskelmia liberaaleihin hallinto-ohjelmiin. Korostamalla digitaalisen tilan performatiivisia piirteitä väitöskirja tarjoaa tuoreen tavan lähestyä "digitaalisuutta" johdon laskentatoimen näkökulmasta.

Vaikka viime aikoina tutkimus onkin lisääntynyt disruptiivisen digitaalisen muutoksen osalta, on kuitenkin vielä hyvin vähän empiiristä ja kriittistä tutkimusta tämän muutoksen mahdollisista vaikutuksista johdon laskentatoimeen sen organisatorisissa ja sosiaalisissa yhteyksissä. Tämä väitöskirja haastaa digitalisaation ja big data -teknologioihin liittyvän yksinkertaistetun teknisen näkemyksen ja tarkastelee aihetta kokonaisvaltaisemmin monitieteellisestä laskentatoimen näkökulmasta.

Väitöskirja koostuu kolmesta toisiinsa liittyvästä esseestä, jotka yhdessä tuovat esiin laskentatoimen laskennallisten käytäntöjen välittävän ja muokkaavan roolin digitaalisessa ympäristössä. Empiiriset havainnot osoittavat ensinnäkin, kuinka data-analytiikka toimii performatiivisena moottorina, joka luo koordinaatiota ja ohjausta luovassa digitaalisessa tuotekehitysorganisaatiossa. Toiseksi havainnot osoittavat, kuinka yksilöiden jokapäiväistä elämää hallitaan ilmaiseksi ladattavien digitaalisten sovellusten markkinoilla. Kolmanneksi havainnot osoittavat, kuinka erityisillä digitaaliseen laskennalliseen tila-avaruuteen liitettävillä ominaisuuksilla näyttää olevan vaikutuksia johdon laskentatoimen rooliin laskennan asiantuntijuutena.

Väitöskirja esittääkin, että big data -teknologioiden "ainutlaatuisuus" johtuu pääasiassa niiden mahdollisuudesta taloudellistaa ja hallita uusia yksilöiden elämänalueita. Näyttää kuitenkin siltä, että nämä laskentatekniikat sijaitsevat ainakin tällä hetkellä edelleen laskentatoimen marginaalissa.

Asiasanat: big data, data-analytiikka, digitaalinen tila-avaruus, hallinnallisuus, johdon ohjaus, laskennalliset käytännöt, laskentatoimen marginaalit

To my loved ones

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To put my dissertation project briefly, perhaps I could borrow one announcement from an old game that expresses it so nicely, “Time flies when you’re having fun.” This has truly been an eye-opening period in my life. Although I am such a person who loves challenges and gets involved in various, sometimes quite unusual projects, I had never thought that this one could be an option for me. The person who is now writing these words is very different from the one who started this journey several years ago. There are moments in life that have tremendous significance and can have huge impacts on how an individual’s future will unfold. Besides my beloved daughter’s birth, the day when I sat down with my future doctoral thesis supervisor Professor Janne Järvinen in a café room was definitely one of such instances. The next day, when I accepted his offer to start working on this dissertation, I could never have guessed, even in my wildest imaginations, the astounding impact it would have on my life, especially my lifeworld. This small step to the unknown opened up a new world that I did not even know existed—a world full of fascinating actors who could be searched and discovered.

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December 2022

Erkki Lassila

List of original essays

This dissertation is composed of an introductory chapter and the following essays, which are referred to throughout the text by their roman numerals:

- I Lassila, E. M., Moilanen, S., & Järvinen, J. T. (2019). Visualising a “good game”: Analytics as a calculative engine in a digital environment. *Accounting, Auditing & Accountability Journal*, 32(7), 2142–2166. <https://doi.org/10.1108/AAAJ-11-2017-3252>
- II Lassila, E. M. (2022). “Free”-to-play game: Governing the everyday life of digital popular culture. *Critical Perspectives on Accounting*, 102434. <https://doi.org/10.1016/j.cpa.2022.102434>
- III Lassila, E. M. (2022). Digital calculable spaces: On the outskirts of management accounting. Manuscript.

The dissertation contains one essay that is co-authored with Professor Janne Järvinen and Dr. Sinikka Lepistö (I). Lassila developed the theorization, research question and research design of the work, and collected, coded and analyzed the data. The co-authors participated in the process by commenting and guiding the development and writing of the manuscript.

Table of contents

Abstract	
Tiivistelmä	
Acknowledgements	9
List of original essays	13
Table of contents	15
1 Introduction	17
1.1 Background	17
1.2 The purpose of the dissertation	19
2 Methodological considerations	23
2.1 Ontological and epistemological assumptions	23
2.2 The empirical setting.....	26
3 Theoretical underpinnings	31
3.1 Performativity and the mediating role of accounting and calculative practices	31
3.2 Governing through numbers	32
3.3 Calculable spaces and calculating selves	33
3.4 Quantifying and economizing	35
4 Summaries of the essays	37
4.1 Essay I: Visualizing a “good game”: Analytics as a calculative engine in a digital environment.....	37
4.2 Essay II: “Free”-to-play game: Governing the everyday life of digital popular culture	38
4.3 Essay III: Digital calculable spaces: On the outskirts of management accounting.....	40
5 Conclusions	43
References	49
Original essays	57

1 Introduction

1.1 Background

“Accounting is most interesting at its margins. For it is at the margins that we see new calculative practices added to the repertoire of accounting.” (Miller, 1998, p. 605)

Accounting systems have been regarded as important and key formal sources of information for industrial organizations (Hopwood, 1972). Traditionally, accounting was perceived as a static technical phenomenon that enabled reasonably accurate and timely calculations and the provision of financial information for corporate management (Hopwood, 1987). Furthermore, for a long time, accounting was not approached as a calculative practice that actively shaped organizational functioning (Hopwood, 1987). The evolution of calculative accounting technologies has relied on optimism about the techniques of calculations. New, and supposedly “better,” calculations have always been expected to overturn preceding ones and their alleged deficiencies (Miller, 1992). Such a narrow and overtly technical view of accounting has neglected accounting’s position in the wider organizational and social contexts (Hopwood, 1987).

It is not unusual that such a narrow and overtly technical, and often even somewhat unproblematic, view of numbers and calculations has been adopted in the literature that examines the emergence and development of big data technologies and digitalization more generally (Cukier & Mayer-Schoenberger, 2013; Warren et al., 2015). However, there are other more critical views on the subject (see Andrejevic, 2019; Han, 2017; Quattrone, 2016; Zuboff, 2019). In general, digitalization and big data technologies are still often viewed in a very positive light and as an opportunity for organizations to collect better and more useful information for organizational decision makers and governing actors to make efficiency improvements (Al-Htaybat & Alberti-Alhtaybat, 2017).

In recent years, the implications of digitalization and big data technologies for management accounting, and accounting more generally, have received more attention from accounting scholars (Andrew & Baker, 2019; Agostino & Sidorova, 2017; Arnaboldi et al., 2017; Bhimani & Willcocks, 2014; Brivot & Gendron, 2011; Moll & Yigitbasioglu, 2019; Möller et al., 2020; Quattrone, 2016; Rikhardsson & Yigitbasioglu, 2018).

These studies have taken various views on digitalization in relation to accounting. Studies have highlighted the new sources and types of data that have emerged along with developments in big data technologies, which could provide new opportunities for accounting professionals for decision-making and control purposes in organizations (Bhimani & Willcocks, 2014). Other studies have shown how big data has implications for regulatory bodies in terms of citizens' privacy concerns (Andrew & Baker, 2019). Furthermore, studies have also highlighted the changes in the way control is enacted in digital surroundings (Brivot & Gendron, 2011) and how the distinction between the controller and the controlled has been blurred in such environments (Agostino & Sidorova, 2017). However, again, the emergence of big data and data analytics has often been viewed from the narrow and unproblematic perspective of the "technical" and from the implications of big data for the technicality of accounting and decision making.

Following Anthony Hopwood's (1987) proposal, this dissertation adopts a more holistic view of accounting beyond the technical and sees accounting in its organizational and social contexts. With such a view, it is possible to problematize the narrow technical view of big data and uncover nuances of big data technologies in relation to management accounting as hybridizing calculative expertise in its organizational and social contexts (Miller et al., 2010). In this dissertation, accounting and related calculative practices are understood as a socially constructed (Hines, 1988) governing apparatus (Miller, 2001; Miller & Rose, 1990; Rose & Miller, 1992), with potential performative and transformative implications for practice (Revellino & Mouritsen, 2015; see also Jeacle, 2012; Law, 2008; Lukka & Becker, in press; MacKenzie, 2006; MacKenzie & Millo, 2003).

This view highlights accounting's functioning as an assemblage of calculative infrastructure (Kurunmäki et al., 2019) that mediates between and links a wide variety of actors and domains of interest (Miller & O'Leary, 2007), enabling governing by numbers (Miller, 2001; Miller & Rose, 1990; Rose & Miller, 1992). It provides a holistic view of accounting and its functioning as a powerful and evolving (Miller, 1998) system of intervention in economic and social life (Miller & Power, 2013).

As a calculative practice, accounting incorporates different technologies that can transform qualities into quantities (Mennicken & Miller, 2012; Miller, 1992). Big data technology is one form of quantifying calculative technology that accounting has incorporated into its calculative regime. When big data and related calculative technologies merge with accounting, they can be regarded as more than just advanced digital data that provides 'better' and more accurate information

about organizational decision-making and control purposes. This merger allows big data to be seen as part of a much larger transformation of digital that changes our society and established practices as a powerful system of intervention in organizing and economizing (Miller & Power, 2013).

The evolution of accounting has been multidimensional, and therefore, it is difficult to define what accounting actually is (Miller, 1998). As Hopwood (1983) puts it, “[a]ll too apparently accounting is a phenomenon which is what it isn’t and can become what it wasn’t” (p. 289).

Accounting’s tentacles have penetrated many areas of life outside factory floors and corporate corridors, providing visibility into wider important and wicked issues of our time (Dillard & Vinnari, 2019). This search, be it from the critical interdisciplinary perspective (Lukka & Becker, in press) or due to smaller emancipatory interest, should be continued. It is important that accounting be investigated with a broad perspective and with multiple methods so that we can better understand accounting and its functioning in new and continuously emerging areas of interest.

This dissertation provides one such view of the everyday expanding area of digital space (Kitchin & Dodge, 2014). With digitalization, new types of data sources have emerged, which have influenced the way in which accounting as a calculative expertise can be practiced (Bhimani & Willcocks, 2014; Rikhardsson & Yigitbasioğlu, 2018). As a disruptive technology, the digital revolution has influenced accounting in many ways. If the boundaries of accounting were difficult to determine before (see Miller, 1998), recent technological developments in digitalization (Knudsen, 2020) may have made such boundaries even more elusive (Agostino & Sidorova, 2017; Bhimani & Willcocks, 2014; Brivot & Gendron, 2011).

1.2 The purpose of the dissertation

The purpose of this dissertation is to increase our understanding of the implications of digitalization, especially big data technologies, for the calculative regime of accounting expertise. This dissertation explores the influences that digitalization and the big data explosion have had on the management accounting domain, especially in the digital software business environment. It explores how the emergence of big data has influenced the transformation of management accounting as a body of quantifying calculative expertise. Accounting as knowledge of expertise has been the function in organizations that has created and

developed new ways to mediate between different and distant domains of interest while generating financial control and visibility for organizations and society at large (Miller & O’Leary, 2007; Miller & Rose, 1990; Rose & Miller, 1992). How has the emergence of big data technologies influenced the traditional position of accounting, especially management accounting, as a calculative expertise?

This dissertation is comprised of three essays. The first essay focuses on the implications of big data for organizational actors and explores how data analytics acts as a mediating performative calculative engine in a creative digital development environment, generating coordination and control within the organization. Free-to-play mobile game development can be seen as a creative digital development environment in which game user-generated big data plays a significant role in the continuous development of the game as a service (El-Nasr et al., 2013; Seufert, 2013). Because modern application development is an ongoing process that may continue long after the initial launch of the application (Waldner et al., 2013), and on which users’ behaviors and changes in market conditions influence, the actual characteristics of the desired end product become ambiguous and difficult to predict in advance. The organizational ambition of developing a ‘good game’ is a constantly evolving objective, an idea that big data and data analytics participate in transforming into a format of meaningful numbers and visualized metrics. The calculative practices of data analytics have a continuous performative effect on the development trajectory of the game as a service. With the perspective taken in this essay, big data represents itself as a form of management control device for governing the actions of organizational actors. As a calculative practice of accounting, big data analytics acts as a mediating instrument between the creative and economic ambitions of organizational actors.

The second essay takes a broader societal view of the implications of big data technologies and the calculative practices of accounting. By using the governmentality thesis as its theoretical lens (Miller & Rose, 1990; Rose & Miller, 1992), this essay reveals new areas of governing of the daily lives of individuals. The free-to-play gaming industry provides empirical evidence to demonstrate how calculative practices of accounting are intertwined with the transformation of digital entertainment consumption from occasional entertainment into a data-generating labor process. This study shows how the concept of ‘free’ acts as a surrogate to enhance the user acquisition, engagement, and monetization that are in the interest of organizational economic aims. End users’ behavioral data from the individuals’ daily lives is transformed by big data technologies into meaningful utterances that bring about opportunities for constructing new problems that require

solving (Miller & Rose, 1990). By following the actions of users in different steps of the user acquisition funnel, developers may construct a processual view of these potentially retainable users' activities through this funnel. Any activity that seems to reduce the possibility of transforming the acquired user into a retained user is seen as an opportunity for intervention. Similarly, after the user has been transformed into a retained user, any activity that might hinder the engagement of retained users or transform retained users into churning users becomes an opportunity for further intervention. From this perspective, big data represents a technology that reaches out to the new mundane and microscopic areas of individuals' daily lives, transforming previously private spaces into commodities to be exploited by economically oriented organizations.

The third essay focuses on the professionals expected to provide calculative expertise in relation to big data technologies. This essay concerns the role of management accounting as a calculative expertise capable of generating calculable spaces and calculating selves (Miller, 1992) in a data-intensive digital development environment. Big data technologies require certain types of technical expertise from those who wish to utilize them. Data-mining and -processing skills seem to be the minimum requirements, together with statistical calculations, if digital raw data is to be transformed into meaningful big data for organizational purposes. This essay shows how a new profession has emerged that seems to occupy the center stage of this technical expertise. These professionals, often called data scientists, transform raw digital data into a quantified form for the decision-making purposes of organizational actors in highly data-intensive development environments. Data scientists seemed to be the ones transforming qualities into quantities and complex processes into figures and visualizations in a manner desired by others. Although data scientists seem to have taken over this new area of digital calculative expertise, management accounting professionals seem to have opted to operate within their traditional area of expertise, generating and connecting calculable spaces and calculable selves from data that does not require as deep an understanding of the techniques related to data mining and statistics. Furthermore, it seems that the often-expected neutrality of accounting calculations does not apply in this context. The accounting profession and its calculations are attributed to business thinking, which is seen in a somewhat negative light by those who see themselves as creative developers. However, the calculations of data scientists do not seem to generate such juxtaposing and instead are viewed in a more neutral light and desired by creative developers. This adopted perspective provides the lens through which big data can be seen as a calculative technology requiring certain types of technical

expertise from those who wish to exploit it while meriting more neutrality than accounting in terms of calculations.

Together, these essays provide the background and means to explore the implications of digitalization, especially the technologies of big data and data analytics, for the management accounting function. The perspectives taken in the essays enable a holistic view of the big data phenomenon in relation to accounting, especially management accounting, in its organizational and social contexts (Hopwood, 1987).

The remainder of the introductory part of this dissertation is organized as follows. In Section 2, the methodological considerations are presented. In Section 3, the theoretical underpinnings are presented. In Section 4, summaries of the essays are included. In Section 5, the conclusions are presented by combining the findings of this dissertation.

2 Methodological considerations

2.1 Ontological and epistemological assumptions

This dissertation adopts ontological and epistemological perspectives familiar from the interpretive accounting research (IAR)¹ tradition (Lukka & Modell, 2017). Such a perspective emphasizes the subjective nature of the social world and focuses on individual meanings and people's perceptions of 'reality' (Hopper & Powell, 1985). One of the ambitions of the early works of IAR (see, for example, Argyris, 1952; Hofstede, 1968; Hopwood, 1973) was to distance accounting research from purely normative theorizing by advancing empirical research (Lukka & Modell, 2017). The conception of reality as a socially constructed space is characteristic of IAR. Hopper and Powell (1985), along with Chua (1986), locate IAR more on the subjectivist than the objectivist end of the spectrum in Burrell and Morgan's (1979) well-known paradigmatic classification, in which alternatives to the mainstream functionalist paradigm are the interpretive paradigm and two critical paradigms (Lukka, 2010). However, IAR should be kept separate from the pure solipsist position, in which reality is reduced to plain individual consciousness (Hopper & Powell, 1985).

In IAR, reality should be conceived of as constituted by intersubjective meanings that become objectified with reasonably stable, although not immutable, properties (Chua, 1986). To develop an understanding of the conduct of others, a process of interpretation is required. Individuals constantly create their social reality in interaction with others, and it is these realities and the ways in which they are socially constructed that are the focus of analysis (Hopper & Powell, 1985). Therefore, the objects and subjects of study should be investigated in the embedded environments in which they perform their daily duties and undertakings.

From the point of view of the other dimension in Burrell and Morgan's (1979) paradigmatic distinction, namely, the sociology of regulation versus the sociology of radical change, this dissertation adopts a somewhat middle ground but perhaps more on the side of radical change. Such a position can be located under the label "interdisciplinary" accounting research, the label invented in the mid-1980s (Lukka

¹ In this dissertation, the notion of IAR includes and is used interchangeably with interpretive management accounting research, and interpretive research (IR) more generally (see Baxter & Chua, 2003; Kakkuri-Knuuttila et al., 2008; Lukka & Modell, 2010). IAR is also similar to qualitative field research methodology regarded as a general approach for examining a certain research topic (see Ahrens & Chapman, 2006).

& Modell, 2017). The ‘interdisciplinary’ label can be understood as referring to scholars who prefer to use qualitative research methods and are inclined toward interpretive as well as more emancipatory intent critical research. According to Lukka and Modell (2017), although critically oriented accounting research might sometimes be distinguished from value-neutral and less politically engaged IAR, such a separation is not always easy due to variations in emancipatory intent. The emancipatory intent familiar with the critical perspective stresses the unfulfilled potentialities of entities. The potentiality of human beings is regarded as being restricted by the prevailing systems of power and domination, and therefore alienate humans from self-realization (Lukka, 1990).

Alongside, or perhaps along with, the ‘interdisciplinary’ research tradition, there exists another parallel research tradition in which this dissertation could easily be located, the ‘alternative’ management accounting research approach (Baxter & Chua, 2003). Similar to “interdisciplinary” research, within this research tradition scholars draw on non-positivistic strands of social theory and are inspired by the interpretive, critical, and postmodern views of accounting. In a review paper, Baxter and Chua (2003) distinguish seven streams in ‘alternative’ management accounting research: the non-rational design school, the naturalistic approach, the radical alternative, institutional theory, structuration theory, the Foucauldian approach, and the Latourian approach. Of these research perspectives, although none are excluded (especially the naturalistic approach), the Foucauldian and Latourian approaches reflect the perspectives adopted in this thesis.

The naturalistic approach seeks to investigate management accounting practice in situ, in its natural setting, to gain intimate knowledge of the field being examined (Tomkins & Groves, 1983). This is a very common approach in qualitative and interpretive studies (see also Lukka & Modell, 2010). With this exploration of the empirical life, the researcher may develop and sharpen the inquiry while leaving room for flexibility and possible shifting points of observation. Such an approach may inform us how the organizational contexts in which management accounting is practiced are changing and how management accounting contributes to these changes but is also changed by them (Baxter & Chua, 2003). It also informs us how management accounting technologies convey local values, meanings, and nuances differently in different contexts (Baxter & Chua, 2003).

The Foucauldian approach enables scholars to challenge more simplistic accounts and origins of management accounting technologies while enabling the reflection of institutionalized webs of power (Baxter & Chua, 2003). Lukka (1990) also points out that although some critical researchers might base their studies

explicitly on materialistic philosophy, Foucauldian researchers are overtly non-materialistic. Foucauldian studies may produce connections between the purposes of practices and the networks of institutionally located discourses (Baxter & Chua, 2003).

Furthermore, the Latourian approach enables scholars to understand accounting technologies in the context of networks of human actors and non-human “actants” (Baxter & Chua, 2003). From this perspective, management accounting figures are seen as fabricated inscriptions, constructed as “facts” to accommodate and persuade the diverse interests of many types of actors. Such idealized concepts as “translation,” “centres of calculation,” and “action at a distance” (Latour, 1987) are some of the key components through which control in management accounting can be understood to be constructed and maintained.

In this thesis, regarding the ontology of reality, it is assumed that some form of physical existence independent of the human mind exists. However, this should not be understood in a sense of naïve realism, which posits that the world, the reality and all the entities it consists of, exists objectively, independently of individual perception, waiting to be discovered (Lukka, 1990). Instead, this thesis leans toward idealistic ontology in which the world is created and depends on the consciousness of acting individuals, and therefore, is essentially subjective (Lukka, 1990), having performative potential.

Nevertheless, the ontological view taken here considers technological artifacts as equivalent participants in a network of human and non-human agencies that are temporarily aligned to achieve particular effects (Orlikowski & Scott, 2008). This view is aligned with the actor-network theory (ANT) originally developed mainly by sociologists Michel Callon and Bruno Latour, along with John Law and others, in the field of science and technology studies (Lukka & Vinnari, 2014). In this view, objects are the effects of an array of relations of symmetrically relevant humans and technologies (Orlikowski & Scott, 2008). ANT, especially the works of Latour (1987, 2005), has been used in accounting research at least since the beginning of the 1990s, often as a method theory (Lukka & Vinnari, 2014), providing a lens through which a certain phenomenon can be investigated. Lukka and Vinnari (2014) point out four key notions of ANT that express the fundamental premises of this approach: actors, translation, alliances, and trials of strength. In addition, and for the purposes of this dissertation, two other ANT-related notions need to be highlighted as crucial: centers of calculation and action at a distance (Latour, 1987).

Why these two additional concepts are added to the list proposed by Lukka and Vinnari (2014) relates to their importance in understanding how accountability, or

in other words, control in accounting, is actualized in the digital context of this thesis. Drawing on Latour (1987) and Miller (1992), centers of calculation enable action at a distance.

2.2 The empirical setting

Research on big data

During the last 10 years, research related to the impacts of the digital revolution and big data technologies on accounting has steadily increased (Agostino & Sidorova, 2017; Bhimani & Willcocks, 2014; Moll & Yigitbasioglu, 2019; Möller et al., 2020; Viale et al., 2017). The empirical settings in which the implications of digitalization for accounting have been investigated have varied. Often, big data technologies–related accounting studies have dealt with such contexts as social media (Agostino & Sidorova, 2017) and the advertisement industry (Viale et al., 2017), or have been conceptually oriented (Bhimani & Willcocks, 2014; Moll & Yigitbasioglu, 2019).

The empirical setting of this thesis draws on the mobile gaming industry, especially free-to-play games. Mobile gaming has had a major impact on the global video gaming industry during the last decade (Nieborg, 2015). Global mobile game revenue is closing in on the 100 billion U.S. dollar mark (Clement, 2021), and free-to-play games generate the biggest portion of this revenue (Coldewey, 2019). People spend increasing amounts of time playing mobile games (Lynkova, 2022). Thus, free-to-play mobile gaming is no longer a marginal phenomenon, as it has significant economic and social value that merits academic interest.

Furthermore, free-to-play mobile game development is first and foremost digital development, in which the product or a service developed is preeminently digital, requiring no physical product manufacturing or distribution. In addition, free-to-play game development has long utilized big data for game development purposes (Seufert, 2013), and therefore provides an excellent context for investigating the big data phenomenon in organizations and in society more generally. In particular, game user research, an emergent field in game development, aims to tie together human–computer interaction, game development, and experimental psychology (El-Nasr et al., 2013).

Data collection

The primary data for this thesis comes from 35 semi-structured interviews conducted with professionals working in free-to-play game development organizations and from the users of such games. As the main data source, access to four game development organizations (three based in Finland and one in Germany) was gained. In addition to the 35 interviews, six were conducted during the preliminary phase of the research. Of these six interviews, three were conducted face-to-face and three in written format. Five of the interviewees were game developers, and one worked in the big data consultation industry. Thus, in total, 28 game development professionals from different organizational functions and levels were interviewed for this dissertation. In addition to other professionals, 10 interviews were conducted with game users. All users were based in Finland and had experience playing mobile games.

All of the interviews were conducted between January 2014 and April 2021. Most were conducted face-to-face, except for five, of which two (user interviews) were held by phone and three with video conference software over the internet. Most of the interviews lasted between one and two hours. In total, more than 40 hours of interview data were collected for analysis purposes. Anonymity was guaranteed for all of the interviewees and their organizations, which was expected to reduce potential reluctance to share information (Gendron & Bédard, 2006).

The secondary data consists of publicly available data on the game industry, observations, and discussions during company visits, several gaming-related workshops, and a game conference. Notes were often written during and after the visits to organizations to record any additional interesting issues about the work environments or discussions outside the interviews. In addition, the author attended several big data and open data-related workshops, where unofficial discussions relating to big data and open data development took place. These discussions were not recorded, as they took place in an ad hoc manner. However, these discussions were recalled partly by field notes after such events. These discussions provided specifics beyond the interviewed professionals and users and added to the emic view of the subject matter (Lukka & Modell, 2010).

Additionally, the author familiarized himself with several games that interviewees had developed or were currently developing and many other games in similar gaming genres. In this way, the author was able to gain hands-on experience and a view from the user's perspective on topics of interest. It also provided the

possibility to see whether certain new features that game developers were planning to implement in their games in terms of desired improvements were truly actualized.

The abductive reasoning approach

This research adopts an abductive reasoning approach (Peirce, 1958) that can be split into three main phases: the preliminary exploratory research phase that was conducted in 2014, the following iterative and more theoretically informed research phase that started in 2015, and the third phase from 2019 onward, when the game users were included and interviewed for the research. The abductive reasoning process normally starts by identifying an anomaly in the literature derived from an empirical phenomenon or from the literature (Lukka, 2010; Lukka & Modell, 2010). This was the case with big data and management accounting at the beginning of 2014. The preliminary step was conducted to get the first impression of how big data technologies had been implemented in the practices of organizations and how such practices could be interpreted from the perspective of management accounting. At the beginning of 2014, there was a very limited amount of literature, especially empirical evidence, on the implications of big data for management accounting and the accounting domain more generally. Initially, the author problematized the management accounting literature on the lack of knowledge and understanding of the implications of big data technologies for existing calculative practices of management accounting in terms of decision making and control practices.

During this preliminary stage, the free-to-play mobile game industry was identified as an industry sector that had implemented big data technologies in its development and business processes; therefore, it was chosen as a suitable field in which to explore the phenomenon further. Another industry sector that dealt with big data technologies was the big data consultancy industry. From this starting point, six professionals were approached who were expected to be familiar with big data technologies and could provide a preliminary understanding of the implications of big data for organizational practices and for the accounting domain specifically.

Access to four free-to-play game companies and one big data consultancy company was granted. In total, six individuals were interviewed during this exploratory phase. Five were game developers, and one was a big data consultant. Face-to-face interviews were conducted with three professionals. For the other three, a list of written questions was provided that they could answer in a convenient moment and could send their responses by e-mailing the original file with their answers to the author.

To gain a better understanding of how game development as a process actually works, the author participated in the game development program called Oulu Game Lab in 2014. The purpose of this one-year program was to develop a new game from an idea into a sellable product that could provide the basis for establishing a new game start-up company. This was an opportunity for the author to experience how the game development process is initiated, how it is organized from scratch, how different experts find their place in such an unfolding organization, what type of everyday work is required for progress, and how individuals build up their roles as members of emerging development teams in a start-up company. This was an excellent opportunity to build up the emic perspective and understanding of the work habits and culture of the game developer community as well as the practical and technical sides of the development as a whole. It provided an opportunity to get hands-on experience and an understanding of the type of expert knowledge required to develop a sellable game from a simple idea. In addition, by participating in the development process and different workshops and gatherings of the game developer community, the author was able to develop a network of connections within the community.

During this initial exploratory and ethnographically oriented entry phase, it was possible to start drafting theoretical motivations about the implications of digitalization and big data technologies for management accounting, especially in the digital development environment. Specifically, it seemed to be problematic that big data and advanced analytics were supposed to provide many advantages for companies that implemented such technologies in their practices (Davenport, 2006), but there was little empirical evidence of the ways in which this actually happened. Some literature seems to suggest that if companies would just implement analytics in their business processes, hire talented and data-savvy people, and promote fact-based decision making as their strategic intent, they could sell more and make their businesses grow (Seufert, 2013). However, there exists little evidence in the accounting literature of how such technologies actually influence the basic practices of organizational decision makers and organizational control mechanisms. In management accounting literature, discussion was still often related to enterprise resource planning systems or information systems in general (see Granlund et al., 2013), but with little emphasis on big data technologies, with a few exceptions (see, for example, Bhimani & Willcocks, 2014). As the literature in relation to big data on accounting was still in a very immature stage in 2014, it represented a problem in literature (Pfister et al., 2022).

With this tentative theoretical motivation, it was possible to develop a plan for how to approach the field, what type of data should be collected and how it could be analyzed. In this way, the author was able to demonstrate a theoretical motivation and clear initial focus for the theoretical and empirical analysis (Alvesson & Sandberg, 2011).

The first step was to develop an understanding of how big data and data-analytic technologies relate to organizational actors' decision making and control. The performativity thesis (Law, 2008; MacKenzie, 2006; MacKenzie & Millo, 2003) and the ability of calculative practices of accounting to render complex processes visible as single financial figures (Miller, 2001), together with the concept of mediating instruments (Miller & O'Leary, 2007), provided a good starting point for the exploration. Using this approach, a better understanding of the role of big data technologies in the organizational context was developed.

After this step, it was possible to broaden the view of the societal level and of the implications of big data technologies for governing the daily lives of individuals outside organizations. Big data seemed to be related to individuals' daily lives, regardless of whether they were at work or leisure. By using the governmentality thesis as a lens (Miller & Rose, 1990; Rose & Miller, 1992), the second step provided a way to examine the connectedness of everyday lives of ordinary people to the decisions of organizational actors and their economically oriented programmatic ambitions.

The final step was to understand how digitalization and big data technologies might have influenced the profession of management accounting as calculative expertise and as a mode of power attempting to act on the actions of individuals and populations (Miller, 1992). This exploration aimed to uncover the actual center of calculation regarding big data technologies. The aim was to uncover the specifics of expertise capable of generating calculable spaces and calculable selves in a digital environment.

By utilizing abductive reasoning (Peirce, 1958), it was possible to move from theory to empirics and from empirical descriptions to theoretical explanations while the research process was unfolding (Lukka & Modell, 2010). Such switching between emic and etic perspectives (Kakkuri-Knuuttila et al., 2008; Pike, 1954; see also Dent, 1991) should help interpretive researchers develop theoretically grounded "thick" descriptions (Geertz, 1973) and explanations of matters of concern.

3 Theoretical underpinnings

3.1 Performativity and the mediating role of accounting and calculative practices

The performativity approach has long been recognized in the accounting literature (Hines, 1988). The thesis postulates that different calculative practices, such as accounting or economics, for example, should be understood more as “engines” constructing entities that influence the world, instead of being understood merely as cameras that aim to describe the world (MacKenzie, 2006). Thus, calculative practices can be understood as having the capacity to enact the construction of reality instead of simply explaining or describing some existing reality (Law, 2008; MacKenzie & Millo, 2003). Such a view is rarely adopted in the literature that deals with big data and digitalization (for an exception, see Kitchin & Dodge, 2014).

There are different concepts of performativity that have their roots in J. L. Austin’s (1962) notion of performative utterances (Orlikowski & Scott, 2008). Gond et al. (2016), for example, distinguish among five foundational perspectives on performativity that are based on different views of what performativity is about: doing things with words, searching for efficiency, constituting the self, bringing theory into being, and sociomateriality mattering.

Austin (1962) distinguishes between declarative and performative sentences. When declarative utterances describe the world to which they refer (the cat is on the mat), performative utterances have the capacity to act on those worlds (I pronounce you husband and wife), and therefore can help make such worlds exist (Callon, 1998). This basic idea was later extended to include, for example, scientific theories and material assemblages (Callon, 2007), economic models and algorithms (MacKenzie, 2006), and the sociomaterial nature of knowledge constitution (Barad, 2003).

Within the field of accounting, Revellino and Mouritsen (2015) examined the performativity of calculative practices and observed how the results drawn by calculations may sometimes generate surprising results that influence the further development of the calculative device itself, thus generating drifts along its development trajectory. The opacity and incompleteness of the calculations and figures that are produced may enhance the construction of the desired reality that such calculations ought to be describing (Busco & Quattrone, 2018; Dambrin & Robson, 2011). This perspective calls for more attention to the performative and

incomplete nature of calculations in general, and calculations related to big data and data analytics in particular.

The performativity of calculative devices requires enactment and action by others (Latour, 1987; Law, 2008). If the entity is not enacted by others, or if it will not produce any action, it will not have any performative power. Therefore, attention needs to be paid “to *both* the conditions and consequences of metrics and models” (Mennicken & Miller, 2012, p. 5, emphasis in original) when the performativity of calculative devices is being examined. The calculative instruments are linked to different programs and ideas; therefore, there is an interplay and interdependence between them. The instruments and practices link the actions and expectations of actors from different domains (Miller & O’Leary, 2007). Miller and O’Leary (2007), for example, use the notion of “mediating instruments” to examine how science and the economy become linked through capital budgeting calculations and technology roadmaps, and thus contribute to the process of making markets (p. 711). Their example highlights the importance of viewing capital budgeting as embedded in the much broader issue of managing and coordinating investments than in the narrow matter of financial valuation.

As accounting mediates between economy and science (Miller & O’Leary, 2007), or tensions between creativity and control (Jeacle & Carter, 2012), accounting practices are constantly engaged in a hybridizing process that seeks to make visual and calculable the constituted hybrids that the practices encounter (Miller et al., 2010). It is this embeddedness of the calculative practices of accounting in the wider network of social and political calculative regimes that this thesis explores. Big data and data analytics are technologies of calculation and thus can be linked to this regime of calculations. Therefore, it is necessary to understand how governing through numbers (Miller, 2001) is expected to happen.

3.2 Governing through numbers

The governmentality framework (Miller & Rose, 1990; Rose & Miller, 1992) that is inspired and based on the works of Michel Foucault provides a fruitful way of comprehending how power is conceived and made operable in liberal democracies. The governing activity should be understood as a form of problematizing activity that aims to constitute a certain form of sociological realm (Rose & Miller, 1992). With such a perspective, accounting is embedded in the complex network of activities and actors that aim to govern economic life within and beyond the workplace (Miller & O’Leary, 1987; Miller & Rose, 1990). As a problematizing

activity, governing requires a problem that can be introduced in such a way that it supposedly requires solving (Miller & Rose, 1990). Theoretical arguments and truth claims may open a space within a discursive field in a manner that makes an object known, while also providing a moral justification and rationale for intervention and regulation (Miller & Rose, 1990). Language, together with different technical devices, serves as a translation mechanism for constructing a realm in such a way that it has programmatic character and need for governing (Miller & Rose, 1990). Then it is through the technologies of governing that such politically rational thoughts are translated into the domain of reality (Miller & Rose, 1990). The role of experts is important here, as their professionalism, vocabularies, and technologies provide mechanisms that can be used for shaping and molding different domains of the private (Miller & Rose, 1990).

Accounting as a form of calculative expertise brings claims of neutrality and objectivity into decision making (Miller, 1992). Individual decision makers can be made governable by linking their decisions to the seemingly impersonal logics of calculation and quantification, while at the same time detaching their decisions from arbitrary judgments and moral bases. Through standardization, accounting numbers can configure persons, domains, and actions as objective and comparable (Mennicken & Miller, 2012). Thus, accounting numbers have the capacity to create and constrain subjectivity at the level of the individual worker, manager, schoolteacher, and so on (Mennicken & Miller, 2012), bringing out the calculable selves that are loosely coupled with the centers of calculations and calculable spaces they inhabit (Miller, 1992).

3.3 Calculable spaces and calculating selves

Management accounting is expert knowledge and a “mode of power that attempts to act upon the actions of individuals and populations” (Miller, 1992, p. 65). Through management accounting, liberal programs of governing can be fabricated and put into action by inventing calculable entities, such as “The Quantified Customer” (Vaivio, 1999). This happens by constructing calculable selves and calculable spaces that are loosely connected together and to the centers of calculations (Miller, 1992). The calculative technologies of accounting are connected to the economic norms and calculative principles, and thus are intertwined with and intrinsic to decisions that are made by the individuals. Therefore, decisions that accountable individuals make can become seemingly neutral and objective, legitimated by the calculations used.

Thus, the governing power of calculations depends on their capability to govern the conduct of individuals (Foucault, 1977). When individuals are made to think about their own actions by the rules and norms imposed on them, their thoughts and behavior are influenced. The imposition of rules and norms is, of course, not always a smooth operation, as individuals have different rationalities and ideals through which they see the world (Miller, 1992). This can generate resistance between professionals and experts who see the world differently (Vaivio, 1999). In addition, the economic calculations themselves are always incomplete and opaque descriptions (Busco & Quattrone, 2018; Dambrin & Robson, 2011), which intersect poorly with the specifics of the real (Miller, 1992), and therefore can always be contested by different experts. As Miller (1992) puts it, “economic calculation is a congenitally “failing” operation” (p. 79). However, instead of seeing this as a problem of economic calculations, Miller proposes that it should actually be seen as a source of their strength. When one proposed way of calculating fails in practice, there is an opportunity and room for another “better” way of making calculations. This creates the view that answers can always be found to problems for those who seek them (Miller, 1992). Be it about the future, profitability, or costliness of some sort of activities that are examined, the calculative technologies of accounting are there to help render such things knowable and amenable to control.

For this search, big data has been said to be able to deliver a volume, velocity, and variety of data. Such data should provide “better” and more timely information for decision-making purposes and remedy the shortcomings of previous calculations and ways of rendering the future knowable (Ibrahim et al., 2021; Vasarhelyi et al., 2015; Warren et al., 2015; Yaqoob et al., 2016). Therefore, trust in calculations and their capability to generate answers to problems is related not only to accounting and economic calculations but also to calculations and quantification more generally (Mennicken & Espeland, 2019). What is specifically interesting in accounting calculations and the constructed entities they produce is their capability to bring out certain ways of thinking about how the world works in economic terms (Miller, 2001), thus shaping the preferences of actors who encounter such figures (Miller & Power, 2013). Of course, this type of new knowledge might collide with local knowledge and fail to gain ground (Vaivio, 1999). This is the uniqueness of accounting: its capability to economize the non-economic.

3.4 Quantifying and economizing

Accounting has a long history that can be traced to the prehistoric era between 8000 B.C. and 3100 B.C. when simple clay tokens were presumably used as artefacts to represent economic transactions (Mattessich, 1987). Similarly, the quantification and avalanche of numbers are nothing new in themselves (Hacking, 1990). Nonetheless, the numbers that can be linked to economic and financial matters have been granted a seemingly neutral and objective stance (Miller, 1992), by which these numbers can be viewed as representing the truth about the object of calculation. Economically tuned quantification can establish comparability and performance assessments between different objects, and thus, they may bring about a form of authority for governing (Kurunmäki et al., 2016). This can have the capacity to influence “who we are, or who we should try to be” (Kurunmäki et al., 2016, p. 3). Such quantification appears to have penetrated almost all aspects of individuals’ everyday lives (see Järvinen et al., 2020; Mennicken & Espeland, 2019).

Kurunmäki et al. (2016) argue that it is important to differentiate between quantifying, economizing, and marketizing because quantification can happen without linking it to economic calculations. Many things can be quantified simply by translating qualities into quantities. However, economizing does much more than that. When quantification is used for economizing, different actors and entities may be constituted as economic actors and entities (Miller & Power, 2013). Thus, economizing constitutes an economic reality that can become performative. For example, different ideals of efficiency, costliness, and performance can be linked to metrics and figures produced by economic calculations (Kurunmäki et al., 2016). Moreover, when these metrics and figures are loosely linked to the identities of individual actors, different sorts of activities, organizations, regions, and so forth, the figures can make these things comparable and thus governable in financial terms. Things that were not financially comparable before, and that might have very different physical characteristics, can be compared through financial figures of cost–benefit analyses, return on investment, and net present value, for example (Kurunmäki et al., 2016). Thus, notions such as competition and benchmarking can be linked to different activities and processes of interest. Although marketizing resembles economizing and can coexist alongside it, it still has its own function and can be regarded as a specific form of economizing (Kurunmäki et al., 2016). With marketizing, the rationality of the market is intended to be extended to domains that were not previously viewed as supervised by the markets.

In summary, the perspective on calculations and calculative expertise above provides a fresh view of digitalization and the big data phenomenon. While digitalization and big data technologies have often been viewed from a technical standpoint and as additions and improvements for efficiency and decision-making practices, the approach adopted in this dissertation enables us to view these developments more holistically in organizational and social contexts (Hopwood, 1987). It provides a lens through which the activities around popular digital cultural products, such as mobile games, can be linked to the economizing and marketizing activities of a neoliberal doctrine.

4 Summaries of the essays

In this section, concise summaries of the three essays included in this dissertation are provided. The three essays are then used in a compilation to make the final argument of this thesis.

4.1 Essay I: Visualizing a “good game”: Analytics as a calculative engine in a digital environment

The first essay explores the role of data analytics in a creative digital development environment. It furthers our understanding of the role of real-time consumer data in innovation activities in a digital product development context and contributes to the literature related to the performative and mediating role of calculative practices of accounting.

This explorative interpretive field study draws on the concepts of cycles of accumulation (Latour, 1987), accounting as an engine (MacKenzie, 2006; Revellino & Mouritsen, 2015), and mediating instruments (Miller & O’Leary, 2007) to examine how continuously updated visualization of real-time user metrics influences the actions of organizational actors by generating a floating and mutable objective of desire, a “good game.” This essay uses data from 23 semi-structured interviews with professionals in different organizational functions and organizational levels of four free-to-play game development organizations, from the executive to the operational level. Three of these companies were based in Finland, and one was located in Germany. All the companies had succeeded in generating one or more hit games that had been downloaded tens or hundreds of millions of times, some of which still had millions of monthly users providing massive amounts of real-time end-user data for organizational purposes.

Free-to-play mobile game development is commonly understood as data driven, in which big data technologies are commonly present (El-Nasr et al., 2013; Seufert, 2013). The study explored the way data analytics, as a calculative engine (MacKenzie, 2006; Revellino & Mouritsen, 2015), enables coordination and control for organizational actors in terms of organizations’ financial objectives. During creative digital development, data analytics acts as a “fact-generating” device (Latour, 1987) capable of transforming raw user behavioral data into powerful explanations through visualizing metrics. These real-time metrics act as mediating instruments (Miller & O’Leary, 2007) between creative and financial

objectives, enabling the generation of new insights and accumulation of knowledge guiding development toward the desired outcome, a “good game.”

This essay demonstrates how game analytics provided the means to quantify developers’ creative assumptions in a timely manner and either verified or refuted their presumptions by transforming the end-user telemetry data into visualized metrics that represented the “goodness” of the game. A “good game” was an ideal, but also a constantly evolving numerical representation indicated by the game metrics. These visual metrics provided the basis for the desire for improvement and perfection (Busco & Quattrone, 2018), a target that would always be unreachable as a final goal.

Together, the game and the analytics created a digital intermediary that enhanced the knowledge accumulation cycle at the center of calculation (Latour, 1987) and decreased the uncertainty related to the input–output relationship (Jørgensen & Messner, 2010) between creative ideas and commercial outcomes. The fast feedback provided by the metrics either verified or refuted the designers’ creative assumptions, revealing how the world works and replacing the existing knowledge of the world with a new world (Miller, 2001), thus influencing the designers’ further actions. The figures produced were enacted as truthful and objective representations of users’ conduct because the figures provided the means for interrogating users without their knowledge.

While developers proposed and implemented new metrics that were seen as required and desired, which connected previously unrelated and separate entities in a new way, they constructed new calculable spaces (Miller, 2001) that influenced their subsequent actions and thus had a performative effect on the world that was being created (MacKenzie, 2006). Such metrics connected users’ non-financial activities to the organization’s financial aims in an understandable manner, becoming actors, mediating instruments (Miller & O’Leary, 2007), linking distant domains together, providing coordination for the organizational actors according to specific organizational objectives (Miller, 2001).

4.2 Essay II: “Free”-to-play game: Governing the everyday life of digital popular culture

The second essay takes a broader societal view of big data and data analytics and explores how individuals’ daily lives are governed through big data technologies. It contributes to governmentality studies by demonstrating how big data technologies enable the problematization of new areas of ordinary individuals’

private space, and thus may initiate new programs of governing and governing ambitions. Therefore, this essay uncovers the transformative power of accounting calculations inherent in and hidden from big data technologies. In addition, the essay contributes to the literature on accounting and popular culture by further elaborating on the key role of calculative practices of accounting in the digital revolution and industries such as free-to-play gaming and the app industry more generally.

This essay draws on the governmentality thesis (Miller & Rose, 1990; Rose & Miller, 1992) and explores how governing calculative practices (Miller, 2001) inherent in free app markets influence the way in which free-to-play mobile gaming is conducted, as well as how accounting molds and shapes the rhythm by which people engage with this instance of digital popular culture. As primary data, this essay draws on 35 semi-structured interviews: 25 were conducted with game development professionals at five game development organizations and 10 with game users.

Research on big data technologies often refers to social media (Arnaboldi et al., 2017; Turow & Couldry, 2018), and when the special characteristics of big data are considered, unstructured data such as video, images, audio, and textual files are often mentioned (Warren et al., 2015). However, the digital space of free-to-play gaming provides additional types of behavioral data that may be translated into knowledge and may be used to act from a distance on the actions of those who use the service and provide the data. Within this context, the rationally calculating selves are the application users who are made operable in their private spaces by propositions made by organizational actors in the name of the organizations' economic ambitions.

This essay demonstrates how new types of mundane events from individuals' daily lives can be translated into calculable and governable spaces, bringing out the calculating self who needs to make continuous decisions according to neoliberal doctrine. New calculable spaces are constantly created by organizational actors, who continuously come up with new problems that need resolution as they follow users' activities through big data technologies. New programs are developed that justify intervention on these occasions through governing technologies developed according to expert knowledge. The self-regulating individual who is brought about remains unaware of such constant interrogation and assumes freedom of choice and freedom from governing.

4.3 Essay III: Digital calculable spaces: On the outskirts of management accounting

The third essay explores the implications of digitalization and big data technologies for management accounting professionals and professionalism. This essay approaches management accounting as a calculative expertise capable of economizing different areas of interest (Kurunmäki et al., 2016) by generating and linking desired calculable spaces and calculating selves to the centers of calculation (Miller, 1992). This study explores how a big data-intensive digital development environment, especially the characteristics of digital spaces (Kitchin & Dodge, 2014), might have influenced this traditional role of management accounting professionals and professionalism. This study contributes to the discussion of the interdependent relationship between the evolution of technology and professional work (see Petani et al., 2021).

The calculative technologies of accounting have been the means for generating action on the actions of others by creating calculable selves and calculable spaces that are loosely linked to the centers of calculation (Miller, 1992). Management accounting has transformed complex processes into financially meaningful figures (Miller, 2001), bringing along with its claims of neutrality and objectivity in decision making, so that decisions seem to be based on factual calculations instead of moral bases (Miller, 1992). Instead of arbitrary power, accounting has been granted the authority and legitimacy of calculative expertise that can render things calculable and manageable with calculation techniques.

The evolution in technology has brought about new areas and opportunities for intervention that were not previously available (Andrejevic, 2019; Bhimani & Willcocks, 2014). However, specific technical know-how is required from those who wish to utilize these opportunities (Kitchin & Dodge, 2014). This challenges existing management accounting professionals and their skills to generate calculable answers to the enterprises' problems (Miller, 1992). Although economic calculation is said to be a "failing" operation (Miller, 1992, p. 79), it seems that this shortcoming of existing ways of calculating has only provided opportunities for other calculative technologies and their alleged advantages. It seems that new calculating expertise has emerged among data scientists, who are expected to remedy the shortcomings of current calculative expertise and their technologies.

This essay demonstrates how optimism toward the capabilities of economic-related calculations has not diminished with the rise of digital data and related calculative technologies. If something has happened, it seems that optimism toward

the capabilities of different sorts of calculations to provide answers to problems has increased. The digital space, together with big data technologies, is generating new expectations in organizations for calculative experts. Such experts are expected to possess knowledge and skills in information technology in the areas of data mining and complex data analyses, with an understanding of business-related issues. New quantification and calculation techniques are expected to help organizations cope with their issues in fast-moving and competitive markets.

While management accountants are expected to be able to economize new areas of interest by transforming complex processes into financial figures, it seems that the characteristics of digital space and big data technologies require a new type of skills that are not yet common in the repertoire of traditional accountants. The digital space brings along with it new ways of governing that influence the surveillance structure of this space (Andrejevic, 2019; Brivot & Gendron, 2011). Self-regulation is no longer generated by the conscious all-seeing gaze from the panoptical center but by the visibility of others, to others, and to the self (Brivot & Gendron, 2011). Thus, the traditional idea of panoptic surveillance (Foucault, 1977) is challenged by this new space that seems to be based more on control mechanisms of panspectric surveillance (Palmås, 2011) and psychopolitics (Han, 2017). These post-disciplinary forms of monitoring no longer rely on subjects who have internalized the controlling gaze, as those who are the subjects of control are often not even aware of the controlling gaze (Zuboff, 2019). Control shifts from discipline to prediction in digital spaces (Andrejevic, 2019). The symbolic role of the camera turns into the operational mode of automated systems and therefore from internalized forms of prevention to externalized modes of pre-emption (Andrejevic, 2019).

If management accounting professionals aim to present themselves as producers of calculable spaces and calculable selves in the future, it seems necessary for them to enhance their skills in necessary areas of software development together with other areas of information technologies. Of course, the option is that those experts who possess such technical skills could try to broaden their knowledge base to accounting and start presenting themselves as experts in relation to financial calculations and economization. This sort of extension in the accounting domain (Suddaby et al., 2015) toward the digital seems to be inevitable due to the present state of mind of powerful decision makers regarding digitalization and the internet of things-related topics.

In this situation, it could be expected that incumbent experts resist if they assume their territories and ideals are threatened by some new expertise that has

different techniques and ideals of how the world works (Miller, 1992; Vaivio, 1999). From the evidence in this study, it seems that there exists little resistance from the accounting function toward the new expertise of data scientists, who seem to have taken their position in the center of calculation (Latour, 1987) in terms of calculating and economizing digital space. They seem to be the ones generating calculable spaces from this digital space. In addition, they seem to be the ones helping others construct the calculable selves of those actors who inhabit these digital spaces. It seems that data scientists, as a new form of calculative expertise, are merging with the existing accounting domain. Because of the development trajectory of digitalization, together with developments in big data technologies, this sort of expertise could be expected to become, if not already be, a key part of the organizational calculative regime. This new expertise can be expected to find a home in the organizational structure. This might be an extension of the accounting domain if accounting adopts these new areas of professional practice due to pressure from the surrounding environment.

5 Conclusions

This concluding section compiles the research of this dissertation and explains how the evolution in digitalization and the emergence of big data technologies in the calculative regimes of organizations have implications for the management accounting expertise that has traditionally generated and linked calculable spaces and calculable selves for liberal governing programs (Miller, 1992). First, this dissertation contributes to the literature on calculative infrastructures and quantification (Kurunmäki et al., 2016, 2019) and their role in governing a wide variety of actors and entities in the digital environment (Miller & Rose, 1990; Rose & Miller, 1992). Furthermore, it contributes to the discussion of the influence of digitalization and the related data explosion on the accounting domain, especially management accounting (Bhimani & Willcocks, 2014; Möller et al., 2020). Additionally, this dissertation contributes to the subject of the evolution and transformation of accounting as a body of calculative expertise (Miller, 1998), and the way in which calculative practices related to big data have entered or not in the domain of accounting.

This dissertation explains how a digital popular cultural product, such as a free-to-play game, can become a floating hybrid (Kurunmäki et al., 2016) of economic and creative ideas that have significant economic and social implications. While developments in digital technology and the rise of big data technologies have often been approached from a technical perspective, this dissertation adopted another approach to this subject. The fusion of adaptable and automatable digital space (Andrejevic, 2019; Kitchin & Dodge, 2014) and the adjudicating and economizing calculative technologies (Kurunmäki et al., 2016; Miller & Power, 2013) is interpreted in this dissertation in its social and organizational contexts.

By investigating management accounting practice in its natural setting, it was possible to gain intimate knowledge of the field being investigated (Lukka & Modell, 2010; Tomkins & Groves, 1983). With such an exploration of the empirical life, it was possible to develop and sharpen the inquiry while leaving room for flexibility and possible shifting points of observation. This approach enabled the researcher to understand how the organizational contexts in which management accounting is practiced are changing and how management accounting contributes to these changes but is also changed by them (Baxter & Chua, 2003). It also informed the researcher how management accounting technologies convey local values, meanings, and nuances differently in different contexts (Baxter & Chua, 2003).

With such an approach, it was possible to interpret the implications of local practices in a wider social context. More than 30 years ago, Miller and O’Leary (1987) showed how budgeting and standard costing in the early 20th century could bring about questions of waste and inefficiency at the individual level, thus extending the accounting domain to new areas of daily life. Similarly, this dissertation demonstrates how the big data and digital environment has extended this neoliberal ideology into new areas of individuals’ daily lives through different digital applications. In the world of mobile free-to-play gaming, individual users are frequently introduced to calculable spaces that purport to make visible the norms and standards, and thus the efficiency and inefficiency of their activity with their games. Depending on users’ activities, different automatically adjustable propositions are offered for game users to “freely” choose alternative courses of future action, thus bringing the calculative ideals into the sphere of leisure activity.

In addition, it is not only game users who are affected by this continuous and dynamic visualization of quantification. Visibility into the actions of all users of the application frequently generates new opportunities for those monitoring the digital space to introduce new areas of inefficiency that might require intervention from the development organization. With this continuous visibility into the actions and reactions of game users who inhabit the digital space, developers may adjust their own ideals and existing assumptions of how the world works (Miller, 1992), which may then generate performative effects on them.

Thus, this dissertation problematizes the common and perhaps sometimes overtly positive view of the implications of big data and digitalization for such calculative expertise as management accounting but also for organizations and societies more generally. Often, digitalization and related big data technologies are seen as enablers of more cost-effective ways of doing things and providers of more detailed, varied, and timely data for decision-making purposes. This view has been adopted in a plethora of accounting-related literature that has highlighted not only the opportunities but also the challenges of digitalization and big data technologies (see, for example, Bhimani & Willcocks, 2014; Moll & Yigitbasioglu, 2019; Rikhardsson & Yigitbasioglu). There are also others who have adopted a more critical view of this subject matter (see, for example, Andrew & Baker, 2019; Brivot & Gendron, 2011; Quattrone, 2016). Although such literature has undoubtedly increased our understanding of the relationship between accounting and technological development in terms of digitalization and the big data phenomenon, we still have limited visibility into how management accounting has been influenced by this digital transformation (Möller et al., 2020).

Together, the findings of this dissertation argue that the “novelty” of digitalization and big data technologies does not relate to the opportunities of these technologies to generate more precise and better calculations for organizational decision making as to their potency to economize new areas of individuals’ daily lives. Today, digitalization reaches almost everywhere in individuals’ everyday lives (Han, 2017; Zuboff, 2019), and into their everyday practices and routines. It does not matter whether an individual is at work or leisure; they are faced with multitudes of calculable spaces that require them to make constant decisions under the doctrine of neoliberalism, aiming to transform individuals into calculating selves and into the image of “homo economicus” (Brown, 2015; Kurunmäki et al., 2016). It does not matter if such calculable spaces are created and developed by management accounting professionals, data scientists, marketing experts, or software designers. The calculable spaces still have a somewhat similar function: to act on the actions of individuals to increase the economizing engagement of these individuals in their digital applications. It does not matter if those calculable spaces are built on traces users leave while browsing the internet (Bhimani & Willcocks, 2014) or if they rely on social media data (Arnaboldi et al., 2017). Whatever the source of the big data, it makes no difference in the issue that individuals faced with these calculable spaces need to make constant decisions about how to react to such spaces. Complying or rejecting a proposal, or even trying to ignore it completely, does not change the fact that action is required by the individual. This action requires a decision, and a decision requires thought, transforming the individual into a calculable self in their private locale.

This dissertation concentrated on mobile game developers, who are arguably not the biggest data abusers in our society, compared, for example, to big social media companies such as Google and Facebook (Härkönen et al., 2022; see also Zuboff, 2019). It could even be argued that many of the mobile game developers who participated in this research did not see their game-related analytics as a means of exploiting user data but as convenient technological applications for supplementing their own creative work. However, they participated in surveillance capitalism (Zuboff, 2019), for example, by buying installations from advertisement channels and selling advertisement space on their own applications to others who aimed to increase their commercial product sales. Therefore, these developers participated in the transformation of their application users into commodities that could be bought and sold.

Accounting calculations are necessary if complex non-financial processes, such as game users’ behavior, are to be transformed into financial figures (Miller,

2001). However, it seems that accounting professionals are not the ones who aim to govern the inhabitants of digital spaces. According to the empirical data of this research, it seems that other functions and professionals, such as data scientists, marketing professionals, and even product developers themselves, are often the ones deciding how the governing of digital space is done. Still, in these decisions, those entities that are constructed by the accounting calculations, such as profits and costs, lurk in the background. Simplified connections between user retention and engagement and company profitability guide decisions. Therefore, accounting is not absent from the decisions made by others.

If others are mainly responsible for translating qualities into quantities from the digital space, the accounting function and its professionals still utilize this quantified knowledge for their own performance calculations and control purposes. However, their governing calculations are directed mainly at organizational decision makers. It seems that the current accounting function is the big data information user instead of the information generator.

The power of big data analytics seems not to lie as much in the volume, variability, velocity, or any other type of V that has been linked to the big data phenomenon (see Wamba et al., 2015) but in its capability to generate new associations between complex processes and entities, thus bringing economic rationalization in new areas of everyday life. In this economizing activity (Kurunmäki et al., 2016), accounting is located on a very central stage. As Miller (2001) points out, the specialty of accounting relates to its capability to transform complex processes into single financial figures, such as costs and profits. Now, the digitalization of societies and the emergence of big data technologies have opened up new territories to which accounting may expand. Organizations that are capable of collecting all sorts of real-time digital data from users of different applications and from other digital sources may now try to utilize such data for their own economic aims. This new visibility may prompt new views into existence that may generate utterances such as “that is interesting,” which might lead to the generation of new problems that supposedly require solving (Miller & Rose, 1990). Big data technologies, together with digital spaces (Kitchin & Dodge, 2014), provide visibility in a way not possible before.

While big data technologies enable a new type of visibility into the world, accounting provides the means to understand this visibility in economic terms. Based on the findings of this dissertation, it seems that although accounting, especially management accounting, is involved in the utilization of big data technologies, the way this is currently done seems to be still in its infancy.

Therefore, big data can be understood as located in the margins of accounting (Miller, 1998). Accounting experts seem to need more understanding of the opportunities for modern big data technologies and the characteristics of digital spaces if they want to stay and keep their positions in the center of calculations (Latour, 1987) of organizations in the future. The world is going digital, and so must the calculating expertise of accounting.

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