Visualising a “good game”: analytics as a calculative engine in a digital environment

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Purpose This research concerns the use of analytics as a calculative engine enabling coordination and control for the development process in a creative digital business environment.
Design/methodology/approach This research employs an explorative field study approach, using interview data from professionals working with free-to-play mobile game development. Drawing on the concepts of cycles of accumulation, accounting as an engine and mediating instruments, this study examines how organisational actors using the analytics in a digital business environment participate in the data generation that accumulates knowledge about and new insights into the desired outcome.
Findings The real-time metrics provided the means for organisational actors to continually monitor, visualise and if necessary intervene in the creative "good game" development process. Timely quantification and visualisation of user actions, collected as digital traces, enhanced the cycle of information accumulation. This new knowledge resulted in a desire for improvement and perfection, which directed the actions towards the organisational objectives.
Originality/value This study furthers our understanding of the performativity of accounting as an engine and the user behavioural data traces as its "fuel" in a digital product development. It highlights the role of analytics as a "fact-generating" device, capable of transforming the raw user behavioural data, the fuel, into powerful explanations through visualisations of ideals. The real-time metrics, understood as mediating instruments, enable the generation of new insights and accumulation of knowledge guiding the further development towards the desired outcome, the "good game".
Keywords Performativity, Calculative engine, Mediating instruments, Analytics, Big Data, Mobile gaming
Paper type Research paper

1. Introduction

> "If inventions are made that transform numbers, images and texts from all over the world into the same binary code inside computers, then indeed the handling, the combination, the mobility, the conservation and the display of the traces will all be fantastically facilitated." (Latour, 1987, p. 228)

In recent years, the digital revolution has changed the way people live their everyday lives, how they communicate with each other, and how they buy and consume goods (Jeacle and Carter, 2011). The volume and variety of data generated by different types of online actions has exploded along with the evolution of digitalisation (Bhimani and Willcocks, 2014). This in turn has had its impact on organisations and their practices (Arnaboldi *et al.*, 2017; Viale *et al.*, 2017). Information technologies, such as big data and analytics, have been opted into the development processes of organisations and have thus enabled them to analyse and visualise large amounts of combinable data from distant events with marginal costs (Bhimani and Willcocks, 2014). The question of what the implications of this revolution are for management accounting and control is an interesting and debatable subject, which has been highlighted by several accounting scholars (see e.g. Arnaboldi *et al.*, 2017; Bhimani and Willcocks, 2014; Quattrone, 2016).

The existing management accounting literature has seen accounting or accounting-related calculative practices (Miller, 2001) as the key mediators between multiple and distinct actors, aspirations, domains and arenas (Jeacle and Carter, 2012; Maier, 2017; Miller and O'Leary, 2007). Commonly, the mediating effect of calculative practices have been studied in the context of physical surroundings with the restrictions physical surroundings bring along with them, such as a notable time lag between the decisions made in product development and the final consumer action (Jørgensen and Messner, 2010). As Gerdin *et al.* (2014) point out, accounting information is able to provide quite an efficient overview of what is happening in an organisation. Perhaps, in a digital environment, we might be inclined to stretch this organisational boundary to cover the whole market (Agostino and Sidorova, 2017; Arnaboldi *et al.*, 2017). In this environment, compared to the "real" material world, where input-output distance can be notable, the combinability and generation of new types of data becomes possible (Bhimani and Willcocks, 2014), which can have an impact on the actors involved (Revellino and Mouritsen, 2015).

While the role of accounting in social media (Agostino and Sidorova, 2017; Jeacle and Carter, 2011) and creative environments (Busco and Quattrone, 2018; Jeacle and Carter, 2012; Maier, 2017) has been studied, there is little research in management accounting in a fully digital product development environment, where advanced calculative technologies enable the quantification and visualization of masses of users' actual behaviour almost in real time for decision-making and control purposes (Arnaboldi *et al.*, 2017). Studies of social media have shown how the digital environment and the existence of real-time data changes the accounting function in such a digital space (Agostino and Sidorova, 2017; Jeacle and Carter, 2011), but these studies do not address the role of real-time data on innovation in the product development process. However, Revellino and Mouritsen (2015) have touched on this specific area in their study of Telepass innovation, in which they show how accounting generates new types of knowledge and functions as an engine furthering the development of innovation. The free-to-play mobile gaming industry sector provides a fruitful arena for further exploration of accounting in such a digital context, highlighting the importance of the generation of combinable traces and their implications for the role of calculative engine in a fully digital product development.

The mobile games sector is also interesting, as it features modern, widely implemented analytical tools in the development process together with new innovative business models (Drachen *et al.*, 2016). On the one hand, the game development industry is widely known for its creativity and artistic freedom. Game development may require a lot of graphical, game content and game mechanics designing, storytelling and many other artistic aspects of creativity to achieve the right

combination for an engaging and fun experience for the players of the game. On the other hand, the mobile gaming industry is also a very intensive and competitive market that requires business skills from participants, i.e. development organisations or the producers of the games, to be successful in the longer term (Seufert, 2013). Development organisations are fighting for scarce resources and thus skills in business-related issues are necessary for the control and management of these resources (Tschang, 2007).

The developers in this industry sector want to create fun and enjoyable "good games" for their users while trying to overcome the issues of harsh competition and rapidly changing markets. Games are no longer passive items for people to scrutinise and play with. They are interactive platforms that are transformed and modified, partly based on the user behavioural data – traces left behind by the actions of masses of users (Arnaboldi *et al.*, 2017; Tschang, 2007). Similarly, as in the fashion industry (Jeacle and Carter, 2012), the financial success of a game is intertwined to a large extent with the creative success of the game design. However, creative aspirations may be in conflict with financial reasoning and thus a tension between creativity and control emerges in this industry sector (Tscahng, 2007). There has been a lot of discussion among game industry participants about the balance between artistical freedom and data-driven development. Recent years have shown some pressure for data-driven development due to the harsh competition (Seufert, 2013). Calculative practices play a central role in this dynamic interaction. While game developers provide a platform for people to enter and start using the service, this is often just the initial stage of the development process as a whole, as the data generated by the users influences the further development of the game, and more importantly the actions of actors in development organisation themselves. This echoes very closely with the study on the Telepass innovation (Revellino and Mouritsen, 2015), which will be elaborated more on next section.

These games are developed for, and operate in, a digital environment where the physical restrictions of the "real" material world, such as the time-space distance between a design decision made in the development stage and the outcome of final user behaviour, are minimised and where the creative development of a single service can continue for an indefinite period if perceived sensible by the various actors in the development organisation. As Jørgensen and Messner (2010) point out, uncertainty of outcomes results from the limited possibility to control the outcome-input relationship. When the time-space distance between the actions taken in the development stage and the resulting consequences of these actions increases, the uncertainty increases and thus a need for some form of accounting arises to control the trajectory of the development process (Jørgensen and Messner, 2010). However, the physical distance between events and locations does not necessarily mean much any more in a digital space. The efficiency by which different types of actions and events can be transformed into digital data and transported from one location to another through an information technology intermediary without much or any distortion has increased (Bhimani and Willcocks, 2014). This in turn has accelerated the speed at which distant "events, places and people" are brought closer, which can be acted upon from distance (Latour, 1987 p.223; Miller, 2001).

Game analytics is a specific application domain of analytics, which is meant to provide business intelligence for game development and research purposes, and according to El-Nasr *et al.* (2013, p. 14-15) it is especially useful for games developed for the free-to-play revenue model (Drachen *et al.*, 2016). The possibility to generate a real-time view by quantifying the actual product usage from the masses of final consumers makes the free-to-play game development an interesting field to study from the perspective of calculative practices of accounting. As the opening quote from Latour (1987) over thirty years ago highlights, the impact of digitalisation on data handling and processing can have quite dramatic effects. The present study explores how a calculative engine such as game analytics can generate coordination and control for creative and financial aspirations of the organisation and why characteristics and attributes of data traces are an important part of this process.

Inspired by the actor-network theory (Latour, 1987; 2005), this study uses the concepts of centre of calculation, action at a distance and cycles of accumulation to highlight the characteristics

of the fully digital product development environment. Theoretical concepts of accounting as an engine (Revellino and Mouritsen, 2015) derived from performativity thesis (MacKenzie and Millo, 2003; MacKenzie, 2006; 2009; MacKenzie et al., 2007; Law, 2008) together with mediating instrument (Miller and O'Leary, 2007), are used for explaining coordination in the product development process. By exploring the practices of professionals working with game analytics in the field of free-to-play mobile game development, this study aims to further our understanding of the role of real-time consumer data on innovation in a digital product development context (Arnaboldi *et al.*, 2017; Gerding *et al.*, 2014) and contribute to the studies of performative and mediating role of calculative practices of accounting (Revellino and Mouritsen, 2015; Miller and O'Leary, 2007). Additionally, this study introduces and explores a new area of mobile gaming, bringing it into the emergent field of research on the role of accounting in popular culture (Jeacle, 2012).

The paper is structured as follows: the next section describes the key literature from which the conceptual framework is drawn. This section outlines the aspects of the concepts of calculative practices as performative engines and the cycles of accumulation of knowledge, which are central to the action at a distance analysis in this study. Furthermore, it presents the concept of mediating instruments, highlighting the performative power of accounting figures due to the associations they may generate. In section 3 we provide a short description of the free-to-play mobile game industry and game analytics. Section 4 describes the process of empirical data collection and the method of analysis. Section 5 presents the empirical data that describes game analytics as calculative engines in the game development process. Section 6 presents the discussion and section 7 the conclusions of the study.

2. Conceptual framework

2.1. Visualisation through calculative engine

Accounting can be understood as a calculative practice that transforms complex processes into single financial figures and thus renders these processes visible and governable (Miller, 2001). The calculative practices, be they financial models (MacKenzie, 2006), accounting calculations or tools (Jeacle and Carter, 2012; MacKenzie, 2009; Revellino and Mouritsen, 2015), rankings (Jeacle and Carter, 2011) or other similar types of calculative devices that people engage with, can be understood as "engines" influencing the world instead of cameras describing that world (MacKenzie, 2006). The performativity thesis (MacKenzie and Millo, 2003; MacKenzie, 2006; 2009; Law, 2008) postulates that economics enacts the construction of reality rather than simply explaining or describing it. Similarly, incompleteness and opacity related to accounting figures may enhance the construction of the desirable reality they ought to describe (Busco and Quattrone, 2018; Dambrin and Robson, 2011). Our approach into performativity follows "a form of performativity where new insights inspire actors to do new things" (Revellino and Mouritsen, 2015). By drawing on the performativity thesis, Revellino and Mouritsen (2015) demonstrate how Telepass, as a radical cumulative innovation, evolves partly because accounting generates surprising results from new types of traces it introduces and thus takes part in the development of knowledge and new insights. Their case illustrates how an innovation can become something that cannot be foreseen at the beginning of the process, as it drifts along its trajectory. This is because the engine accumulates such new traces that cause the innovation to drift and renew the engine itself, while presenting new opportunities and new relevant sources for calculative practices, thus extending and generating the interests of various stakeholders (Revellino and Mouritsen, 2015).

Furthermore, the level of performativity of these engines depends on the power of the engine, i.e. the actions and impact they generate afterwards, meaning how strong the information provided is regarded by others (Latour, 1999, p. 124; 2005, p. 107), or how useful new insights for doing new things can be generated by these engines (MacKenzie, 2009). Accounting can be used to create procedures that can create notions such as profit or costs and thus render visible the ambitions and

concerns of others, revealing a new world from the particular knowledge of the existing world (Hopwood, 1992; Miller, 2001). A strong claim, such as a "fact", requires various entities to be mobilised and translated together as an assemblage (Latour, 2005), which then needs to be enacted as such. Facts are socially constructed (Latour, 1987) and if they are enacted as such, they can have quite some power over the actions of others. As Law (2009) argues, "theory is only translated into practice if it is enacted in practice". This translation is constituted by recombining heterogenous elements, which can be human or non-human, in a new way, after which previously non-existing characteristics of the entity might be actualised, or the entity could even be given its existence (Ferreira, 2017; Quattrone and Hopper, 2005). These new entities or characteristics can be turned into quantifiable and calculable objects and thus become the subject for various calculations and even for governing (Miller, 2001). In this type of quantification or numbering, the calculating activity performs the construction of the reality it describes, generating new entities and politics, rather than just informing management (Georg and Justesen, 2017; Sullivan and Hannis, 2017; MacKenzie, 2009; Vaivio, 1999).

However, an engine requires "fuel" to generate power. The fuel of the calculative engine is the raw data, such as traces left by financial transactions, which are transformed into economic calculations and meaningful notions such as profit and costs by different calculative practices (Revellino and Mouritsen, 2015). The fuel can also be non-financial data, traces left by users of digital services when searching and browsing the internet (Bhimani and Willcocks, 2014). Innovations which are actualised and enacted on a digital platform enable the collection of new types of data (Bhimani and Willcocks, 2014) or traces left by its users, which can then be combined in a new way to bring out new characteristics of the innovation or even generate new entities into being (Ferreira, 2017; see also Holm, in MacKenzie *et al.*, 2007). It may require mediation and new associations to be made between previously unconnected and divergent expectations or already known but separate entities (Ferreira, 2017; Quattrone and Hopper, 2005). In a digital business, for example, sometimes cost and revenue sources may be difficult to be connected with traditional accounting methods and tools, and thus may require more innovative methods of combining different entities (Bhimani and Willcocks, 2014). This is also very much true in the free-to-play mobile gaming industry, which will be elaborated more in the following section.

When previously separate and unrelated issues or events are brought and viewed together in a formation, previously unseen connections between these known but separate entities might be discovered, allowing a certain location to become a centre accumulating knowledge on many others and thus action at a distance becomes possible (Latour, 1987, p. 219-232). This endeavour can be costly and time consuming, especially in a natural physical environment, as it may require a lot of physical movement or transportation of materials, artefacts or people and therefore, anything that would accelerate this accumulation cycle would be welcomed by these centres (Latour, 1987, p. 215-219, 228). This accumulation cycle can be enhanced by new technology, as Latour (1987) pointed out several decades ago (see the opening quote from Latour). The digitalisation of goods and services, together with the increase in the calculating power of information technology, has lowered the costs and increased the speed of the information accumulation cycle (Bhimani and Willcocks, 2014; Latour, 1987, p. 219-223). And it is not only numbers, images and texts, but also previously physically distributed goods and services that are contemporarily transformed into binary code, such as music and games (Waldner *et al.*, 2013), providing the possibility for these goods and services to become systems that can be used to generate accumulative and combinable traces when they are being used (Revellino and Mouritsen, 2015).

2.2. Digital traces and mediation

Digitalisation of the economy has made more entities traceable and combinable with incredible speed and reach. Traditionally, many different types of scorecards and dashboards are developed for management accounting purposes in order to help enhance performance, speed up decision-making

and take the customer perspective better into account in decision-making (Velcu-Laitinen and Yigitbasioglu, 2012). According to Bhimani and Willcocks (2014), there has been some consumer-related information that has traditionally been discarded, possibly due to a lack of technological capabilities or a direct link to economic transactions.

Currently, online searches, website visits and other normal activities people do online are leaving a trail of information that is available in real time for the calculating purposes by third parties (Bhimani and Willcocks, 2014; Viale *et al.*, 2017). As Revellino and Mouritsen (2015) illustrated, as soon as Telepass started working in a digital environment, it enabled the accumulation of knowledge about the behaviour of motorists, which could then be translated into a new innovation that furthers the innovation itself, but which also has financial implications. This kind of non-financial transaction-related data could thus be seen as a mediator of innovation activity. The generation and collection of new types of raw data becomes possible, enabling surprising discoveries from previously unknown connections. However, at the same time it could also create tension between creativity and commercial interest among the organisational actors (Jeacle and Carter, 2012; Tschang, 2007), because this new knowledge can be contradictory to the existing understanding of "how the world works" among the actors inside the organisation (Vaivio, 1999).

Calculative practices of accounting can be understood in a broader sense than just in a mathematical or numerical format. Calculative practices can be understood as complex calculus including intuition and judgement, which is integrated into professional practices outside the accounting function (Maier, 2017). Of course, financial figures are just one way of representing the world, as non-financial figures also provide valuable information (Vaivio, 1999). By using calculative practices of accounting, an organisation can be made more economically oriented than it otherwise might have been (Hopwood, 1992). According to Miller (2001) "calculative practices of accounting are always intrinsically linked to a particular strategic or programmatic ambition" and they do not act directly on others, but rather upon the actions of others. Game analytics, as a calculative practice, could be understood as a device which ensures that actors using this device will behave in accordance with the specific organisational objectives (Miller, 2001), such as the pursuit of a "good game". These figures can then be used for calculating purposes for decision-making, by linking knowledge with action through a process of mediation, which could then lead to a pragmatic and balanced decision (Quattrone 2016).

Furthermore, in their seminal paper, Miller and O'Leary (2007) analyse how "Moore's Law", which predicted the doubling of transistors on integrated circuits roughly every two years, linked science and economy together through capital budgeting decisions in the microprocessor industry. This mediation was enabled because Moore's Law had both a cost function and the technology trajectory embedded within itself (Miller and O'Leary, 2007). As a mediating instrument, accounting is thus more than a calculative device that renders a phenomenon visible with single figures. It is also a set of ideas or rationales that can be articulated by different actors, which then might even lead to the creation of more calculable objects when embedded in organisational practices (Miller and Power, 2013).

The mediation also becomes evident in a study by Jeacle and Carter (2012) who demonstrated that in the fashion industry a "delicate balance between the demands of creativity and control" exists. A tension between creativity and control originates from different drivers for different group members. The role of the creative designer was to drive the creativity in fashion, while the merchandiser tried to control the expenditure. The buyer acted in between, trying to convert the designer's creativity into a saleable product (Jeacle and Carter, 2012). In this group of actors, each of these members acted in the disciplinary manner to maintain the whole team effort in coordination. The accounting was the important mediating instrument, which maintained team unity in the journey towards the reasonable outcome, as it resolved the tensions between creativity and control (Jeacle and Carter, 2012). In their study, human actors with business-oriented professions, such as a merchandiser and a buyer, still played a major role in a controlling and coordinating effort.

Similarly, ambiguity and the incompleteness of accounting indicators and visualisations make figures unexhaustive, leaving room for debates and enabling questioning and the engagement of organisational actors in the pursuit of something desirable, which is possibly not even achievable (Busco and Quattrone 2015, 2018). This type of illusion of perfection (Busco and Quattrone, 2018) is an analogy of the pursuit of the "good game" in our study.

Besides providing information through visual inscriptions, calculative practices themselves can form and re-form organisational life, especially when used by actors who believe in these numbers (Gerdin *et al.*, 2014). As this happens, individuals may become calculating and operable individuals, "calculating selves", with the freedom to choose, who also take specified economic norms into account in decision-making (Miller, 2001). Therefore, as a control tool, accounting can be used to coordinate the activities of different actors and diverse domains (Jeacle and Carter, 2012; Miller and O'Leary, 2007). Similarly, Revellino and Mouritsen (2015) illustrated how calculative practices as engines can be persuasive and thus lure people into action.

According to Bhimani and Willcocks (2014), in the era of digital accounting and the digital economy, it becomes even more important to understand the ambiguous connections between different functions in relation to financial flows. But ambiguity and incompleteness are inherently part of the accounting figures (Dambrin and Robson, 2011; Quattrone, 2016), generating a paradox between assumed full control through big data technologies and uncertainty of their connectedness (Arnaboldi *et al.*, 2017). In the era of the digital economy, it seems that the instantaneous manner of acting on data-driven insights is encouraged by some (Bhimani and Willcocks, 2014; Seufert, 2013), while cautioned by others (Busco and Quattrone, 2018; Quattrone, 2016). For the proponents of data-driven decision-making, organisational actors should be inclined to use new types of data as much as possible, while others suggest that these figures should be approached more cautiously, and they should be seen more as platforms for mediation and initiators of discussion, instead of representations of immutable truths (Quattrone, 2016). This type of debate over the interpretation of how to approach quantification and numerical inscriptions is nothing new (see for example Robson, 1992; Latour, 1999), nevertheless, and even more so, during the digital era we are living in right now, it should be an important subject of discourse. The figures produced by calculative practices of accounting should not be understood as a truthful representation of any remote context, but instead as inscriptions, which provide the means to overcome the problem with the action at the distance (Robson, 1992). In this endeavour the properties of the raw data, which represents the fuel for the calculative engine, and the key ingredient for enabling mediation through figures, generated by new associations made, may become a key driving force for action.

3. Game analytics in the digital free-to-play environment

As the world has become digitalised, many traditional industries have transformed their products and services from physical to digital (Waldner *et al.*, 2013). Traditional business models that were based on physical products and their reproduction and distribution have now been undermined by intangible reproduction in the gaming and music industries (Benghozi and Paris, 2016). Digital distribution is starting to be more important than physical sales in the games industry (Orland, 2017). A new generation of consumers is used to listening to music or playing games on their mobile devices by downloading this content to an increasing extent for free, or for a very small financial investment.

The concept of providing products without any initial financial investment into the hands of consumers is no longer a bizarre phenomenon in these industry sectors (Drachen *et al.*, 2016; Rayna and Striukova, 2014; Marchand and Hennig-Thurau, 2013). The free-to-play revenue model has increased its significance and, in the meantime, revolutionised the gaming industry (Alha *et al.*, 2014). Around ninety-five per cent or more of these free-to-play consumers will never make any monetary transactions (Rayna and Striukova, 2014), and thus will never become paying customers. While games are normally designed to entertain or provide fun experiences for gamers, in the free-to-play revenue model, games should also be designed to persuade players to spend some money or

to monetise by some other means (Alha *et al.*, 2014), and this requires creativity from development organisations. Monetising with this kind of revenue model is based on different streams of revenue, such as micro-transactions from selling virtual items or revenue streams from in-game advertisement (Koskenvoima and Mäntymäki, 2015).

The top five grossing mobile games by revenue in 2016 were all free-to-play category games. As an example of revenue streams, Pokémon GO by Niantic, which is a free-to-play game, earned USD 204 million in August 2016 (Etherington, 2016), while Clash Royale and Clash of Clans, which are free-to-play category games from a company called Supercell, both generated over USD 100 million in April 2016 alone (Brightman 2016). Analytics can be used as a means for generating information on the issues consumers value, and game analytics is thus widely used in this sector (Drachen *et al.*, 2016; El-Nasir *et al.*, 2013, p. 23), providing a fruitful setting for the present study.

El-Nasr *et al.* (2013, p. 55) define analytics as "the science of gathering information from the runtime user interactions with a piece of software or website and processing it. Analytics is a discipline that combines statistics, engineering and software design". Game analytics is the application of analytics that should provide business intelligence for game development (El-Nasr *et al.*, 2013, p. 14). Game analytics consist of telemetry data, which is raw data collected outside organisational boundaries, and game metrics, which provide visualisation and quantitative measures of this raw data (El-Nasr *et al.*, 2013, p. 14). Game analytics is widely used in free-to-play game development by developers as a means of visualising and quantifying user behaviour in a timely manner and as a baseline for raising questions such as why there is user churn from the game or how gamers might be converted into paying users, for example (Drachen *et al.*, 2016; Hamari, 2015). Therefore, by using these calculative practices in a digital environment, organisations can attain more direct visibility of the markets and have closer relationships with their consumers (Marchand and Hennig-Thurau, 2013). As the product is in digital form, it is possible to collect telemetry data about the usage and behaviour of the users and also to make changes to the product according to the analysis of gathered data (Waldner *et al.*, 2013).

In the free-to-play business model, price points for purchasable in-game items can be made flexible, and developers can iteratively tweak these price points and game mechanics according to user behaviour (Hamari and Lehdonvirta, 2010). The existing literature describes the relationship between good customer retention and monetisation (Koskenvoima and Mäntymäki, 2015). Good customer retention indicates that users are willing to repeatedly return and spend time in the game environment. Thus, games should be designed to be good enough to encourage users to spend their time playing the game. However, a study by Hamari (2015) indicates that enjoyment of a game may also reduce the willingness to buy virtual goods. This means that games which can be played without any purchases and which would provide enough enjoyment for the user would not be optimal in terms of monetisation and profitability for the company. According to El-Nasr *et al.* (2013, p. 15), game analytics is not just a tool for developers to adjust a product according to user behaviour or other relevant telemetry data, but it is something that can guide the whole business of the company, from the strategic level to a more tactical level.

4. Methodology

This study is an explorative qualitative field study, the primary data of which is collected by semi-structured interviews that were conducted with respondents from the free-to-play game industry sector, where game analytics were expected to be widely used. Respondents were chosen from non-randomly selected companies in order to ensure that the selected companies are developing free-to-play games, aim for business related to game development and have at least some financial interest in their activities. Access was gained to four organisations. All of these companies were already recognised by the industry and had proved to be profitable, continuing businesses. Company A and Company B already had several hugely successful games on the market. Both were regarded as top-ranking gaming companies providing free-to-play games. Company C had a couple of successful

games on the market. Company D was the biggest in terms of number of employees and it also had games that were not free-to-play in its portfolio. The number of employees in the studied companies ranged from fewer than twenty in the smallest company to around ten thousand in the largest one. Annual company revenue in 2014 ranged from over ten million to over a billion euros. All of the companies had one or more "hit games", all of which had been downloaded tens or hundreds of millions of times, and some of which still had millions of monthly users providing massive consumer data available for analysis purposes.

The interview data consists of twenty-three interviews from different organisational functions and organisational levels, from the executive to the operational level. In this way, the interviews provide an illustration of the practices around and reasons for the use of analytics and metrics at different professional levels, such as practices of management in company-wide business-related decision-making and practices of developers at detailed product-level decision-making. The first interviews were arranged during the spring of 2015, and the data collection continued until the summer of 2017. Interviews were recorded and transcribed verbatim for analysis purposes. In total, over twenty-nine hours' worth of interview data was collected. During the company visits, several of which were made to most of the companies, data was also collected by observations and discussions outside the interviews in order to gain a better understanding of the working culture and working practices in each organisation. Notes were also taken during and after the visits in order to record any interesting specifics about the working environment or any discussions outside the interviews. Also, publicly available data about the history of these companies and their development was collected during the research. Additionally, some company-specific confidential figures and data were presented during the visits as examples of the topics discussed. One of the authors also participated in several gaming-related workshops and one game conference to better understand the industry specifics beyond the informants' companies. Therefore, the triangulation of data was achieved through concrete examples of confidential figures, from the interviews containing specific control questions from interviewees working at different levels and in various tasks in the organisations, and through observations during informal discussions outside the interviews.

To guarantee the anonymity of all interviewees, this study will not identify specific professionals by their titles, but instead categorise them in terms of the professional area they were working in. For the purposes of this study, the following three categories were established: product development (PD), finance and business management (FBM) and business intelligence (BI). In product development there were professional titles such as artist, game developer, game lead and executive producer. In finance and business management, professionals had titles such as CEO, finance director, business controller and project portfolio manager. In the business intelligence area professionals had titles such as head of analytics and data scientist. The number and functions of the interviewees by organisation are as follows: Company A, 1 (PD), 3 (FBM) and 1 (BI); Company B, 1 (PD), 2 (FBM) and 1 (BI); Company C, 3 (PD), 4 (FBM) and 1 (BI); Company D, 5 (FBM) and 1 (BI).

There were four different themes that were discussed with each of the interviewees. These themes related to practices around analytics and metrics, their implications for practice, managerial and coordination practices, and the emergence of accounting in the organisation. Several questions were prepared for each theme, but not all of them were applicable for all of the interviewees due to their different tasks in the organisation. Examples of the questions asked were: what is the main function of analytics in your work? What are the most important metrics in your work and why exactly these ones? How often do you follow these metrics? What kind of information are these metrics providing and how is this information utilised? Who are the key partners in your organisation and why these ones? Who decides which metrics should be calculated and followed? Who can see these metrics? There was no strict order for the questions, because interviewees were given the possibility to answer

and lead the discussion according to their own preferences, as long as it was relevant for the purposes of the study topic. This was due to the exploratory nature of the study.

The data analysis was an iterative process where open coding was used (Neuman, 2007). Core themes were identified from the transcripts of the interviews following an abductive logic by going back and forth between the data and the literature, where the empirical data continuously redirected the theoretical view and vice versa (Järvenpää, 2007). This process was conducted throughout the data collection period. Open coding enabled us to identify the most important themes and to perform second-stage coding for further analysis of those themes. Throughout this process, a flexible approach was adopted in both the analysis and gathering of data, so that the authors were open to any surprises that may have come up (Burgess, 1991). The following sections describe the outcome of this process.

In the following empirical section, when we refer to design, we refer to the designing of the individual game and gameplay itself, its graphical design, its rules and mechanics, and its storyline. In a product development team, there can be several designers responsible for different areas of game design. For example, the game lead or lead designer is commonly responsible for the work of other designers in a team, their coordination and communication within a team and outside the team. Game developers, of whom there may be few or plenty, design different game-specific levels where players are supposed to do different things, for example. They are also responsible for the whole environment of the game so that it follows the agreed storyline or narrative. Other examples could include things such as game mechanics designers, who design and balance the rules, i.e. the mechanics of the game. There may also be graphical designers designing the artistic features and visualisation of the characters and figures used in a game. All these different design tasks and roles can be performed by a single person or they can be distributed among several individuals or groups of individuals.

When we refer to game development, development organisation or developers, we refer to the whole game development organisation as a company and its tasks, which can include the previously mentioned product development team focusing on the game design and development; the business management function, responsible for the business aspects of the organisation and can include the marketing function, focusing on the marketing aspects of the game or several games; the finance function, focusing on the financial issues related to the whole organisation; and the business intelligence team, focusing on the analytics and business intelligence side, providing support for the rest of the organisation.

5. Game development and the calculative practices of analytics

5.1. Visibility of the world of a "Good Game"

The main objective of each individual respondent and apparently of all the organisations seemed to be the development of a "good game".

> "The key thing is that the game is good and that a crowd has to be able to keep coming back to the game again and again." (FBM, Company B)

It was said to be the most important thing and an outcome of a creative process, a process that was initiated by an individual or a group of individuals. It also seemed to be a common understanding that, if this first target were to be met, then financial success would follow. The following quotes suggest that creativity is a prerequisite for business in "good game" development:

> "… the financial aspect comes through that the game is good […] players want to spend their time on it and consider the time used valuable for them and that they see value in money spent…" (FBM Company A)

> "… if we make fun games, people will come back for more, which then leads to a healthy game." (BI Company D)

Both of these quotes clearly indicate the simple connection between "good games", which relates to user enjoyment quantified by such things as frequency and time spent playing, and the positive financial outcome. When respondents were asked to provide a description of a "good game", it seemed to be a very difficult task.

> "That's a good one. We are always debating inside our company about the definition of a 'good game' […] I see it that a 'good game' is a bit too broad a concept in a sense. […] we stay in this certain sandbox where we can make both business and 'good games' and the better games we make, staying in that sandbox, the better it is for both, for our firm and for ourselves. Because we feel that we make good games…" (PD Company A)

A "good game" seemed to be related not only to artistic matters, which required more creative thinking, but also to the financial aspects related to the financial reasoning for business. It seemed that organisational actors had to take both of these domains into account and find a balance between the two. In a sense it created certain boundaries for acting when thinking about the possible development trajectories to be taken. This seemed to be in line with El-Nasr *et al.* (2013), who point out that the goal of good game design is to create games that provide a good user experience in order to acquire and retain users, and the goal of a game development company is to generate revenue by monetising these users (El-Nasr *et al.* 2013 p.32).

There were several different metrics that were mentioned by the interviewees, some more often than others, but which seemed to be commonly used in free-to-play mobile gaming development. The level of interest in specific metrics seemed to depend not only on the profession of the interviewee, but also the development stage of the game. Some of the metrics, such as retention rate, average revenue per user (ARPU), conversion rate, daily active users (DAU) and customer lifetime value (LTV), were referred to as important metrics or as key performance indicators (KPIs) by several interviewees. This seemed to be in line with previous research that certain metrics seem to have become more or less industry standards (Koskenvoima and Mäntymäki, 2015), and are also followed by the free-to-play game developers. Furthermore, some game-specific non-financial metrics, which were related to detailed user behaviour inside the game environment, were mentioned by game developers who worked closely on game design details. Their metrics related to such things as how far users played through certain levels, where they stop playing, how many times they attempted these levels, or which kind of virtual items or avatars they most commonly used.

It was mentioned by many of the respondents that one has to believe in the numbers coming from such a huge mass of users. If the numbers indicate that something does not work, then it has to be fixed. As one of the finance and business respondents put it:

> "…and eventually it is the opinion of the masses that should count most if one wants to make a business out of it." (FBM Company C)

The opinion of the masses referred to the information generated through visualising the actions and behaviour of these masses by accumulating traces they left when acting with the games. Another respondent from product development described this in another way, relating the metrics directly to the game design and the developer's assumptions about the level of difficulty of the game:

> "Of course we trust in metrics. If we think a certain level is really good, but players think it's too difficult, then of course we will make it easier." (PD Company C)

Instead of just providing timely visibility within the organisational boundaries (Gerdin *et al.*, 2014), these objectively viewed figures created timely visibility of the world of players outside the organisational boundaries and made this world more calculable and comparable (Miller, 2001). It provided almost real-time visibility of the consumers' actual behaviour with the product and the markets in general.

The data revealed very early on that regardless of the interviewee's organisation or organisational level, the analytics were seen in a positive light and as useful tools by all. One of the respondents used an interesting metaphor to describe this relationship:

> "… it is an essential tool. A bit like… it's like how a construction worker regards his nail gun." (FBM Company C)

More specifically, analytics were seen as supporting tools that can provide important information for different purposes. A couple of respondents from different organisations actually used the same metaphor when describing free-to-play mobile game development without analytics:

> "If there were no analytics in use, it would be like driving a car blind…" (FBM Company A)

Analytics provided the means to achieve broad visibility of the overall situation in a timely manner, but also the very details of the actual usage of a certain product or service. Analytics were thus a source of information, especially for the product developers, when making improvements to the game:

> "… if one wants to improve the game and update the game, then it (analytics) is used for things such as in which direction it (the game) should be improved, how it should be improved, and which part should be improved, especially during the development process." (PD Company C)

Through the use of analytics, designers could access information on the details of consumer behaviour and what exactly was working in the game and what was not working so well. They could get understandable quantified figures about the way the game was actually played, and thus analytics provided the means to start asking questions, such as why it was played in that way and how it could be further improved.

> "…With analytics I can get feedback or information in general, what was good and what was bad in the game. How the game is played. Why it is played this way. Why everyone (game characters) is dying at the first level. Where they die. At which point in the game they are dying. Why they can't pass this level. How many are skipping the tutorial. […] Without analytics we can get such information as number of downloads or daily active users, but we can't get inside information about the game itself." (PD Company C)

This kind of detailed gameplay-specific and game design-related information about the way consumers were actually operating with the game was transformed into quantified figures by analytics, and by doing so could be linked back to the creative process itself.

The hard data from the metrics provided a sufficiently detailed and reliable information source for the evaluation of the status of "good game", and also about the different design features of the game that might still need to be developed further. The metrics derived from the behavioural data

of final users were used as surrogates for things such as design quality, engagement or monetisation. Telemetry data was interpreted as the "real" objective opinion of the markets.

> "I see it as a good feedback channel for what you do. People are never able to say anything to your face if you are a creative person, working in the creative sector, so it's one of the most important things that you get real feedback. In my opinion it's maybe the best channel then, for this kind of cold feedback. Numbers don't lie." (PD Company C)

Even if the figures provided the means to get more objective feedback, according to the respondents they were not supposed to start driving the development as they were only regarded as means and not ends. However, detailed game-specific metrics could be used for making such abstract issues as the degree of difficulty of the level design or frustration levels of users visible, thus making these concepts more calculable and comparable (Miller, 2001). The game analytics, working as an engine, made these new entities visible for the organisational actors, who could then scrutinise these figures further. Still, a massive amount of raw user behavioural data was required for the generation of new meaningful insights by these figures.

> "… a developer can't say if the field is difficult or not. Instead, ten million players are needed. So that we can see if the field is too hard or not […] we get kind of a graph, that we get the difficulty in relation to the field progression and we aim to deal with it […] before the user data exists, not much more than only rough evaluation is possible or we can only very roughly aim for that direction. And then, after we receive analytics from there, then we can tweak it and those difficult parts..." (PD Company C)

The engine thus required raw telemetry data for it to operate, and thus the fuel for the engine was a prerequisite. When the user data started to accumulate, the engine started to run, producing visualised metrics that could be used for the further development of the game along with its monetisation.

5.2. Mediation between creativity and financial reasoning

To get visibility of the commercial attractiveness of the game, a certain group of metrics seemed to be commonly used. For example, the retention rate was one key metric for most respondents. The retention rate was seen as one of the KPIs that could provide visibility and an indication of whether the game was ever going to be successful, or if it had any potential for further development. A "bad" retention metric was seen as representing an indication that people who had downloaded the game would not see enough value in the game and would not play the game enough to convert into paying users. It seemed to be a fundamental principle or even a theory-like understanding among the mobile gaming developers, which was enacted as such in practice (Law, 2008). One of the respondents from finance and business described it as follows:

> "…Retention is where it starts from. Nicholas Lowell explained it quite well: if retention is really bad, then you have run out of people in the world before you have managed to make money from that game. And it's true. It's all there is. Retention has to be good. And to achieve that good retention, the game itself has to be good for real, in all of those different areas." (FBM Company B)

If the retention rate was seen as good or good enough, even with not so good monetisation metrics the game could be seen to have enough potential so that further development was feasible. Many interviewees stated that lower monetisation could be fixed as long as there is a good indication from retention, but it would be more difficult or even impossible the other way around. The low retention rate would also mean less behavioural data available from the users for different calculative purposes.

This could be related to the dynamic relationship between the calculative engines and innovation (Revellino and Mouritsen, 2015). It is easier to innovate in terms of monetisation mechanisms than the core game design because if there is enough fuel for the engine to trigger the accumulation of knowledge from insights into user behaviour, then there might be a way to develop new calculative practices that can then be used for the organisation's financial aims. But if the fuel itself, the continuous behavioural data from the user masses, is missing, then it is more difficult to accumulate the knowledge to further the innovation.

Retention was seen as being closely related to the decision about whether to continue development, and it seemed to be an interesting metric for all professions. It was one of the first indicators and the means to open up discussion about the overall healthiness of the game and its design. If the overall game design and its features and monetisation methods were not properly designed, consumers would act accordingly, and this would be indicated simply by the retention rate metric.

> "… What is the retention rate and how many of them (users) are coming back… things you can influence are there at the game end […] you will make new updates and content […] in a certain way like the game as a service […] the end result could, for example after one year from launch, be really good, if you just keep building it up […] with a pretty OK game you can still build up quite a steady business [...] and it will get better for sure […] some other things could be more difficult to change. Basic things you cannot change…" (FBM Company C)

A game was not only a technical solution for players to have fun experiences, but also a calculative instrument (Revellino and Mouritsen, 2015) for organisational actors during the development process. Besides the core game software, there was also additional software included, which was used for the purposes of data collection and information accumulation, and thus for the purposes of monitoring user behaviour to accumulate knowledge about the preferences of these users. Creative ideas of organisational actors were challenged by the consumers through the indication by the metrics and could either verify or refute the presumptions made by organisational actors.

> "…one needs to go much deeper into the side of creativity. Like what things that fan of ours, that player of our games, would really like to do with that game? What do they really want to do? For that, analytics are also needed, so that we can identify new kinds of regularities, what happens there (in the markets), and the assertion of that new creative idea. To know that this was actually a good thing. That this was going in the right direction, that this was the right thing to do, so that we can verify the impact of that idea." (FBM Company B)

The continuous behaviour of the masses visualised by the metrics provided the means for business professionals to make calculations in terms of financial aims in a timely manner. The design-related presumptions made by the organisational actors about the "goodness" of the game could be visualised by quantifying the actual behaviour of consumers.

> "… we follow our gut feeling when we are developing a game. [...] then we can of course validate it, as retention provides us with an understanding that people enjoy that game. And I would also say that ARPDAU (average revenue per daily active user) partially, as it tells us that… people are not foolish. They won't spend money on things they don't like. So, in a sense they both measure it, at least some aspects about the 'goodness' of the game, if people are willing to spend their time and are willing to spend money." (PD Company A)

Thus, organisational actors need to act as "calculating selves" by taking specific economic norms into account in their decision-making (Miller, 2001). The quantifying characteristic of the game analytics made things more calculable and comparable (Miller, 2001) and thus provided the means for these calculating selves to compare and calculate different options. These metrics, as inscriptions, concretised the enjoyment from the creativity perspective and money spending from the economic perspective, and thus worked through analytics as a mediating instrument (Miller and O'Leary, 2007), linking the domains of creativity and financial reasoning together.

The analytics were not the only thing the development decisions were based on. Analytics, together with player feedback and the developers' own gut feelings, were all factors to be considered. A respondent from product development described how developers often had a certain vision or idea about the features they would like to add to the game, regardless of any pre-analysis of data.

> "…In general our game development teams already have that feeling about the things they would like to do next. And it can be such a strong feeling that there is no time for analysis. And we do not find it as meaningful to overanalyse the data […] it is more like, when the development team puts a new game out in beta, they know that this is a cut-down version of the full game. And they already have in their minds what the missing feature is […] a bit like a plan and the feeling of where they want to take the game […] metrics are there to provide background information…" (PD Company A)

He further explained how the development of the game during the beta phase, when there is already telemetry data available from the consumers, would be performed using different sources of information: developers' own experiences, knowledge and intuition, user community feedback and hard data. These different sources of information together would then be used for decision-making for further development of the game. According to him, it is a combination of the vision that the game team already have and the additional information coming from the community and the metrics, which of course might change the prioritisation. Similarly, as in the case presented by Maier (2017), these calculative practices that are used in game development can be understood as complex calculus involving intuition and judgement, which are integrated into professional practices outside the accounting function. Thus, in addition to other data, real-time user behavioural metrics provided the means to gain visibility of the very detailed product usage of masses of users, which enabled the combination of new types of data for accumulating knowledge and new insights about the product at the centre of calculation (Latour, 1987). For the product development actors, this data could then either verify or refute the developers' creative presumptions.

Without analytics, organisational actors would have had a hard time getting this kind of continuous data about a game design's suitability according to consumer preferences among the masses of consumers located outside the organisational boundaries and from the whole market in a timely manner. Interpretations made about the retention rate and the actions it generates afterwards, for example, seemed to link creative and financial preferences of the organisational members together. It combined previously separate entities together, such as a game designer's choice of position of an artefact in a game and the user's opinion about this position, and subjected them to the scrutiny at the centre of calculation. It represented one of the calculative practices which was acting as a mediating instrument (Miller and O'Leary, 2007) in the game development process, linking the creative thoughts of product development members and the financial reasoning of business management together through indications about the consumer preferences of the "good game".

Developers were able to use the accumulated knowledge from the metrics of the current and previous development projects in future projects, about things that worked in the past and might still work in the future. By knowing where players were struggling and stopping their involvement in

the game, they could try to improve that specific part and thus influence player behaviour to encourage them to continue playing longer by offering an even more engaging service. This could be a fine example of a calculative practice used at the centre of calculation for influencing the actions of others (Miller, 2001), as these metrics influence the actions of developers as they pursue the development of a "good game". Furthermore, this calculative practice works as an engine, as it lures people into action (Revellino and Mouritsen, 2015) by translating user behaviour into meaningful insights about game design.

By following the number and activity levels of consumers, such as frequency and time spent playing, organisational actors seemed to be able to get an indication of the potential of a "good game" from both sides, from the goodness from a creative perspective but also its business potential. A healthy game was a combination of separate but related metrics.

> "…It's a combination of acquisition, retention and monetisation. So, it's games where we can easily get people to play. That's the acquisition part. They stay to play for longer. And then, of course, we are in business, at some point we need to make some kind of money, in whatever form that is. […] all of that in combination is a healthy game." (BI Company D)

The more consumers there were who download and spend time playing the game and thus were active with the game, the better it was for the accumulation of raw data, the fuel for the engine, and knowledge and thus better for the business. Even if the game developers concentrated only on the specifics and the details of the game design itself, as long as they improved the non-financial metrics related to the enjoyment of users, they would know that they also enhanced the goodness in terms of financial metrics and the business in general. As the data was timely and easily available in an understandable form and there was an obvious link between the design decisions and the user behavioural outcome, the game developers were able to influence the data accumulation and knowledge building and eventually to coordinate their tasks in line with the economic objectives of the whole organisation.

5.3. Enhancing and re-forming the engine

As we can see from the previous sections, analytics and metrics were used for gaining timely visibility of the world of consumers and overall market behaviour, as well as for verifying presumptions made by the organisational actors. Metrics, like any other accounting figure, cannot provide ready answers as they are inherently incomplete and imperfect representations of something else (Busco and Quattrone, 2015), but they are the means to start asking questions such as why the figures are as they are and what the reasons behind them are.

> "…this helps build the picture as to why retention is bad. In other words, is it in that game or is there something annoying in that game, like other things such as adverts that start running immediately or is it buggy, is it crashing on some devices. Kind of, what is the root cause for retention being so bad? What presses that retention down? It's always exactly this, you can't… just with that retention parameter, the grounds for it, you can't make decisions, but you have to know why that param… the metric value is something." (FBM Company B)

The retention metric was not enough in itself, but it was an indicator to start looking for the details behind it. Game development teams were said to be in charge and to have the final word in decision-making related to the game development process. As one finance and business respondent put it:

> "… I don't have power over what happens on the game side. Our starting point is that game development teams will do the work related to it independently. Possibly more, let's say, things related to market regions or platforms. There I have more of a vision and opinion which is listened to. […] Things related to games, the opinion of the development team carries a lot of weight […] This is not to say that game teams would not listen to others..." (FBM Company A)

Another respondent from finance and business commented similarly that game development teams had much deeper knowledge about the specifics of the game and were so much deeper into the game, that they knew better about what is good and what is not good for the game in terms of user experience.

> "…in general our, and I guess in general in the game business, the fundamental idea is that, decisions should be made at a low a level as possible. Those who know the products and are so to speak responsible for that creative process and that product, should make the decisions independently." (FBM Company B)

Business professionals outside the game development teams did not have such detailed knowledge about the creative vision as the game development teams did, as they were not so "deeply" involved in the game design itself, or the link between detailed game design-specific features and the metrics. Thus, they seemed to have more uncertainty related to the input-output relationship (Jørgensen and Messner, 2010) compared to the actors in game development teams. However, they could continuously follow the metrics as a timely source of information, interpret these metrics from a business perspective, and question the game development teams about the commercial attractiveness if the figures indicated anything concerning. Furthermore, business intelligence professionals worked very closely with the game development teams and with the detailed game-specific metrics.

> "… these metrics which I produce have a bigger role than those finance ones. Those are maybe a bit too rough already, that finance data in general […] Like, noticing that there is something with older (existing) players and so forth, and those are commonly very hard to detect from the finance metrics per se […] all kinds of decisions are usually based on more specific analysis and more on these game metrics." (BI Company A)

The non-financial game-specific metrics provided detailed information about the users' interaction with the game, which was not available from anywhere else. When they compared different cohorts of users, they could start predicting fairly quickly how this cohort would be performing in the future. Business intelligence professionals were the ones working very closely with the development teams and sometimes interpreted the details from the analytics. They were also the ones who could be turned to in order to create more complex and specific algorithms for some new things to be measured. One respondent tried to illustrate the location of different sections of analytics in a whole game development process in the following way:

> "The business-related analytics could be understood to be located in the outermost circle of the ring, if the innermost circle of the ring had all those analytics related to things that happened in the game." (FBM Company C)

With this quote he was trying to emphasise and highlight the importance of details in game metrics. The innermost circle is at the core of game development and business-related metrics are there to provide a wider overview of the business in general. The game analytics and the business intelligence

professionals seemed to be the link between business management and game development teams, as they provided calculations for both domains.

> "For our top managers, by which I mean our game unit directors, games business directors, they sort of look exactly at those same operative metrics as the game development team. The game development team can go much deeper and look at those events in the virtual world, […] But these KPI metrics of ours are the same. There is no such thing as 'here are the directors' key indicators and here are team's key indicators'; instead we look at those same numbers. What product development is following is the same as what the business directors are following." (BI Company B)

Analytics could thus initiate discussion and foster communication between different individuals or groups of individuals. So, even if the financial metrics provided incomplete and imperfect information, it could still contribute to the management of knowledge through communication between the organisational actors (Busco and Quattrone, 2015). The events in a virtual world were connected to the other metrics, such as key performance indicators. When compared to the actors in the fashion industry (Jeacle and Carter, 2012), actors in game development organisations had the possibility to link users' behaviour in the virtual world to the other metrics and thus seemed to have a shorter time-space distance to comprehend and thus less uncertainty about outcomes (Jørgensen and Messner, 2010) related to the commercial success of the design proposal. On the one hand, the product development teams and business intelligence professionals had a much deeper understanding of the details of the game design and the link between these design features and the consumer behaviour visualised by specific metrics. Business professionals, on the other hand, could follow metrics on a daily basis and initiate discussion with game development teams or business intelligence professionals if any alarming issues were detected.

> "… now you can react to it very quickly. […] in traditional business probably, you can get monthly reports in which subsidiaries report to the headquarters, 'here are this month's sales', and then they figure out how that last month went. We can follow it on a daily basis and a weekly basis, so that we can react to it very quickly when necessary. […] with it comes things such as it increases the feeling of security about it a little. That you know where you are when the data comes in daily. When necessary, you can even look at it on an intraday basis." (FBM Company A)

Business management could therefore continuously follow how the markets were reacting to updates coming from the game development teams and react quickly if necessary. This mitigated the uncertainty related to the commercial success and also to the product development process, as these figures came in on a daily basis straight from the final consumers interacting with the product. The algorithmic models behind these figures could be constantly optimised.

Decisions about which metrics should be used were not decided by any one function. They were described by respondents as a team effort and a process of propositions and discussions between different organisational actors. Proposals could come from many internal actors.

> "We of course also allow others (than analysts) to pick up things there about what kind of data should be collected, if it helps others to operate. In principle we have that sort of performance perspective in there. Everything which affects the progress of the players in a game, everything which affects their in-game economy, so to speak." (BI Company B)

The bundle of metrics in use was thus evolving with the evolution of the game. If some new type of data, from the actions of players, were considered important for collection by some organisational actor, for the sake of developing even a "better game", it could be done, thus further developing the calculating engine and its efficiency.

6. Discussion

The findings of the present study discussed in the previous section provide an illustration of the digital product development environment, where modern calculative technologies are deployed in a creative development setting in an attempt to create a "good game" and to overcome the issue of harsh competition and rapidly changing markets. The game analytics, when understood through the conceptual framework of calculative practices as engines (MacKenzie, 2006), provided the means for transforming complex processes such as consumer behaviour into single real-time figures, thus rendering a "good game" visible for the organisational actors during the development process. Various metrics as visual inscriptions provided the grounds for knowledge accumulation, decision-making and further action among the organisational actors. The game analytics, as an assemblage of inscriptions producing the calculative instrument, provided the means to quantify creative assumptions of individuals or product development teams in a timely manner, and either verified or refuted these presumptions through transforming the multitude of end-user telemetry data into visualised metrics that represented the goodness of the game.

The continuous feedback from the users in the form of data about their behavioural actions generated further action among the game development team members, as they tried to improve the game in the direction of the idea of a "good game". The "good game" itself was an ideal and a numerical representation indicated by the metrics. There were no specific and exact figures available that would represent the end of development in the sense of a perfect "good game". This could be interpreted as an illustration of how the real-time user behavioural data can introduce a desire for "improvement and perfection" (Busco and Quattrone, 2018), while it is difficult to predetermine the exact end of any necessary improvements.

The user behavioural data was also a prerequisite for the calculative engine to generate any action on the organisational members. Thus, it worked as a fuel to power up the calculative engine (Revellino and Mouritsen, 2015). After the data started to accumulate, the engine could generate its power by providing new knowledge and insights, which was seen as strong information by others (Latour, 2005, p. 107) because it generated further action. Game-specific metrics revealed detailed information about the players' gaming behaviour inside the virtual game world, which could be monitored by the game designers working at their computers while enabling rapid knowledge accumulation (Latour, 1987, p. 215-219) about the things which worked and which were not working so well. This accumulation of knowledge influenced the further development process.

The efficiency of accounting for information provision from inside the organisational boundaries, as mentioned by Gerdin *et al.* (2014), was expanded to cover the whole market of end users blurring the distinction between a centre and the distant periphery (Agostino and Sidorova, 2017). The digital environment, together with the information technology infrastructure, made it possible to transform and transport the actions of final consumers into the centre of calculation (Latour, 1987, p. 232) for timely information provision and stretched the "real-time reach" beyond traditional organisational boundaries. As we have seen in previous section, for the industry actors, game analytics generate strong claims by mobilising and translating various entities together as an assemblage (Latour, 2005) in a form of different metrics. Entities, such as difficulty of the level, enjoyability of the gaming and engagement of the game, are generated from the traces left behind by millions of users when interacting with the service. These real-time metrics are seen as objective truths about the distant periphery, generating new insights and inspiring organisational actors to do new things (Revellino and Mouritsen, 2015), such as constantly updating the game in pursuit of the "good game", which is a form of an illusion of perfection to strive for (Busco and Quattrone, 2018).

While these metrics are followed, enacted and enhanced frequently, due to the continuous process of the search for improvement, they generate continuous action, both in the organisation and in the markets. Therefore, the performativity of the calculative engine (MacKenzie, 2006) may manifest itself in the rapidly changing mobile gaming markets. The more power the engine has, the more action it can generate (Latour, 1999, p. 124; 2005, p. 107; MacKenzie, 2009) and thus the faster the change.

This fast cycle of knowledge accumulation enabled the time-space distance between the design change as an input, and the consumer action as an outcome, to be diminished, thus reducing the uncertainty related to the input-outcome relationship (Jørgensen and Messner, 2010). In the existence of uncertainty, due to the large gap in terms of the input-outcome relationship, such as in the fashion industry (Jeacle and Carter, 2012), tensions may arise between different group members who are driven by different drivers, such as creativity and commercialism. Therefore, accounting tools and perhaps professionals who are capable of deciphering these tools may be needed to resolve these tensions by providing the means to find a reasonable compromise between these actors.

Our empirics have illustrated how the product development teams were provided with more independence on decision-making related to the design choices. This could refer on the one hand to the lowered level of uncertainty of final outcomes, as the organisational members are able to receive fast feedback straight from the markets in terms of assumptions made by the developers. On the other hand, it may be related to knowledge accumulation, as the designers frequently gain insights into and knowledge about the design features that work and those that do not work. This is in contrast to the fashion industry, which is material in nature and where the creative assumptions proposed by the designer cannot be verified or refuted by final consumers, as these ideas may already be rejected by the accounting-related calculations. This prevents the cycle of accumulation from happening, leaving the designer with the original assumption about the creative choice.

The free-to-play mobile game development environment also seems to differ from the film industry (Maier, 2017), as the co-creation of a service together with consumers becomes possible after the data from the masses starts to accumulate. It becomes possible to start accumulating knowledge from the actions of users who are distant, to find ways to improve the service according to the financial ambitions of an organisation (Miller, 2001). This study supports the findings of Revellino and Mouritsen (2015), who concluded that calculative practices can be understood as engines that can help to shape innovation, if the effects of the innovation itself are involved in developing it further. Unlike in the film industry, the film crew have no possibility to act upon the actions of their consumers by utilising the information about the final consumers' behaviour during the creative process, but instead they have to rely on other means of calculative practices to cope with the finite financial resources and time restrictions. Therefore, informal accounting records may become necessary as there is a time lag between the creative assumptions and feedback from the audience.

As was described in the previous section, the developers are also able to propose and add new types of metrics to the stack of existing ones, if they think these new metrics might be used for new insights for affecting the progress and behaviour of the players. Thus, previously separate and unrelated issues or events are brought together in the form of a metric, and previously unseen connections between separate entities can be discovered. Those developers participate in the building of new centres of calculation (Latour, 1987, p. 232), which through knowledge building about the players can aim to act at a distance on these players (Latour, 1987, p. 219) while also affecting the evolution of the calculative engine itself (Revellino and Mouritsen, 2015). Therefore, they also participate to the improvement of the fuel intake and thus eventually the improvement of the power of the engine, making it even more persuasive and performative (MacKenzie, 2006), as it provides more and more new actionable insights into the conduct of the players (Revellino and Mouritsen, 2015). What types of games are eventually offered to the markets depends partly on the collection of metrics, or inscriptions (Latour, 1999, p. 306), used in the product development process. What is measured partly drives the further development of a game, influencing the outcome and eventually

the whole market. But, as the behaviour of players changes, either because they have been acted upon through the updates made to the game, or for other external reasons, this change will be visualised through the metrics back to the organisation in almost real time, generating further action from the actors at the centre, speeding up the changes in mobile gaming markets.

The retention rate metric, which is given high priority in the stack of metrics by actors in free-to-play mobile gaming, provides a good illustration of how a theory, or a strong claim, is translated into practice as it is enacted as such (Law, 2008). Our informers described how the retention rate had to be good for the game to have any potential in the markets. This is understandable if the "fact" that only a small portion or few per cent of users will convert into paying customers is taken as a truth (Rayna and Striukova, 2014). This assumption can be problematic, as it is not a property of nature or a natural law and can only be empirically demonstrated afterwards, but it is the pre-assumption used commonly in free-to-play development (Seufert, 2013). Nevertheless, retention rate is associated with the "good game", from both perspectives, from a creative and a financial one. If people will come back again and again, it suggests on the one hand that they enjoy playing the game, i.e. it's a good game to play. On the other hand, business management may expect them to stick around long enough to enable enough of them to be converted into paying customers or to be available to advertisers, to generate cashflow at some point in the future. The "fact" of there being few converting players links the retention rate to the financial interests of the organisation in the form of a future potential, giving it predictive power through calculations, while also linking it to the idea of the "good game". At the same time, the retention rate represents the interests of actors in creative product development, also linking those interests to the "good game". The retention rate metric thus becomes a mediator, or a mediating instrument, which partly drives the development trajectory towards the programmatic ambition of an organisation (Miller, 2001), an ever-changing entity called the "good game". Similarly, other metrics introduced in this study may be understood as mediating instruments (Miller and O'Leary, 2007). These metrics are thus more than calculative devices that render a phenomenon visible with single figures, as they are also a set of ideas that can be articulated by different actors leading to the creation of more calculable objects (Miller, 2001; Miller and Power, 2013) as we have previously described. The analytics are a combination of different calculative practices and metrics, which can be understood as a calculative engine working as a mediating instrument between financial and creative ideas, coordinating the actions of individual actors towards the ambition of a "good game" in this creative digital environment.

We have highlighted the importance of the fuel for the engine, without which the engine would not be able to generate action or induce any interest among others (Latour, 2005). The properties of the fuel also seem to make a difference to the power of the engine. Quattrone (2016) explains how data is attributed by those who produce and consume it. This means that what is measured is measured for a reason. Behind the reason might be politics, egos, traditions or whatever raises the need for measuring something. In our study, the reason for collecting a certain type of data comes at least in some part from the desire for the generation of a "good game", which is a subjective matter and a combination of heterogenous elements, including those financial and creative aspirations. This means that the "good game", which can ultimately only be determined by looking at different metrics that are produced by the data collected, seem to contain politics, egos, and other pre-existing subjective views of the world. When the fuel is attributed with such multifaceted subjective views, how can anyone, and we have described how organisational actors do, trust those figures produced by the engine, and treat them as objective truths? The "octane rating" of the fuel might explain at least part of it. The volume of the data seems to be one of the properties determining the "truthfulness" or objectivity of the data. Graphs and figures produced by millions of users is attributed more objectivity and accuracy in terms of details than figures from few hundred or few thousand users. Another factor increasing the octane rating of the fuel seems to be related to the concealed measuring of users. As was described in the previous section by the interviewee, it can be difficult to get good feedback from people when they know they are being interrogated. Therefore,

when users do not even know that they are constantly being interrogated, and even less for what reasons and how, they can reveal their true behaviour and thus provide "better", more objective data for calculating purposes. This is the opposite of the idea of a panopticon and transparency of measuring, which can generate self-regulating individuals (Miller, 2001). However, as we are talking about users and the quality of the data they are generating, it seems to increase the efficiency of fuel, making the figures produced by the engine seem more objective and powerful to others.

7. Conclusions

This study has illustrated how real-time user data can introduce a desire for "improvement and perfection" (Busco and Quattrone, 2018), while working as a "fuel" to power up the calculative engine (Revellino and Mouritsen, 2015) through knowledge accumulation cycles (Latour, 1987, p. 215-219), thus influencing the development process trajectories through mediation (Busco and Quattrone, 2015; Miller and O'Leary, 2007; Revellino and Mouritsen, 2015).

This study highlights the role of user behavioural data as a fuel for the calculative engine (Revellino and Mouritsen, 2015), without which the engine is not powerful enough to generate action on others (Latour, 1987; 2005). While the fuel is a prerequisite for the powerful engine, the level of power depends on the "octane rating" of this fuel. Rather than yielding to the clichés about volume, variety and velocity anecdotes, which are the original three mentioned characteristics of big data, the concepts of cycles of accumulation (Latour, 1987), the accounting as an engine (Revellino and Mouritsen, 2015) and the mediating instruments (Miller and O'Leary, 2007) are used for explaining the coordinating role of analytics in a digital product development environment to contribute to the literature in three main respects.

First, the digital platform as an intermediary enhances the knowledge accumulation cycle (Latour, 1987, p. 228), decreasing the uncertainty related to the input-output relationship (Jørgensen and Messner, 2010). After releasing an update to the market, the changes in user masses behavior is visualized back to the developers almost in real time, providing fast feedback about the significance of any implemented design features and changes. This furthers the developer's knowledge on insights into users' preferences towards the design features, verifying or refuting their previous assumptions or the understanding of "how the world works" (Vaivio, 1999), replacing the existing knowledge of the world with a new world (Miller, 2001). These visualised figures are seen as truthful and objective representations of users' conduct, as these masses of users are not aware of the type of the interrogation they are subjected to by the organisation.

Second, this fast knowledge accumulation and the possibility to connect and link previously unrelated and separate entities together in a new way (Bhimani and Willcocks, 2014), and to visualise them in the form of a graph or a metric, may introduce a desire for improvement and perfection (Busco and Quattrone, 2018), driving organisational actors to develop even more associations between different types of data and calculations. This in turn might generate new types of traces and thus surprising results (Revellino and Mouritsen, 2015), enhancing developers' ability or desire to intervene in the search for a "good game". The ideal concept of a "good game" is materialised through the assemblage of heterogenous and changing metrics, which therefore has no exact, pre-determined appearance or essence. A "good game" is a combination of creativity and an organisation's financial aims, and is determined only by the way it is calculated, thus being an incomplete and opaque description (Busco and Quattrone, 2018; Dambrin and Robson, 2011). Therefore, the way in which the mathematical formula, which links creativity and financial reasoning together, is developed, determines how a "good game" is defined. Thus, the game together with the analytics, when they are constantly developed further by introducing new calculative devices for accumulating information, perform the world being created (MacKenzie, 2006).

Thirdly, when new associations are generated between creative actions and financial calculations, by introducing inscriptions such as a retention rate metric, which informs its users about their actions, it may translate creative actions into financial notions, such as a profit, thus providing

guidance for the actions of the users of the inscription (Gerdin *et al.*, 2014). These types of metrics may become actors, mediating instruments (Miller and O'Leary, 2007), linking distant domains together while providing coordination for the organisational actors according to specific organisational objectives (Miller, 2001), at the same time as assuming these actors believe in these figures (Gerdin *et al.*, 2014).

These contributions further our understanding of the role of real-time user data on innovation activities in a digital product development context (Arnaboldi *et al.*, 2017; Gerding *et al.*, 2014). The focus in a performative and mediating role of calculative practices of accounting (Revellino and Mouritsen, 2015; Miller and O'Leary, 2007), should highlight the role and characteristics of real-time user data more as a fuel for the engine and with a specific octane rating for its power for mediation. For the mediation to happen, it requires powerful explanations to be generated, which then generate action and enactment from others (Latour, 2005, p. 107; MacKenzie, 2009; Law, 2008). If the mediation happens, but without much power, it will not be enacted, and it will not generate action. Thus, future research on digital platforms and calculative instruments could try to focus more on the reasons behind the collected data itself and the way formulas for calculations are developed, and how they are attributed by those who produce them (Quattrone, 2016), instead of taking data for granted for anyone working in a digital environment.

This study had a very specific context, which could be understood as an extreme example of a digital development environment, and thus it remains uncertain as to how far these findings can go in different types of digital development environments. It also remains uncertain how much impact company-specific differences, such as the life-cycle stage of the company or the selected company strategy on game genre, might have on these findings. Therefore, further research is needed from this perspective. Nevertheless, it could inspire researchers to further investigate the impacts of digitalisation on management accounting issues, as this study introduced and explored a new area of interest – free-to-play mobile gaming – bringing it into the field of research on the role of accounting in popular culture (Jeacle, 2012). What might then be the implications for everyday people's lives, for the people who use these types of products? For further research it might be worth exploring how this type of performativity through real-time user behavioural data might link to the wider societal issues and institutions, such as taxation authorities.

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