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Examining the Core Dilemmas Hindering Big Data-related Transformations in Public-Sector Organisations

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Abstract

This study examines public organisations planning big data-driven transformations in their service provision. Without radical structural change or managerial system changes, leaders face dilemmas: simply bolting on big data makes little difference. This study is based on a qualitative empirical case study using data collected from the cities of Helsinki and Tampere in Finland. The three core dilemma pairs detected and connected to the big data-related organisational changes are: (1) repetitive continuity vs. visionary change, (2) risk-taking vs. security-seeking and (3) technology-based development vs. human-based development. This study suggests that organisational readiness involves not only capabilities; instead, readiness involves absorbing knowledge, making decisions, handling ambiguities, managing dilemmas. Thus, big data-related transformations in public organisations require embracing the world of dilemmas, since selected and cancelled experiments may each have valuable outcomes. The capability to act on intentions is a prerequisite for readiness; however, a preparedness to detect and address dilemmas is central to big

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data-related transformations. Thus, the ability to make dilemma decisions is a more complicated characteristic of readiness. In conclusion, our data analysis suggests that traditional public organisational and chance management approaches produce unsolved dilemmas in big data-related organisational changes.

Keywords:
Big data, public organisation, dilemma approach, readiness, change management

Introduction

Public-sector organisations are increasingly turning to BD analysis to identify opportunities to integrate and/or reinvent service provision models (Lake 2017; Leavitt 2009; Lin et al. 2010). Simultaneously, a rise in dilemmas is forcing local authorities to choose between either/or and yes/no choices concerning services altered and transformed as a result of BD. By BD-related and BD-driven transformations, we mean carrying out and implementing BD-based innovation and decision-making (see also Klievink et al. 2017). The aim, rooted in information processing theory (Beer 1979; Stinchcombe 1990), is that a BD evidence trail will identify and justify beneficial changes that would otherwise remain hidden or be difficult to justify. Examples of this approach include the works of Cukier and Mayer-Schönberger (2013), Ward and Barker (2013) and Barnes (2013), who build on Batty's (2013) analysis of the 1,200 exabytes of data supporting London's Oyster Card, revealing travel patterns and pinch-points.

The term BD can be traced back to the late 1990s, gaining mainstream appeal in the mid-2000s (Madsen and Stenheim 2016). There are numerous definitions of BD, it refers to data sets too large for typical database software tools to capture, store, manage and analyse (Kitchin and McArdle 2016; Malomo and Sena 2017; Manyika et al. 2011). For this paper, we build on that of Kitchin (2014), which characterises BD as high in volume, high in velocity, fine-grained in resolution and comprehensive in scope. Furthermore, "the 'bigness' of Big Data's high volume of observational units" extends to "terabytes or petabytes of data" (Kitchin 2014, 262): a description that effectively summarises and illuminates the size and possibilities of harnessing BD for public goods and their service provision in public organisations and for profit in the private sector (Kim et al. 2014).

Existing research, such as Oztruk (2010) and Chen and Hsieh (2014), identifies cases in which the use of BD has made a valuable difference to public-service provision, especially in public healthcare and transportation. There are also uncertainties relating to the use of BD in public-sector organisations that create new challenges for managers as Pink et al. (2018) Klievink et al. (2017) illustrate. Additionally, there is evidence that organisational change creates dilemmas in public-sector organisations when there is a collision of old and new "worlds", especially, as Hampden-Turner (1990, 2009), Kuoppakangas (2015) and Laine (2018) argue,

those featuring technological change. Hence, dilemmas often characterise transformations in ways of working, leading to readiness in terms of discarding of the old ways or a choice between the old and new ways in an either/or vein, shown in research by Laitinen et al. (2017a, 2017b), Laine (2018) and Stenvall et al. (2018). Western choices are often framed as binary: based on the assumption that one rational choice will always be superior to others. By contrast, Hampden-Turner (1990) argued, some Asian cultures reject the binary in favour of a reconciliation of differences: a quite different way of resolving dilemmas.

This paper explores the challenges public-sector managers face in BD-related organisational transformations, by clarifying Adrian et al's (2018) idea of readiness and synthesising it with Hampden-Turner's (1990) dilemma approach. We (a) identify the core dilemma pairs hindering public-sector managers in their BD-related transformation work and (b) revisit Hampden-Turner's (1990, 2009; Hampden-Turner and Trompenaars 2015) dilemma approach in the novel context of BD-related transformations in public-sector organisations. Our research offers an advanced dilemma approach for change managers to overcome some of the difficulties of BD-related readiness and transformations.

The paper explores dilemmas involving BD-related changes in two case organisations in the cities of Helsinki and Tampere and the tensions that arise in connection to BD-related transformation attempts. We show, following Hytti et al. (2015) and Suomi et al. (2014), that unresolved core dilemmas could create unforeseen paradoxical outcomes, hindering successful organisational change. The empirical cases, the cities of Helsinki and Tampere in Finland, are chosen not as early innovators, but, rather, as innovators using BD. We begin by defining readiness in the context of BD transformations and introducing the dilemma approach. Then follow a brief summary of the two cases and a review of the method. Next, we discuss the results and empirical data analysis. The paper considers the implications of this work for the two case organisations in their BD-related organisational transformations in terms of public-service provision.

BD-related readiness in the public-sector context

Here, we explore the previously un-problematised idea of readiness as it applies to BD-related organisational changes and transformations to improve public services (Klievink et al. 2017).

IT-related innovations may be incremental (e.g. citizen data storage) or more radical (e.g. online service booking/payment). In all cases, they process an existing body of service knowledge more efficiently. The major difference introduced by BD-related innovation is that it creates a new knowledge base (see Klievink et al. 2017). Whereas the results (if not the process) of IT-related innovation are visible, the starting point of BD innovations are not only invisible (embedded in data);

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they may also be counter-intuitive. Secondly, from a knowledge-creation viewpoint, IT-related innovations result in new closely coupled systems, whereas a BD-related innovation, once established, continues to gather, structure and interpret data. In short, it is more dynamic and, as research shows (Bryant et al. 2008; Chen and Liu 2014; Cumbley and Church 2013; Miller and Mork 2013; Tech America Foundation 2012), can give rise to flows of correlations, each exposing new opportunities to improve.

Solow's (1987) productivity paradox – IT is everywhere except in productivity statistics – encapsulates several decades of research demonstrating that people's attitudes and ways of working can be barriers and result in dilemmatic outcomes in IT-related innovation. Researchers such as Adrian et al. (2017, 2018) and Halaweh and Massry (2015) suggest that the same enablers and barriers that apply to IT-related innovations are also relevant to BD-related innovations. From the perspective of the technology used and people's interactions with the innovations, this is true; however, from the perspective of knowledge, the two are quite different, for the reasons given above.

Capability analyses of the implementation process, such as Adrian et al.'s (2017, 2018) ten-capability list, aim to bridge intentions, actions and results by disaggregating readiness factors. Further, Halaweh and Massry (2015, 28–29) apply capability analysis to BD-related innovation and suggest a six-factor list: *top management support, organisational change, data availability and change, infrastructure, required skillset, privacy and security.* In this study, the alternative argument, from a knowledge perspective, is two-fold. Firstly, a line of argument is not pursued here that best practice lists are of limited use when crossing culture and context. Secondly, and pertinent to the current research, that where BD systems continuously gather and analyse data; intentions (i.e. plans) are dynamic: they alter, unlike even the most open IT project (Kitchin and McArdle 2016). BD analysis creates new knowledge and new potentialities, the exploitation of which is not simply a matter of capabilities; instead, it requires continuous cycles of intent (plan) decision-making. BD, like IT, poses issues of capability. Unlike IT, however, established BD systems also give rise to new knowledge, creating continuous decision cycles that also create uncertainties tending to result in dilemmas (Pink et al. 2018; Hampden-Turner 2009).

One of Adrian et al's (2017, 2018) capabilities is readiness, which, unfortunately, is left undefined. Klievink et al. (2017, 268), following a similar capabilities approach, suggested that readiness amounts to *organisational alignment, organisational maturity* and *organisational capabilities*. Their independent variable was alignment: that is, readiness exists where maturity and capabilities align with goals and values.

We believe the idea of readiness is under-theorised and argue that readiness in BD-related innovations and organisational transformations cannot be reduced to capabilities, which is a necessary but insufficient condition. For successful BD-re-

lated organisational transformations, one must accept that a flow of BD correlations and innovations may continuously impact what goals are and the actions necessary to deliver intent (Hampden-Turner 1990, 2009; Mittelstadt et al. 2016; Pink et al. 2018). From this knowledge and knowledge-implementation perspective emerges a more dynamic concept that does not reduce readiness to capabilities, but, rather, includes readiness to absorb knowledge, to make decisions, to grapple with ambiguities and to detect and address competing values, resulting in dilemmas that might hinder BD-related transformations (Hampden-Turner 1990; Laine 2018, see also Špaček and Gatarik (2017).

The readiness postulated in this study invites a preparedness to manage dilemmas, to decide, an intention to try actions to detect innovative change and a high rate of experimentation (see also Hampden-Turner 2009). Since change is limited by the need to maintain stability and a high experimentation rate, there is a high rate of early cancellations of innovation: many BD correlations will not translate into causal relations (i.e. the intended result of the new action fails to materialise; Kitchin 2014; Pink et al. 2018). From this perspective, therefore, readiness means considering a wide range of options resulting from BD analysis, selecting experiments, and quickly cancelling those that fail. Readiness is quickly processing a wide range of knowledge and also quickly acknowledging those experiments that fail. Thus, readiness involves detecting and reconciling the world of dilemmas, since selected and cancelled experiments may each have valuable outcomes (Hampden-Turner 2009). Capability to act on intent is a prerequisite for readiness; however, preparedness to address dilemma decisions is the more difficult characteristic.

Dilemma approach

In relation to the idea of readiness and the dilemma approach, the earlier section illustrated a dilemmatic situation in which organisational change and development may generate tensions between two values: maintaining stability and promoting experimentation. Both are valuable for organisational success and survival; however, when attained simultaneously, they create a dilemma pair that tends to polarise at the either/or end of the continuum and that requires reconciliation (Kuoppakangas 2015; see Figure 1). Stability is needed for an organisation to function and operate, while new developments are needed for its future success. When seeking to attain both values simultaneously, managers must balance and reconcile the dilemma pair with both/and solutions instead of either/or solutions, which yield a zero-sum outcome and no new developments for the organisation (Hampden-Turner 2009; Laine 2018; Suomi et al. 2019).

Thus, mutually exclusive but equally desirable intentions and outcomes create dilemmas, which, as Hampden-Turner (1990) argued, lead to tensions over values (Suomi et al. 2019; Kuoppakangas 2014, 2015). Dilemmas differ from the sort

of policy options Pollitt and Bouckaert (2011) discussed, since decisions concerning the latter can be resolved through the application of data. Unlike paradoxes, which are irresolvable, dilemmas can be resolved. Literature discussing these terms abounds. The works by Quinn (1988) and Argyris (1990) are classic examples, and a more recent example is the study by Smith and Lewis (2011). Another approach, which is recommended, for example, by Storey and Salaman (2009) and Pollitt and Bouckaert (2011), advises organisations to avoid dilemmas. As noted above, however, this is not possible for public-service organisations seeking to improve services via BD-related transformations.

The view in this study is closer to that of Rittel and Webber (1973) and Hampden-Turner (1970, 1981, 1990, 1999, 2009), as developed by Laine (2018) and Hytti et al. (2015), i.e. that public service organisations face dilemmas whose speed and range grows with BD-related transformations. Like Carlson et al. (2017), we consider dilemmas to be distinct from paradoxes. Hence, we see dilemmas as managerial challenges that require practical resolutions and paradoxes as a philosophical concept (Kuoppakangas 2015, 82). Building on Weick (1995, 130), we understand the framing of dilemmas as a social construct, arguing that resolution by reconciliation requires the social referencing of discourse by active agents. Importantly, therefore, the reconciliation of dilemmas is not always a logical and rational process; instead, it is a pragmatic alignment of competing values intended to create new solution for, in this case, public-sector service provision. Hampden-Turner (1990) and Kuoppakangas (2015, 82) point out that dilemma reconciliation being not rational does not mean it is irrational; instead, different rationalities and sets of values come into play. In the case of public services, this includes such subjective and normative considerations as service users' wellbeing, happiness and emotional attachment.

Further, BD-related transformations in public-service organisations face a heightened speed and range of dilemmas, the reconciliation of which involves both objective information and the subjective feelings of involved agents. Dilemma reconciliation, then, is the process of agents (leaders, managers and other employees) clashing in their respective values and organisational values, seeking both/and reconciliations that improve organisational and public value overall. Hampden-Turner (2009, 8) noted that "[v]alues are not things but differences." Hence, "values extend on a continuum so that there cannot be high without low, broad without narrow or rules without exceptions" (Suomi et al. 2014, 464). For example, as Suomi et al. (2014) discussed, an organisation may engage in a collaborative service-delivery arrangement with another (competing) organisation, implementing both competitive and collaborative governances and reconciling a collaboration/competition dilemma with applying collaborative competition (see also Hampden-Turner and Trompenaars 2015).

Figure 1 demonstrates how a potential dilemma pair "Dilemma/Dilemma" is reconciled. Instead of leaving opposing value extremes "Dilemma" and "Dilemma"

polarised at each end of a continuum, creating tensions and resulting in an unreconciled dilemma pair when attained simultaneously, the "Dilemma" and "Dilemma" value extremes on each end of the continuum are placed diagrammatically in the following vein.

Figure 1

Hampden-Turner's (1990, 158; 2000, 355; Kuoppakangas 2014, 141) approach to the dilemma reconciliation process
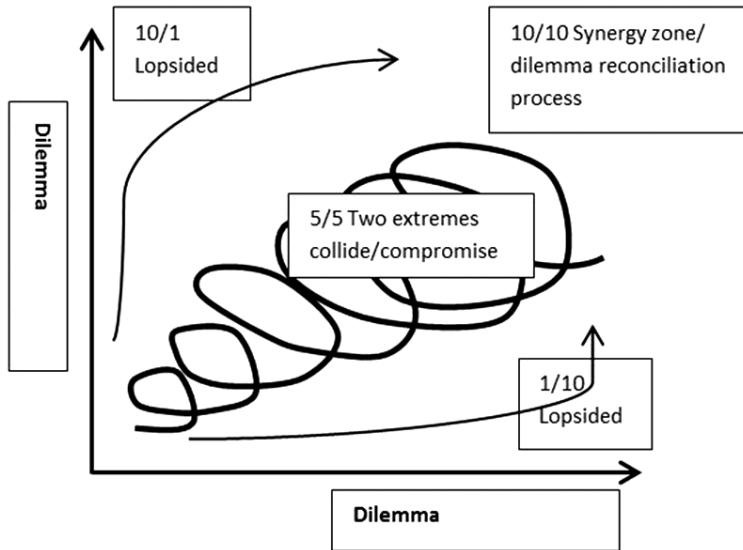

Figure 1 is modified from the original work of Hampden-Turner (1990, 163) to illustrate a both/and approach of dilemma reconciliation to finding synergy between the two competing values of a dilemma pair (Dilemma/Dilemma) on the Y and X axes, avoiding collusion. The looping arrow is helically drawn towards a 10/10 synergy zone (reconciliation), rather than proceeding lopsidedly to a 1/10 or 10/1 result or stopping at only a 5/5 compromise (Kuoppakangas 2014, 2015).

What processes are involved in dilemma reconciliation and its nature? Firstly, it is worth noting that reconciliations are contextual, situated and provisional. Dilemma reconciliation is an on-going process, not static. Further, one reconciliation is temporary, but still not paradoxical (Hampden-Turner 1990; Kuoppakangas 2015). Hence, the detection of the core dilemma pairs and distinguishing them from "derivative dilemmas" is a key factor of successful reconciliations. In addition, a successful reconciliation of one core dilemma pair may also result in the reconciliation of other detected dilemma pairs and "derivative dilemmas", which are "subsets" of the core dilemma pairs "and will reconcile themselves automatically" when the core dilemma pairs are reconciled (Hampden-Turner 1990, 30).

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Alternatively, a successful reconciliation of one core dilemma pair may generate new dilemma pairs that require further reconciliations. Hence, "resolve means to solve again and again" (Hampden-Turner 1990, 20), and dilemma management is an ongoing strategic endeavour with organisational transformations and changes (Hampden-Turner 2009; Suomi et al. 2014; Laine 2018). In contrast, Smith and Lewis (2011, 387) suggested: "A dilemma may prove paradoxical, for instance, when a longer time horizon shows how any choice between A and B is temporary." To use the Hegelian terminology, today's synthesis is tomorrow's thesis. Over time, values, power and opportunities alter; if they did not, there would be no dilemma. Dilemma management and dilemma reconciliations require accepting reconciliations' transitory nature (Hampden-Turner 1990, 2009; Hytti et al. 2015). Further, dilemma resolutions can prevent dilemmas from ending as organisational paradoxes.

Secondly, this study does not follow the idea of a compromise in which both values lose instead of gaining (Hampden-Turner 1990; Hytti et al. 2015). Hence, the fundamental idea of dilemma reconciliation is that "the combination of contrasting values is more precious and useful than their separation" (Hampden-Turner 2009, 5). Reconciliation may reconstruct power, the intensity of feelings and concessions to maintain a dialogic community: rationality is unlikely to prevail when values clash. What is essential is that a dilemma approach promotes transparent clashes. As Suomi et al. (2013) noted, in such a setting, values become both separate and connected. In effect, values become socio-cultural artefacts whose meanings are (re)-negotiated in the practical change context of the potential dilemma. For example, Hampden-Turner (1990) considered how a "universal" value might be interpreted differently by different agents, only to find that applying values to problem-centred discourse fosters reconciliation.

While reconciling dilemma pairs, ideas are distributed (through teams or organisations) to create new solutions, as Hampden-Turner (2009) and Tsang and Zahra (2008) conclude, to ideally reconcile competing values and options. These processes do not occur in a *tabula rasa*; instead, change evolves (and only transforms in airport books) into organisational transformations, the integration of changes and service improvements and the balancing of change and continuity. Since local public services in Finland are funded by taxes on citizens, are often delivered to vulnerable people (e.g. the elderly, ill and young) and are subject to scrutiny, legitimacy and accountability, balancing risk with proven standards of delivery is an important aspect of all local public-service innovation (Kallio and Kuoppakangas 2013; Kuoppakangas 2014).

Conceptually, this study draws on the incorporation interaction of combining the tenets of readiness (Adrian et al. 2017, 2018) and the dilemma approach (Hampden-Turner 1990). The hindrances in BD-driven transformations in the two case organisations of this study are associated with the individual actors' (manag-

ers) either/or choices and their readiness for BD-related transformations that might generate dilemmas in public organisations.

The two cases

The City of Helsinki and the City of Tampere collaborated within the Six City Strategy – Open and Smart Services (6Aika 2015), which is a strategy programme for urban development for the six largest cities in Finland. The Six City Strategy's objective is to strengthen Finland's competitiveness by using the collaborating cities as innovation and development platforms. The strategy with political support at the EU, national and city levels has three focus areas: open innovation platforms, open data and interfaces, and open participation and customership.

The City of Helsinki has promoted their smart-city strategy for some years by, for example, developing a mobile application cluster and focusing on open data. With open access to public data, individuals and companies create new and more versatile services. The City of Helsinki's logistics has been monitoring utility-vehicle usage for many years but has not found proper ways to optimise the BD for, e.g., decision-making, storage, and route optimisation. For these purposes, the department of technical services and logistics of the City of Helsinki was piloting BD in a two-year project. The project developed the city's capabilities to create exploitable BD to be used as an innovation platform. This was done by creating a strategic uptake framework that covers issues from technology and governance to ecosystems, and by utilising the previous, real-life piloting of BD in key spearhead domains.

The City of Tampere has implemented BD practices step by step. New practices have been adopted, like software with the purpose of helping to analyse BD for planning and decision-making. The other direction for BD is to develop new technologies that help move from manual to automatic practices in collecting and using data. The City of Tampere has not yet created platforms for BD, but it is an increasingly important ingredient in the development of services.

Method

Citing two cases from the cities of Helsinki and Tampere in Finland, this paper aims to (a) identify the core dilemma pairs hindering public-sector managers in their BD-related transformation work and (b) revisit Hampden-Turner's (1970, 1981, 1990, 1999, 2009; Hampden-Turner and Trompenaars 2015) extensive work on the dilemma approach in the novel context of BD-related transformations in public-sector organisations. The focus is on individual active agents within their institutional and social contexts and how they reason and rationalise their challenges in BD-related transformations. In so doing, the paper gives the core dilemmas meaning in the context of BD-related readiness and transformations in public-sec-

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tor organisations and examines the emergence, and possibly construction, of organisational core dilemmas linked to BD-related changes in the two case organisations.

Empirical data was gathered in 2016 and 2018 using 23 thematic interviews with fifteen informants from Helsinki and eight informants from Tampere (notated here by informant number – for example, interviewee #2 from City of Tampere (T-2) or interviewee #23 City of Helsinki (H-23) – in the text to ensure anonymity, see also Table 1). Following Silverman (2011) these were recorded and transcribed. The informants included seven individual interviews and 16 in four focus groups. Purposive sampling and the snowball method guided the selection of key informants possessing rich information of the subject (Patton 1999). During the interviews, the informants were asked to discuss *challenges and their possible resolutions related to BD-driven transformations in their change-management work.*

Table 1

Informants representing the case organisations

Helsinki N-15	(H-1)–(H-13), (H-22)–(H-23)
Tampere N-8	(T-14)–(T-21)

The thematic interviews lasted from an hour to two hours. Data gathering ended when the interviews achieved saturation and provided only repeat information (Silverman 2011). Selected interviewees were managers who had been involved in BD-related service innovation projects in the cities of Helsinki and Tampere. Data was collected in connection to a collaborative project between the two cities focused on utilising BD in public services.

All informants were managers (including a couple of leaders from both case organisations who cannot be identified/notated differently due to anonymity reasons) involved in both strategy- and implementation-level discourses related to introducing BD-related transformations in the two case organisations. Selection criteria for the informants included having a comprehensive understanding of how and why their organisations considered or utilised BD in their activities. Most of the informants had knowledge of the management system and BD; for this reason, the informants had experiences with change management challenges concerning BD-related organisational transformations.

Nearly half of the informants had a degree in engineering sciences. Some informants had a background in the social sciences or administrative sciences. The educational background appeared not to affect the informants' viewpoints on core dilemmas. The informants typically had at least 2 to 10 years' working experience in city organisations.

Since we wanted to draw on the dilemma approach (Hampden-Turner 1990) to the BD-related transformations at both case organisations, we adopted a qualita-

tive case study and content analysis method (Silverman 2011) capable of organising the empirical data to highlight the dilemmas in context and the dynamics of the dilemma reconciliation processes (following Brown et al. 2008; Dailey and Browning 2014; Hampden-Turner 1990). In addition, the qualitative case method with the thematic interviews enabled us to collect rich data on the two case organisations' BD-related transformations (Eriksson and Kovalainen 2008, 80; Silverman 2011). Furthermore, the chosen qualitative methods and rich case studies offer the possibility of drawing numerous levels of analysis from the empirical data. Moreover, the chosen methods were able to provide a richer understanding of the topic under scrutiny than quantitative methods (Silverman 2011). These methods do not allow quantitative generalisation; however, that is not the aim of the study. Nevertheless, Lukka and Kasanen (1995, 83) argued that, with qualitative methods, there is a possibility of generalising. If researchers successfully disseminate their conclusions and argue for its relevance, it is possible that the conclusions will apply in other similar organisations (Kuoppakangas 2014, 132). Thus, it is logical to assume that the detected core dilemma pairs of this study exist in connection to BD-related transformations and development of public services more generally. Our focus is on BD-driven transformations and what kinds of challenges managers face in their change management work, as well as the dynamics of the detected core dilemma pairs possibly affecting readiness in connection to BD-related public-sector organisational change.

The empirical data from both case organisations was analysed in four phases. First, the data was transcribed carefully (the quotations from the empirical data selected in this study were translated from the original language of Finnish to English) and reflected upon, then iteratively coded and themed. From the coding, we identified emergent data-driven themes, which we discuss in the analysis section following the dilemma approach in an abductive vein (Dubois and Gadde 2002; Eriksson and Kovalainen 2008, 21; Yin 2003). During this analytical process, we found that there were inherent challenges in BD-related transformations. Thirdly, our analysis identified several major themes that were plotted and elucidated. In a fourth phase, based on iterative analysis, the main topics and themes of importance were synthesised, forming the three core dilemma pairs detected in this study (Silverman 2011; Hampden-Turner 1990; Yin 2003). The content analysis of both case organisations' interviews revealed that both cases had three significantly similar core dilemma pairs, which we discuss in the analysis section.

The following section presents our findings, the competing values affecting readiness, which we structure around three core dilemma pairs emerging from the empirical data: (1) repetitive continuity/visionary change, (2) risk-taking/security-seeking and (3) technology-based development/human-based development.

Core dilemma pairs in BD-related transformations

As illustrated above, the empirical data analyses revealed inherent challenges in the BD-related transformations of the two case organisations in this study. The following three core dilemma pairs were detected in the empirical data analysis from the informants' discussions on how they balanced value-driven either/or choices of attainments and how their readiness for BD-related transformations was hindered during this process. In addition, the three identified core dilemma pairs (1) repetitive continuity/visionary change, (2) risk-taking/security-seeking and (3) technology-based development/human-based development) categories are somewhat overlapping, in line with Hampden-Turner's (1990) dilemma approach.

Repetitive continuity/visionary change

Repetitive continuity refers to an implementation of BD that involves changing current practices as little as possible. For instance, BD may be utilised in existing practices by converting them to technology-based practices. The interviewees presented examples describing how manual invoicing or data collecting had been automated utilising new technology. Moreover, based on the interviews, both case organisations, Helsinki and Tampere, first implemented BD changes of an incremental nature. In the case organisation from Helsinki they had innovated, developed and incrementally utilised BD-led logistics in terms of monitoring utility-vehicle usage and were still searching for proper ways to optimise the big data for, e.g., decision-making, storage, and route optimisation. In the case organisation from Tampere, on the other hand, they had developed a 3-D City model, which illustrates the City's transportation infrastructure and architecture in a 3-D fashion. The platform was planned to be accessible freely for the citizens and use of industry in the future. However, the development and implementation work of the platform were still incrementally on-going during the interviews of this study.

The starting point for visionary change is intention. The interviews suggested that this may be a service system strategy in which technology and the use of big data plays a central role. This approach, thus, includes a new vision, such as BD as a platform for reforming service practices.

The repetitive continuity/visionary change dilemma pair was most concretely shown in the interviews as a vision of how BD development should be promoted as a change project. In addition, some informants described BD-related transformation as more than a change project: "*This is a tremendous change project, or, even better defined, we are making the change instead of it being only a project that ends when the project ends*" (H-22). It is a question of classic incremental change: will the implementation of BD proceed incrementally by changing single practices or by aiming to generate a "major development leap", in which the future vision is used to drive the technology-based reform? One of the interviewees described his

organisation as follows: "*our profile is that of a producing company, not a think tank, which might embrace the world in a bigger way*" (T-7). At the same time, however, several interviewees from both case organisations pointed out the need for visionary change when developing BD. "*The old-fashioned slowness of public sector changes should change*" (H-23).

Some of the interviewees even considered it impossible in the technical sector to disregard current practises required by visionary change. Informants from both case organisations dwelled on the matter of BD readiness in terms of skills: "*I often wonder, do we have enough knowledge and skills in-house? It is better to be sure than regret*" (T-16). As another interviewee similarly explained: "*It is a fact that the traditional IT knowledge and skills do not fit the cloud computing and BD-led service innovations and transformation*" (H-23). Moreover, the informants had a willingness to update their skills and learn new ways of working; hence, most of the informants were not prepared to abandon their current ways of operating based on what would be required of them in the future: "*People need to do things in new ways… have the courage to test new ways of doing instead of sticking to old*" (H-5) and "*it is easier to continue doing things the same way as you are used to*" (T-19). From the perspective of change, it should be noted that the interviewees from both case organisations explained that practices and processes differ depending on whether an organisation was incrementally developing current practices or implementing visionary change.

Risk-taking/security-seeking

The second dilemma pair with BD is risk-taking/security-seeking. This dilemma pair is closely related to the dilemma pair of repetitive continuity/visionary change. According to our informants, risk-taking occurs when, for instance, technology development and the potential gains involve insecurity and uncertainty: "*It may be uncertain where the implementation of technology related to BD is leading and what results it will bring about*" (T-15). Further, "*… if problems are found, you do not want to do anything to them. You just say that the system is no good… you are not taking part in developing it [BD-related transformations]. You just keep saying how bad it is… let's work the way we used to*" (H-9). These responses reveal that the interviewees faced insecurities linked to BD-related transformation. Despite this, there may have been a willingness to advance technological development and implementation due to its significant change potential: "*Organisations just need to grow out of their risk avoidance*" (H-22).

From a security-seeking approach, the implementation of BD is more cautious. In this case, according to one interviewee, "*you want to develop technologies that work here and now*" (H-3) and "*at least the BD-innovations should have a practical value for citizens' everyday lives*" (T-20); thus, the development work involves no great uncertainties or risks of failure. Yet, possible failures are acknowledged: "*Not even the professionals always know how to use everything [technology and BD*

analysis], but sometimes the attitude might be different, and you are ready to try …, but there is fear of something irreversible happening …" (H-13).

There is also a question of security-seeking related to BD analysis. The matter of risk was mentioned in most of the interviews: "*I and also with colleagues, we often wonder how the BD data and the analysis can be trusted, since the data are so fragmented and still handled by humans/people, and we might make mistakes. In the context of BD, the possible mistakes multiply. How can we take the risk and carry the responsibility of the consequences, since we are a public organisation … using tax-payers' money in all of the BD-related transformations?*" (T-18).

Also, some of the informants in both case organisations explained how the current organisational culture was hindering BD-related transformations: "*The culture of city organisation is a barrier in many organisational transformations*" (T-17). Furthermore, some interviewees from both case organisations explained how they had experienced that the more senior (in terms of age) managers were more security-seeking and unwilling to alter the organisational culture than their younger colleagues, who were more open to BD-related changes. However, most of the interviewees admitted that they, themselves regardless of their age group, young or senior, had experienced some level of change resistance and uncertainty in connection to the BD-related transformations due to potential risks.

In addition, in both case organisations, the matter of leadership commitment to BD-related organisational changes was seen as highly important in terms of successful BD-related transformations: "*One huge problem has been that the top-level leaders do not commit to these BD-related changes. … They should just accept that they do not have the knowledge and skills needed yet, and most of us do not, but we all can learn*" (H-22). This quote illustrates the situation at both case organisations.

Technology-based development/human-based development

Several interviewees in both case organisations saw challenges between technology-and human-based development in BD-related transformations. Many interviewees also interpreted the situation, particularly in the early stages, to be that BD was eagerly accepted because the technology created new possibilities to develop operations and services. As one of the informants explained: "*… sometimes, there is somebody [in our team] who knows how the technology works, and she/he has gathered together a group and said, 'Let's have a look at how this works', and then we have sat down and worked on it … you'll learn together … it creates team spirit and camaraderie*" (H-1).

On the other hand, several interviewees emphasised that, ultimately, BD development depends on people. One of the interviewees crystallised this idea by saying: "*Technological development used to lag behind people and their dreams, but now it is the other way round*" (T-14). The possibilities of technology and, in this case, BD

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are currently not fully utilised due to people's lack of readiness in terms of attitudes, expertise and abilities to adopt.

The interviewees verified that, after the early stages, the actors had themselves started developing BD technology and working on ideas for its use: "*It is a huge learning and empowering experience when you can be part of BD-related innovations and transformations for genuine practical use and value*" (H-22). Numerous informants discussed the importance of bottom-up engagement in BD-related transformations: "*I have to admit that I still have not seen any real value in BD-led innovations, but maybe I have not been engaged in the development enough*" (T-19). Here, the two case organisations differed: the Tampere informants were more critical in their view of BD-related transformations than informants from Helsinki. The managers in Tampere had been less involved in the BD-led development from the very early stages. In contrast, in Helsinki, the managers had been engaged from the very beginning and had even triggered the BD-related transformations: "*We gathered together with our teams to brainstorm, which is how the BD-related ideas began*" (H-23).

Interestingly, there were other differences between the two case organisations in connection to this core dilemma pair. For instance, at the time of the interviews, Tampere had developed its own software for utilising BD, whereas Helsinki had developed, for instance, reporting and various monitoring systems for working machines. Another difference was that the City of Helsinki informants stressed the importance of bottom-up- over top-down-triggered and -led BD-related transformations. In contrast, the Tampere informants expressed the importance of having clear top-down-triggered and -led BD-related transformation to secure change success. Hence, informants from both case organisations stressed the importance of leaders' commitment to BD-related transformations as one of the most important success elements in organisational changes.

Data analysis and discussion

Here, we make sense of our data in the light of the dilemma approach (Figure 2) and the idea of readiness. The results revealed that even though the two case organisations had different kinds of BD-related service innovations and developments they still met the similar core dilemmas hindering their organisational transformations. We structure the discussion around the three sets of core dilemma pairs and their reconciliations.

Repetitive continuity/visionary change

Continuity and change are essential features of all innovations: particularly in public services for vulnerable people, resolving this dilemma is critical. Change is especially difficult in complex services in which technical process and protocols are

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followed for the well-being of the service user (Laitinen et al. 2017a, 2017b). Tsang and Zahra (2008) noted the further difficulty of organisational structures inhibiting the performance of judgements and upskilled tasks by staff from lower points in the hierarchy (see also Klievink et al. 2017).

In the repetitive continuity/visionary-change dilemma pair, the dynamics of disregarding existing and adopting new practices also relates to organisational routines. Breaking emotional attachments to old ways of working requires more evidence than BD provides; it requires subjective acceptance by staff that new ways of working are better and more in line with organisational values (Hytti et al. 2015). In each "time and operating environment", the opportunities and risks inherent in both continuous and visionary change pose challenges to managers that may be unique to the two case organisations. What is generalisable, however, is the inadequacy of simply deducing a justification of change from statistical analysis of BD. Changing old ways of working through the acceptance of and readiness for a new vision combines both subjective (emotional attachment) and objective (BD) evidence. Change is a cognitive process involving new emotional attachments: only cars "move on"; people's change transitions (here, BD-related transformations) are both subjective and objective (Stenvall et al. 2018; see also Adrian et al. 2018). Our evidence does not suggest opposition to BD-related transformations that improve services; however, it does suggest that the repetitive continuity vs. visionary change dilemma pair takes emotional time to overcome.

Incremental changes "one step at a time" (Kuoppakangas 2015, 56; Lindblom 1979) have been traditionally connected to public-sector organisational transformations. Similarly, this study reveals that both case organisations had applied incremental BD-related changes in their service provision. However, critics have argued that incremental changes are often limited to the short term and have a tendency to neglect innovations (Boulding 1964; Kuoppakangas 2015, 56; Yehezkel 1964). Moreover, as this particular dilemma pair involves balancing incremental and major leap change, one of the key steps in reconciling this dilemma is to begin by taking up smaller BD projects aligned with the public organisations' values (Klievink et al. 2017). The suggested synergy zone (10/10) of this core dilemma pair is the both/and choice in which incremental changes are interlocked with new visions of BD-related transformations. Hence, working together with sufficient time for those involved in growing readiness through transformations and reaching the whole vision of possible pros and cons in BD-related transformations can result in the attainment of objectively tested BD transformations both in detail and on the whole (see also Hampden-Turner 1990, 88–89, 100).

Risk-taking/security-seeking

This dilemma pair, which has its roots in the public sector in organisational and professional values, involves transparency and legitimacy, or the social acceptance

of taxpayers resulting from loyalty to legislation, social norms and expectations (Deephouse and Carter 2005; Kallio and Kuoppakangas 2013. Risk-taking is not expected in a public-sector organisation as it is in private firms; thus, these two values are on a collision course. Further, risk-taking involves uncertainty and may jeopardise city organisations' legitimacy. However, risk-taking is part of organisational development and value creation (Hampden-Turner 1990, 2009).

According to the empirical data uncertainty created by BD-related change, as well as the possible risks hindering readiness (Klievink et al. 2017; Pink et al. 2018), it was found that taking up new roles in addition to organisational routines is vital. Pollitt's (2006) point concerning time to change is important: altering roles, relationships and routines takes time to assess new risks and to feel comfortable. Both of the case organisations were concerned about BD-related transformation risks. However, based on the empirical data in Helsinki the risk-taking readiness was somewhat stronger than in the city of Tampere. The bottom-up proactiveness in negotiating the risks of failure and acceptance of the uncertainty of not knowing everything concerning BD-related aspects could be overcome by learning-by-doing. Hence, such an approach is not common in public-sector organisations where the public legitimacy is a value, thus security-seeking is inherited with its culture. In Tampere the security-seeking attitude was found to be more prominent than in Helsinki. The results reveal that in Helsinki the top leaders were more willing to take responsibility than in Tampere. This can be because the managers had been more involved in the BD-related innovations themselves than in Tampere, and they kept communicating with and involving the top leadership during the whole process. As Brook et al.'s (2016) work with social workers revealed, many public-service professionals in technical domains (e.g. juridical, medical, science or engineering) are risk-averse, and professional and other external standards protect both service users and staff. The findings suggest that in BD-related transformations, individuals re-asses risk from inside new ways of working in terms of belief in their self-efficacy (Shah et al. 2017). Importantly, these aspects of risk/security, though assessable before change, can only be verified through learning-by-doing and creating an intensity of organisational learning and capabilities (Adrian et al. 2018; Hampden-Turner 1990, 2009).

Here, the interpretation of the risk-taking/security-seeking dilemma pair evidence is similar to that of Cegarra-Navarro et al. (2010, 914). Since risk exists, managers faced with change need the time and opportunity to assemble the objective and subjective information necessary to assess risk in the new context. Further, in line with the results of this study, leaders' commitment to organisational changes has been recognised as a key factor in successful transformations and been vastly discussed in existing research (Burner 2011; Burnes and Jackson 2011; Halaweh and Massry 2015; Laine 2018).

In addition to overcoming uncertainties (Klievink et al. 2017; Pink et al. 2018 linked to the BD-related transformation, the risk-taking/security-seeking dilemma pair is vital to organisational changes and potential reconciliations. According to the results of this study, the synergy zone (Figure 2, 10/10) can be reached when leaders are committed to BD-related transformations, carry potential risks and simultaneously empower managers and their teams to simulate trials and tests in action, resulting in bottom-up innovations and education of leaders (Baack 2015). This could be framed as the collective and personal growth of readiness through risking yet retaining organisational and actor-level security (Hampden-Turner 1990, 100).

Technology-based development/human-based development

Services are experienced subjectively by both users and providers (Dubois and Gadde 2002). Understandably, therefore, the interface between technology and people can never be simply a technical matter, as people feel the effects of technology (new equipment or BD). As Tsang and Zahra (2008) noted, all new technologies involve issues related to transformations while implementing new interfaces. Friction between technology-based development and human-based development yielded mixed responses, ranging from approval to suggestions of a lack of thinking concerning how human/technology interfaces might change.

Interestingly, according to the empirical data, the managers from both case organisations focused on the newly used technology (e.g. telemetric, 3-D applications, robotics and augmented reality), rather than the technological stimulus for the change (BD suggesting access improvement). As Goodall and Warner (1997) found, once the use of new technology is embedded, it often results in approval. Thus, a major challenge for leaders (as revealed in the empirical data of this study and indicated by, e.g., Brook et al. 2016) is the acceptance that the top-down imposition of change often fails when managers lack the time and opportunity to assemble a multi-method evidence trail. Most of the managers felt that it was essential that they and their teams were either engaged or given sufficient time to adjust to the new technology: that is, to distance themselves from old and to implement new ways of working. In addition, a sufficient amount of time may enhance change acceptance (see also Laitinen et al. 2017a, 2017b; Stenvall et al. 2018).

Simply because a technology is mature and old, it cannot be assumed that all managers are familiar with or can easily conceptualise using it or BD in new work routines. Thus, in addition to BD evidence, strong leadership understands that effective change is rarely imposed from the top down; instead, leadership values fellowship and distributes knowledge and power (Bolden 2011; Uhl-Bien 2006). However, according to the results of this study, it is important for leaders to remain responsible for issuing BD-related transformations and for enabling managers to empower and engage in bottom-up BD-related development and transformations (see also Hampden-Turner 1990, 101).

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To reconcile technology-based development and human-based development, managers and their teams must collectively engage in BD-related developments, leaving sufficient time to absorb the new knowledge and adjust attitudes to enhance readiness and foster successful organisational change (Shah et al. 2017; see also Špaček and Gatarik 2017). Moreover, the early engagement of managers and their teams in a bottom-up vein with top-down commitment and empowerment for BD-related transformation is part of the reconciliation leading to readiness and the synergy zone (Figure 2, 10/10) for the both/and resolution labelled here as technological reasoning corrected by feedback from the environment (see also Hampden-Turner 1990, 22).

Furthermore, this study follows Hampden-Turners' (1990) argument that core dilemma pairs are often overlapping instead of separate. Thus, reconciliations of different but overlapping dilemma pairs can be similar, as seen here for the three core dilemma pairs examined in this study. Moreover, a successful reconciliation of one core dilemma pair (e.g. technology-based vs. human-based development) may support reconciliations of the risk-taking vs. security-seeking and the repetitive continuity vs. visionary change dilemma pairs.

Conclusions

This study aimed to (a) identify the core dilemma pairs hindering public-sector managers in their change management work connected to BD-related transformations and (b) revisit Hampden-Turner's (1990, 2009; Hampden-Turner and Trompenaars 2015) dilemma approach in the novel context of BD-related transformations in public-sector organisations. The research shows that synthesising the dilemmas approach with a carefully crafted view of readiness creates a valuable lens through which to explore organisational change catalysed by the use of BD. Our focus was on individual active agents within their institutional and social contexts and how they reason and rationalise their challenges with BD-related transformations. The paper provided the three core dilemma pairs meaning in the context of BD-related readiness and transformations in public-sector organisations, scrutinising the emergence and, possibly, construction of organisational core dilemmas in connection to BD-related changes in the case organisations.

Further, we have concentrated on public organisations that have tried to utilise BD but have not made radical changes to their organisation structures. In these organisations, people consider data sources, data warehouse issues, data collection, data analysis and decision-making simultaneously. The two case organisations' managers attempted to solve hinderances in BD-related organisational transformations. Hence, transformations in organisations are deeply cultural; as Laine and Kuoppakangas (2015) note, in each culture and context, leaders, managers and employees must nuance and adjust the importance of different values.

As Hytti et al. (2015) and Laine (2018) show, public organisations involved in change processes need to encounter dilemmas that hinder organisational change. Given the results of this study, the core dilemma pair involved in BD-related transformations – repetitive continuity/visionary change – is similar and typical to those of public organisations involved in change processes (i.e. incremental change versus revolutionary transformation) (Kuoppakangas 2015). In summary, our findings suggest that dilemmas persist in the new BD-related organisational change context and that they are open to detection and reconciliation to prevent them remaining unsolved organisational paradoxes (see also Smith and Lewis 2011). Even when detected, where dilemmas are left unreconciled, this inhibits successful organisational change. We therefore conclude that using BD does not of itself reconcile dilemmas and that BD-related organisational change still faces the challenge of dilemma reconciliation. Use of BD, without the readiness to alter management systems and structure is unlikely to result in transformational change.

Thus, the suggestions for practitioners are firstly that effective readiness therefore includes a preparedness to address dilemmas and in doing so ensure that strategy leads structure. This is especially true for dilemma pairs of risk-taking/security-seeking and technology-based development/human-based development. Secondly, readiness therefore presumes the preparedness of leaders to convince teams and managers of the wisdom of resolving dilemmas. Thirdly, where leaders lack such readiness, the use of BD is unlikely to result in transformational change. This view of readiness is quite distinct from the technical capability perspective adopted by Chen and Liu (2014).

Additionally, our findings dispute those of Pollitt and Bouckaert (2011), who advise leaving dilemmas un-reconciled; our findings suggest this has negative outcomes. We note that while some researchers seem to believe that accumulated BD bodies of "facts" are sufficient to justify change, this is not the case. Our research endorses Weick's (1995) that staff often have an emotional commitment to structures, relationships and ways of working; presentations of BD may help alter these emotional commitments, but they do not per se necessarily result in altered attitudes – doing remains part of the managers' and leaders' role.

In summary, our data analysis suggests that *traditional organisational and change management approaches produce unsolved dilemmas in BD-related transformations*. This means that there is a need for new kinds of theoretical approaches in the context of BD-related organisational changes. Thus, the dilemma approach adds to the discussion of readiness and capabilities, and dilemma reconciliation is a valuable approach for public organisations pursuing successful BD-related transformations.

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