Critical realism and performance measurement and management: Addressing challenges for knowledge creation

Abstract

Purpose:
The aim of this paper is to explore the implications of adopting a critical realist position for the study of performance measurement and management (PMM) systems.
Methods:
This paper discusses recent challenges to knowledge creation in PMM, arguing that overcoming these will require revisiting often implicit philosophical assumptions related to how the world is and how we learn about it. A critical realist perspective is explored and illustrated with the case of a software company attempting to empower and motivate its team.
Findings:
Critical realism provides a means of building interdisciplinary knowledge in PMM. In addition to a generative view of causality, critical realism could augment a systems view of PMM by adopting a stratified view of reality and through its applied approach to knowledge building. The case illustrates the RRREIC approach and highlights the interplay of mechanisms of different scales, and how this requires interdisciplinarity.
Research Implications: Approaching the study of PMM with critical realism requires going beyond a particular tool or practice to understand the theory behind it. Such an approach can facilitate a layered, nuanced analysis of the issues facing organizations in a changing context.
Originality / Value:
This paper adds to discussion of philosophical topics in management and PMM and could help resolve ongoing challenges to knowledge building in the field, especially around barriers to conducting interdisciplinary research. In combination with rigorous methods, a strong philosophical base can facilitate relevant, lasting theories that can respond to a changing organizational context.

1 Introduction

Performance measurement and management (PMM) is one of the fundamental tools of organizing, potentially facilitating learning or control and leading to improved organizational performance (Altin *et al.*, 2018; Bititci *et al.*, 2018; Franco-Santos *et al.*, 2012). However, researchers have noted difficulties with its ability to explain individual and organizational successes and failures (Choong, 2014a), to meet the challenges of the current organizational context (Bititci *et al.*, 2012), and

to reach a consensus of what PMM consists (Franco-Santos *et al.*, 2007; Marr and Schiuma, 2003; Micheli and Mari, 2014). Therefore, it should perhaps come as little surprise that researchers and practitioners alike disagree on its effectiveness in bringing about positive outcomes such as improved communication, control, motivation, and strategic alignment that are often sought through their use (Folan and Browne, 2005; Franco-Santos and Otley, 2018).

Underlying these challenges are two related issues: complexity and disciplinarity. PMM is complex in the sense that it is made up of a potentially infinite number of elements that interact to produce outcomes (Ashby, 1956, p.39). Understanding how PMM works requires not just social and technical factors, but also how these interrelate and interact in environments which are constantly in flux (Bititci *et al.*, 2012). Attempts at developing best practices with universal means to achieve performance through PMM have largely failed (Schleicher *et al.*, 2018). Developing theories that can successfully inform interventions with a more nuanced response, however, requires confronting how the myriad of components interact to produce outcomes (Okwir *et al.*, 2018), and much research remains overly superficial (Neely, 2005).

At the heart of this challenge is the need to reconcile multiple views in a field that draws on several disciplines (Franco-Santos and Otley, 2018). The difficulties in building integrated knowledge in PMM also stem in part from a tendency for each discipline to remain isolated or "silo"(Marr and Schiuma, 2003), and stymies progress towards better understanding how and when such practices lead to improved performance by hindering theoretical integration and theory-informed interventions (Siedlok and Hibbert, 2014). This comes at a time when the context in which PMM operates is changing: economic, social, and technological factors are affecting how and why PMM is used (Bititci *et al.*, 2012). The issue, then, is that PMM research needs to find a way to cogently respond to complexity while building relevant knowledge that can inform interventions in a changing environment.

This is a pressing problem because PMM needs interdisciplinary studies to address its complex problems. PMM has been noted as having a significant relevance issue for practice (Andersen *et al.*, 2014; Mingers, 2015). This paper argues that addressing these issues requires revisiting underlying philosophical assumptions that inform PMM theory development. As will be argued, traditional, empiricist approaches are insufficient on their own to address complexity because they are inevitably forced to reduce it. As an alternative, this paper adopts a critical realist approach to PMM.

As a philosophical position, critical realism addresses issues related to what reality is like and how it can be known. Researchers of many disciplines, including management, have increasingly adopted a critical realist position when conducting research (McGhee and Grant, 2017). Critical realism has appealed to

researchers from a wide range of disciplines because of its commitment to a realist ontology, its appreciation of complexity, its recognition of meaningful activity, and its compatibility with multiple methodologies (Wynn and Williams, 2012). Specifically, it will be argued that a critical realist approach could provide an appropriate platform from which to develop relevant, interdisciplinary approaches to PMM and its inherent complexity by adopting a stratified view of reality. Next, critical realism has described a particular approach for learning about a stratified reality. This approach will be considered, as it could be especially appropriate both for maintaining relevance as well as building knowledge within PMM.

Therefore, this paper addresses two questions:

- **RQ1:** What are the implications of adopting a critical realist approach for creating knowledge of PMM?
- **RQ2:** How can a critical realist approach contribute to research about PMM?

The paper is structured as follows: First, the basic concepts of critical realism are explored as they relate to PMM. This is followed by a consideration of a critical realist approach for studying how these may be employed to bring about positive individual and organizational outcomes. Finally, an illustrative case study demonstrates an application of a critical realist approach.

2 Background

This section will present an overview of conceptual difficulties within the study of PMM as a backdrop for a critical realist-inspired interpretation.

2.1 Knowledge building challenges in PMM

There has been a great amount of interest for PMM, understood here broadly as the choices around the quantification of the efficiency and effectiveness of organizational performance in order to improve it, and the related processes of data capture and information provision (Franco-Santos *et al.*, 2007; Neely *et al.*, 1995). PMM has the potential to positively impact organizational performance, but faces challenges around theory development and relevance as a discipline. These will be discussed below, specifically as they relate to the need to integrate levels and to address underlying philosophical issues.

First, PMM faces challenges for knowledge building, which are driven largely by its inherent complexity (Bourne *et al.*, 2018; Okwir *et al.*, 2018). PMM has been presented as adaptive social systems (Okwir *et al.*, 2018) which operate in situations which differ from organization to organization. This environment resists the development of "best practices", because it is characterized by limitless

openness: what drives the success of one effort in one context may differ in another (Chenhall, 2003). Establishing causality given these conditions with a mind to inform practice is problematic (Bhaskar, 1975).

However, PMM faces an additional challenge in addressing this complexity because it is traditionally divided along disciplinary lines. PMM research has three dominant focuses: an interest in evaluating and improving individual performance, and the theories around it, a focus on the technical aspects of measurement, which seeks to understand or develop valid or novel measures of performance, and an organizational view, which is interested in systems of performance measurement and measurement practice (Ferreira and Otley, 2009). These perspectives draw on a wide range of management and organizational disciplines, primarily operations management, accounting, and human resources (Franco-Santos *et al.*, 2007; Tweedie *et al.*, 2018), but also information systems (Choong, 2013), public administration (Bürkland and Zachariassen, 2014; Pollitt, 2018), business in society (Wood and Garnett, 2010), and strategy (Adler, 2011; Henri, 2006).

Each of these perspectives center on different aspects of PMM, but may not specify which aspect of performance is of concern. For example, when examining research stemming from a human resources background, Schleicher *et al.* (2018) note that only 25% of reviewed papers stated the purpose of PMM within the organization. This is a worrying statistic considering that even studies within the same discipline quantify outcome variables in quite different ways (Franco-Santos *et al.*, 2012).

As a means of addressing the issue of purpose and complexity, researchers have increasingly adopted a systems perspective of PMM (Bourne *et al.*, 2018; Choong, 2013; Okwir *et al.*, 2018; Schleicher *et al.*, 2018). Broadly, a system is taken to be two or more components that interact to produce outcomes, with a boundary, in which each component is also a system. The advantage of this perspective is that it requires defining purpose while maintaining the importance of system components. At the same time, it potentially recognizes synergistic effects where the whole is greater than its parts, though how this synergy is meant to come about is sometimes vague (Choong, 2014b).

However, as will be argued in the following section, a systems approach alone will not resolve the barriers to knowledge building in PMM. First, disagreements exist around what is meant by the word "system" in general, and especially in situations where the various elements: inputs, transformation process, and outputs, are subject to human interpretation (Atkinson and Checkland, 1988). Next, PMM appears to have adopted a primarily "hard" systems view (Choong, 2014b) which adopts several aspects of General Systems Theory (Von Bertalanffy, 1968). The hard take on systems thinking has been challenged because it de-emphasizes the how individuals interpret the components of PMM, which may differ wildly (Checkland, 1983).

The issue goes to the heart of PMM, which has traditionally centered on an unproblematic quantification of efficiency and effectiveness. Research recognizing the social nature of measurement and management is gaining prominence, but it is still the minority (Beer and Micheli, 2018). Further, despite this recognition, there are continued calls for considering technical and social aspects separately, whereas in practice this line is hard to draw (Beer and Micheli, 2018; Bürkland and Zachariassen, 2014; Dechow, 2012).

One potential way forward, and a major component of ongoing disagreement, is to address a lack of sufficient consideration of underlying philosophical assumptions. Specifically, the vast majority of PMM research takes a positivist approach which relies on a model of causality that requires artificially reducing complexity (Micheli and Mari, 2014; Miller and Tsang, 2010). As will be argued in the following section, this approach to causality is incompatible with the nuanced take on PMM, and ultimately requires an artificial flattening of levels, making a truly integrated study of PMM impossible.

2.2 Addressing complexity and integration with critical realism

Philosophical assumptions are not often addressed in research but are important because they drive the decisions made behind objects of study, methodology, and conclusions. Every researcher has these, but they may not be explicit. These perhaps seemingly trivial positions have profound implications for research and practice. Many of these as they apply to management have been discussed extensively (Mingers, 2000; Wynn and Williams, 2012), and so the following paragraphs will concentrate on how critical realism can address the need for dealing with multiple levels and of developing PMM theory.

[INSERT TABLE 1]

This section will compare the positions of post-positivism, interpretivism, and critical realism on five issues relating to PMM. These are the aims of science, ontology, and specifically causality and emergence, epistemology, and the dominant mode of discovery (Table 1). Critical realism begins by separating ontology, the study of being, from epistemology, the nature of knowledge. In other words, it separates questions of what is from questions of how we (humans) know. This differs from the two other dominant approaches and has profound implications for the aims of research and how it is carried out.

First, critical realism differs from a positivist or empiricist perspective of causality, which relies on seeking "constant conjunctions" of events. Under this perspective, reality is reduced to what can be experienced, and the goal of science centers on developing law-like statements about reality (Bhaskar, 1975). An example would be the long-standing debate on the effect of Corporate Social Performance on financial performance (Wood and Garnett, 2010). A study adopting a posit-

ivist approach might attempt to connect Event A, corporate social performance–measured in any number of ways—with Event B, improved financial performance, perhaps moderated or mediated by Event C. Numerous such studies have been carried out, without clear results.

At the other extreme, interpretivist approaches either adopt a strong idealist position, in which each person constructs their own reality, or a weak idealist position, where reality exists but is constructed inter-subjectively (Healey and Hodgkinson, 2015). Interpretivist positions do not necessarily deny reality (Walsham, 2006), but it may be problematic, multiple, or entirely socially constructed (Smith, 2006).

Both of these positions present a major barrier to achieving interdisciplinarity because they essentially rely on a flat ontology: in the case of positivism whether two events (no matter their scale) are temporally related, rather than on explaining why they may be related. In practical terms, such a position implies asking "What works?", rather than "What works, for whom, in what circumstances, and why?" (Pawson, 2013). On the other hand, the interpretivist position complicates any attempt at arriving at transferrable knowledge (Smith, 2006)—reality is reduced to the ideal.

In contrast to constant conjunctions of events, critical realism presents a "depth ontology", which consists of experienced events (the empirical), events which could be experienced (the actual), and the real or "deep" (Fleetwood, 2014). This "deep" consists of intransitive entities (physical, social, and cognitive), which have the power to generate observable events through the operation of mechanisms. Take a typical information system. Under the critical realist perspective, the physical infrastructure is real: the fiber optic wiring and its properties, the artefacts that store the performance data and allow it to be communicated, the paper on which performance data is printed. Language and the symbols of PMM are also real, as are their interpretations. For example, Bürkland and Zachariassen (2014) discuss how users of an enterprise resource planning system interpreted the system as incomplete, and so sought to constantly add to it. In this case, the interpretation is real because they had real effects: actions taken to add measures to the system. Also, the conventions, norms, regulations, etc., and other social phenomena which may not be interpreted by a particular individual can also be real.

In rejecting a view of causality as constant conjunctions of events, critical realism adopts a generative model around mechanisms and structures (Mingers and Standing, 2017). This approach sees events as occurring (or not) as the result of the interaction of these mechanisms, often acting simultaneously and at multiple, stratified levels. Astbury and Leeuw (2010) note that they are 1) generally not directly observable (at least at the level of interest) 2) sensitive to context and 3) generate observable outcomes. Social mechanisms are constrained by preexisting, intransitive structures which, if social, may be reproduced or transformed by hu-

man agents (Archer, 1995). These combinations have been referred to as "CMO" or "CSMO" configurations (Bhaskar, 2014; Pawson, 2006), for Context, Mechanism, Structure, and Outcome.

For example, Tan and Harvey (2016) use a CMO framework to explore how four mechanisms, a target system, symbolism, signal function, and feedback system, generate outcomes relating to particular types of use of performance information in voluntary organizations. These mechanisms are not necessarily "activated" and so may or may not result in the outcome of interest—in this case, the use of performance information for improvement. However, the possible lack of an outcome does not mean the mechanism does not exist—it simply has not acted in this instance.

The above discussion also affects the extent to which a systems view of PMM will be useful for addressing complexity. More than interrelated components, the systems view has been presented from all three of the above positions as a means of addressing the issues of PMM today. The main issue is with how these differ on how they see emergence (Table 1). Under the positivist position, there is a general tendency towards hierarchical reductionism, i.e. , seeking lower and lower levels in order to locate a more robust explanation. Smith (2011, p. 38) refers to the potential for flattening as trying to answer the question "What is this?" with "What is this made of?". At the other extreme, the interpretivist position, sees systems as a means of seeing the world, but denies ontological emergence (Karakayali, 2015).

Critical realism sees higher-order levels as made up of interrelating components at a lower level, but which have emergent properties which are both taxonomically and causally irreducible to these (Bhaskar, 2010; Mingers, 2014). Therefore, the approach resists reductionism because a lower level will not be able to explain a higher one on its own—Archer (1995) refers to this as upward conflation. On the other hand, a higher order entity cannot be used on its own to explain the behavior of a lower one, as would be the case of explaining individual behavior based solely upon the systems within which they operate. On the other hand, a higher order entity cannot be used on its own to explain the behavior of a lower one, as would be the case of explaining individual behavior based solely upon the systems within which they operate.

Emergence and stratification takes on more than one form within critical realism. For example, Bhaskar and Danermark (2006) have employed the concept of scale. Scale refers to the relative ordering of mechanisms according to their level. For example, Bhaskar and Danermark (ibid.) use seven: physical, biological, psychological, psycho-social, socio-economic, sociocultural, and normative to analyze disability research. These levels are meant to be case specific—in studying violence against women, for example, Price (2014) observes traumatic childhood experiences, lack of opportunity, oppressive face-to-face interactions, patriarchal culture, inequalities in society, colonialism, and global patterns of inequality.

Because entities are made up of interacting components at different levels, but whose behavior cannot be understood by understanding these components alone, there is both a need to explore the mechanisms of each (multidisciplinarity), as well as how these interact (interdisciplinarity). What critical realism stresses is that although arguments can be made for the importance of a particular level (disciplinarity), no one would be sufficient for a complete understanding of the problem (Bhaskar, 2016). Therefore, critical realism has the potential to avoid artificially flattening ontology and allowing for an interdisciplinary study of PMM.

2.3 A critical realist approach to knowledge building

Critical realism has developed a particular method to respond to open, complex systems, and it will be argued that this can facilitate disciplinary integration and also the issue of relevance. This discussion centers on the critical realist approach to applied research, consisting of resolution of complex phenomena into components, redescription in an explanatory way, retroduction of hypothetical explanatory mechanisms or retrodiction of antecedent causal events, elimination of alternative competing explanations, identification of the acting mechanisms, and finally correction of existing theories (*RRREIC*) (Bhaskar, 2010). As will be argued below, the combination of abductive redescription, retroduction and retrodiction, and epistemological relativism is seen as particularly advantageous for PMM.

Resolution is the initial response to complexity and involves appreciating multiple causes, mechanisms, and theories that could explain the situation of interest, including a consideration of it in its context (ibid.). The key levels of explanation begin to emerge during this stage, though there is no *a priori* conception of the levels of interest in developing a particular explanation. Next, redescription goes a step further by deepening the analysis and centering on "causally relevant facts", often by incorporating existing theoretical lenses (Bhaskar, 2010; Rotaru *et al.*, 2014).

Retroduction involves developing a mechanism that could explain the empirical events to be explained (Mingers, 2004). Retrodiction, on the other hand, seeks to move from the components of interest to their interrelations and causes. That is, retrodiction seeks to understand antecedent states of affairs and the mechanisms that drive them via existing theories, and observing these in the conditions under study (Mcavoy and Butler, 2018). Since under open systems this implies understanding the mechanism(s) at play, explaining events generally involves a combination of retrodictive and retroductive processes. This combination of retroductive and retrodictive processes enables a creative process of study (Bhaskar, 2016, p.81) which allows complex phenomena to be better understood in unique contexts.

Once plausible mechanisms have been proposed, then research moves to elim-

inating less plausible explanations and inferring to the best possible one through empirical corroboration (Wynn and Williams, 2012). Critical realism is epistemologically relative, meaning that the methods used can vary according to the needs of the study (see O'Mahoney and Vincent, 2014, for a discussion). It is also fallible, because our knowledge of reality will always be separate from reality itself. Because of this separation, any subsequent identification and correction of theory is tentative. However, this does not hold that all findings will be equally valid or equally wrong, but rather that some explanations will better approximate reality (Zachariadis *et al.*, 2013).

3 Illustrative Case

To illustrate a critical realist approach to studying PMM systems, a case in which a performance dashboard was developed to empower workers and address on-going issues during a time of transition. The case focuses on HireTech, a small company in Western USA which develops software for recruitment and selection.

3.1 Study context and methods

The study was participatory, in that the researcher assumed an active role in developing the performance measurement and management system, attending meetings and developing major portions of the reporting infrastructure and the reports themselves. Data were also collected through semi-structured interviews, observation of meetings, informal conversations, archival data, and company communications. The focus of this study is this period of significant strategic change in 2016, with follow-up interviews in 2017 and early 2018.

The case is ideal for illustrating the approach, not only because it allowed the process of change to be observed, but also because it required actively confronting issues of level and boundaries, which were aided by the parameters set by circumstances. In the study the research participated as an external consultant and the primary focus was on the PMM, yet the case demanded attention to other areas, which could be incorporated into PMM practices.

The project described here formed a part of an ongoing program to build an empowered team, understood here as a sense of meaning, competence (clarity in goal and process), self-determination, and impact. The study followed the RRREIC described previously steps in a cyclical fashion, beginning with a broader view of the situation at the organization in general, and then focusing on a particular element of interest (Table 2). This case describes one such instance around the development of a performance dashboard and its relation to the PMM system. These cycles will be described to illustrate the approach to consider the distinct levels involved.

[INSERT TABLE 2]

3.2 Cycle 1: Understanding the PMM system

The purpose of Cycle 1 was to begin to *resolve* an essentially limitless amount of complexity, keeping in mind the interest of the project and the interests of the case organization as communicated by the CEO, in this case a focus on empowerment. Resolution involved observations from participating in meetings, interviews, emails, and other archival data sources such as the company web page.

Here the open nature of social systems is evident in a potentially limitless number of related events. For example, not only had the founder recently returned as CEO, the company had changed headquarters, and strategy was likewise evolving, moving to a new pricing model and targeting a new market segment. Other aspects that arose in interviews and through observations were shifting objectives for the software development team, investor doubts, an office switch requiring new commutes for many, high turn-over rates, and several new initiatives related to the evolving strategy. The interest of the project, then, was to make sense of these events in some way to assist in creating an inspired, motivated team with initiative and understanding of the goals of the organization: an empowered team.

To *redescribe* these events in a theoretically meaningful way, the boundary for what was considered the PMM system was drawn from the literature, specifically Ferreira and Otley (2009), who consider a PMM to include vision, key success factors, organizational structure, strategy, measures, target setting, evaluation, rewards, information systems, change, the means of use, coherence of the system, culture, and contextual factors. Such a broad conception of PMM effectively delineated the boundary of the system of interest without being overly restrictive.

Adopting an existing framework helped to order events and to distinguish the system of interest from others. For example, a system of data capture had been designed not only to communicate information for the sake of empowerment, but also (and indeed primarily) to improve the product, and to facilitate communication with outside stakeholders for the purpose of gaining funding.

A process of *retrodiction* and *retroduction* followed in order to develop a list of possible explanations for the now ordered events. These processes consisted of maintaining a sort of "diagnosis table", based on existing literature reviews around PMM systems (*e.g.* Van Camp and Braet, 2016) and the knowledge of the author. Where no explanation could be found in PMM literature, possible explanations were *retroduced* and subsequently sought in general organizational and management literature.

[INSERT FIGURE 1]

Figure 1 shows the system meant to measure and manage performance, and its relationship to organizational strategy. The entities and relations shown in Fig-

ure 1 are result of *elimination and identification*, where solid black lines indicate mechanisms that were identified as acting and critical in achieving the goal of empowerment. Dotted black lines indicate relations which were seen as important but not hindering the achievement of an empowered team at the time of the study. So a participative design involving the whole team to identify measures was meant to increase focus on the essential, thereby decreasing information proliferation, which lowers strategic focus. Entities with the PMM system—the availability of these measures, along with timely, open discussion of feedback—would decrease fear of negative repercussions and defensiveness and increase understanding of goals and roles. Combined with a pro-social mission (in this case, getting people jobs), these elements would lead to empowerment: a motivated team capable and willing of taking the appropriate action to achieve organizational goals.

Note that the relationship between any two of these would require a deeper, separate consideration of mechanism. For example, a great deal has been written on the links between fear and defensive behavior (*e.g.* Argyris, 2010). However, for the purposes of understanding the relationship between the PMM system and empowerment at the systems level, the mechanisms connecting openness, fear, and defensiveness had to be largely ignored. Likewise the PMM system acts upon and is constrained the organization (the grey arrows in Figure 1), itself acting within a local, national, and global environment.

Finally, developing an explanatory framework found in Figure 1 involved the *elimination* of several mechanisms found in PMM literature and discussed at the case organization. For example, an incomplete set of measures can lead some groups to see the PMM system as unfair or coercive (Wouters and Wilderom, 2008), and therefore a potential barrier to empowerment. However, a team survey, interviews, and informal discussions revealed that staff felt the measurement set was complete and therefore not contributing to a lack of empowerment.

Based on the findings at this stage and as a means of increasing the availability of strategic measures and participation, the project moved to redesigning an existing performance dashboard.

3.3 Cycle 2: The Dashboard Component

The decision to focus on the performance dashboard required a reconsideration of events, as analysis now centered on technical and psychological components and their interactions. This refocusing was necessary because some elements important to understanding the PMM system were more or less so when designing the dashboard. For example, how the dashboard related to other PMM system components such as targets and reward structures was important in understanding outcomes of the system, but could do less to inform the dashboard design.

So, this stage of the project considered elements related to technological and

physical infrastructure, and how these could be best leveraged to contribute to the goal of empowerment. For example, a sophisticated and existing information infrastructure allowed much data to be readily accessible. Database reporting software could then be used to display this information in real time on a monitor placed at the entrance of the company's main office. These observations and others formed the basis of a new stage of *resolution* around the performance dashboard.

However, developing a new performance dashboard as a component of the PMM system used to communicate performance information, also required seeking a suitable means of *redescribing* how the elements might relate. Again, an existing theoretical framework was adapted to order how feedback information is interpreted by the individual (Ilgen *et al.*, 1979) and how these relate to motivation, understanding, and ultimately empowerment (Grant, 2008; Hall, 2008). These were not the only existing theoretical frameworks on the technical or psychological aspects of PMM, but rather were selected in light of the aims of the project.

In the case of the dashboard, the main form of reasoning used was *retrodiction*, in that, at the level of interest, existing theory seemed to provide a practically adequate means of understanding and taking action. However, the acting mechanisms were again subjected to a process of *elimination and identification*, largely through seeking practically adequate indications through interviews and throughout its development.

For example, during development various visual elements were used to positively frame performance. At one point, these were met with suspicion ("What's with these stars!?", one employee exclaimed in response to one update). The visual properties were then modified based on feedback until a suitable solution was implemented.

[INSERT FIGURE 2]

Figure 2 presents the program theory that informed the dashboard project. This shows the technical aspects, along with a participative design, facilitating understanding and credibility, and ultimately a sense of ownership of the dashboard itself. Together, ownership and a positive framing could influence team members' awareness of their positive impact and the goals of the organization, leading to individual empowerment.

3.4 Cycle 3: Revisiting the whole and subsequent

As a component of a wider PMM system, the impact of the new performance dashboard was expected to be limited. Therefore, to achieve the ultimate goal of empowerment it was necessary to move again from a focused perspective on psychological and technical aspects relating to the dashboard back to the wider system and its relation to the organization. Here, new events needed to be *re-*

solved and persisting challenges reconsidered. These required new theories to explain outcomes, or, in their absence, a new process of retroduction, followed by elimination, identification, and subsequent corrective action.

4 Discussion and Conclusions

This paper discusses a critical realist approach as a means of addressing complexity and for gaining relevance within PMM studies. As such, it forms a part of a growing but still limited literature on the implications of critical realism for research practice. Specifically, it is argued here that critical realism can help PMM address issues by facilitating interdisciplinary knowledge building.

First, it is argued that a critical realist approach could augment systems perspectives to contribute to the development of relevant knowledge. The present discussion centers on the *RRREIC* approach, which provides a means of approaching complex phenomena acting in open systems by first resolving the events involved, and then redescribing them in a meaningful way. However, what this paper means to illustrate is that the combination of retrodiction, retroduction, and elimination is especially powerful for building knowledge. In the case that a theoretical framework is used, it requires fitting it (or not) to the complex and unique situation of study that could explain how certain components relate. But then, if no such theory is practically adequate, it allows a process of retroduction to develop potentially new explanations that could explain the outcome of interest, at which point they can be evaluated and corroborated through empirical evidence, or eliminated as unlikely or implausible. Therefore, such an approach actively and deliberately pushes the boundaries of current knowledge by constantly subjecting current knowledge to scrutiny.

Such an approach also has several limitations and these were evident in the illustrative study. First, there was a clear trade-off in the field between activities related to understanding mechanisms and achieving a practically adequate solution. In the case of the performance dashboard development especially, evaluative activities were limited due to the resources available and the scope of the project.

These limitations, which are likely to arise in field work (Suomala *et al.*, 2014), draw attention to the importance of developing collaborative research approaches to support deeper explorations of mechanisms that can extend beyond a particular case. The case study relied on indicators of practical adequacy and therefore the extent to which results could be generalized is limited. Here, researchers have cautioned against adopting the critical realist position that all knowledge is corrigible as an excuse for lack of rigor (Contu and Willmott, 2005). Indeed, the results of this case study would need to be further corroborated in other contexts in order to validate them (Smith and Johnston, 2014).

Second, critical realism could address barriers to knowledge building in PMM due to a tendency towards disciplinarity by adopting an emergent, stratified view of reality. In the case study, opportunities for interdisciplinary study were made clear by including the concept of scale. For example, connecting the system components in Figure 2 would require a consideration of mechanisms at a deeper level. For example, underlying biological processes of the around perception (*e.g.* Cleveland and Mcgill, 1985) can be used to understand how visual displays are read and interpreted, but in the case study were treated as a system component and subsumed under the item "Visual properties" (See Figure 2). On the other end of the spectrum during Cycle 1, both organizational and societal factors, *e.g.* attitudes about the role of measurement in general, could have helped explain the context and contributed to a more complete explanation. Both of these potentially interesting levels needed to be temporarily abstracted to allow for action within the scope of the study. This concentration on fewer levels was intentional to allow for the creation of a practical intervention and is typical when project scope is small (Mingers, 2014, p.144). Future studies could further consider scale in PMM systems to develop more complete explanations.

This deliberate treatment of level in the study of PMM could benefit practice because it demands appreciation of complexity that gives fair treatment to the big picture as well as the small. In the case study, what seemed to be a limitation for the dashboard was actually helping to create an atmosphere of empowerment, because the organizing effort around its apparent limitations helped create an atmosphere of openness and of mutual support. In this way, critical realism can help avoid artificially and unknowingly reducing complexity, which ultimately can lead to incomplete explanations and inadequate solutions.

In pursuing interdisciplinarity, there is an opportunity to merge current discussions of systems thinking in PMM with critical realism. It is argued here that systems thinking alone is not enough to address complexity because it does not necessarily address how components of the system relate. Therefore, future discussion could develop these themes and their relations, as it has been argued elsewhere that both approaches stand to benefit from integration (ibid.).

In addition to the limitations above, it should be noted that in adopting a critical realist approach, researchers should be aware of both development of themes and ongoing debate amongst critical realists and realists (Richards, 2018), and also other alternatives to positivism such as pragmatism. A limitation of the present discussion is that only a small number of concepts have been considered that could be relevant to PMM. Much of the recent evolution of critical realism has been foregone. Another ongoing challenge for applying critical realist ideas is the use of jargon and specialist language which restricts their use (McLachlan and Garcia, 2015). Additionally, as a relatively new position, guidance on how to proceed with the processes of elimination and identification is just beginning to emerge (Robert

Isaksen, 2016).

How can managers benefit from critical realism? As a philosophical approach, it is unlikely that the benefit will be direct, but rather would come from research. However, critical realism does have interesting implications. A focus on generative mechanisms, for example, requires going beyond PMM tools and fads to understanding how, why, and when they work. Combined with a stratified view and an approach for diagnosing complex situations, critical realism provides a powerful meta-framework for problem solving. This discussion has illustrated such an approach in the development of a PMM system.

Critical realism facilitates the kinds of interdisciplinary approaches that are required to tackle complex problems (Siedlok and Hibbert, 2014). This focus is seen as especially timely, as PMM is operating in a rapidly changing organizational context with new technologies, new forms of organizing, and changing values (Bititci *et al.*, 2012; Stolz, 2016). Therefore, this paper has potential societal implications because it presents one means through which PMM can remain relevant given these changing conditions. At the same time, practitioners stand to benefit the most from the adoption of a critical realist approach, because ultimately the artificial flattening of levels impedes the ability to develop practically adequate solutions. Therefore, the approach provides a potential means of bridging the research–practice gap.

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Issue	(Post)positivism	Interpretivism	Critical Realism
Primary Aim of Science	Prediction - Seeking law-like statements	Varies from purely understanding to improvement of local situation	Explanation to improve practice
Ontology	Reality exists, and is that which is experienced	*Either strong s*ubjective idealism under which each person constructs his or her own reality or weak internal realism where reality exists as an intersubjective construction	Reality is stratified into the actual, empirical, and the real or ``deep''. The deep is comprised of
Causality	Conjunctions of events	Either does not exist or is not considered, though some recent discussions promote a generative view (Walsham, 2006)	Generative mechanisms: interrelated entities with causal powers
Approach to Systems	Functionalist, rationalist: The world is systemic and observable	Systems *thinking* can be used to learn about the world and address problems; there is no assumption that the world is systemic	The world is systemic, in that structures and mechanisms can be seen as entities which interrelate. Systems terminology is compatible with this view, where each entity can be seen as a system and component (Mingers, 2014)
Emergence	Tends toward hierarchical reductionism: mental and physical states are fully determined by underlying natural laws, and	Not possible	Emergence is real: higher-level phenomena emerge from, but are irreducible to, their underlying components. Ontology is stratified in several was: Scale, 4-planar social being, and empirical, actual, real
Epistemology: How do we know?	Objectivist: Facts can be separated from values	Idealist / subjectivist: social reality is constructed by the observer, and each construction is equally valid and legitimate (from Mingers, 1984, p. 92) (strong). Weak subjectivist: emphasizes individual perceptions but accepts the possibility of extra-individual structures (Walsham, 2006)	Epistemic relativism with Fallibilism; facts are value-laden
Mode of Discovery	Induction and deduction	Primarily abduction; may revert to induction	Retroduction and Retrodiction in the RRREIC process
Common methodologies	Favors quantitative methods, with a hierarchy of evidence	Favors many types of qualitative methods	Epistemological relativism: Open to methodologies

This table is orientitative and it should be noted that researchers within each approach often hold differing views on each of the

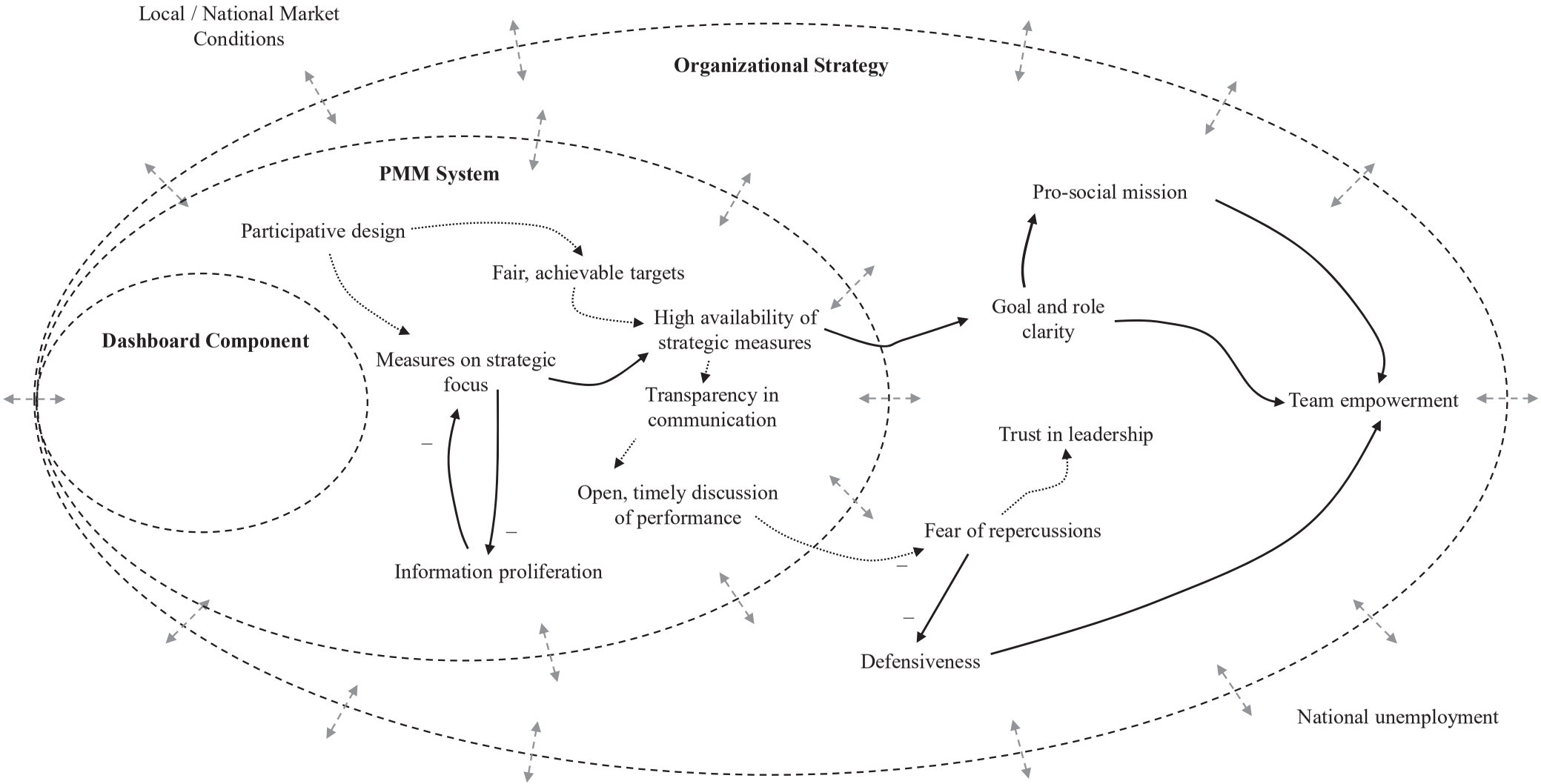
RRREIC Stage	Methods and Collection	Cycle 1: PMM System	Cycle 2: Component focus
Resolution: Exploring Events	Interview, Observation, Archival Evidence	Initial problem statement followed by interviews, observation, use of archival data to break situation into its components	Problem redefined in light of ongoing interviews and survey results
Redescription	Thematic Coding, Literature Synthesis	Enumeration and incorporation of PMM theories using Ferreira & Otley (2009) to organize in relation to problematic situation	Enumeration and incorporation of PMM theories centering on feedback (Iglen et al. 1993) in relation to problematic situation that could be addressed by a new performance dashboard
Retrodiction and retroduction			
Elimination	Survey, observation, and seeking practical adequacy	Broad categories eliminated via survey & interview (e.g. issues of goal clarity and information availability)	Empirical corroboration through interview and observation: positive v. negative feedback and reported increased use
Identification		Focus on measurement properties and data availability: deciding on dashboard component to focus on	Mechanism theory (Figure 2) developed to inform corrective action
Correction		Corrective action: Preparation of Cycle 2	Dashboard completion and revisiting of initial problem statement

Cycle 3: Re-Expansion to System

Re-resolution: Additional events from ongoing observations incorporated

Incorporation of new PMM theories in light of previous findings

Action plan for next PMM component


Local / National Market Conditions
Organizational Strategy
PMM System
Dashboard Component
Participative design
Fair, achievable targets
High availability of strategic measures
Measures on strategic focus
Transparency in communication
Open, timely discussion of performance
Information proliferation
Pro-social mission
Goal and role clarity
Team empowerment
Trust in leadership
Fear of repercussions
Defensiveness
National unemployment
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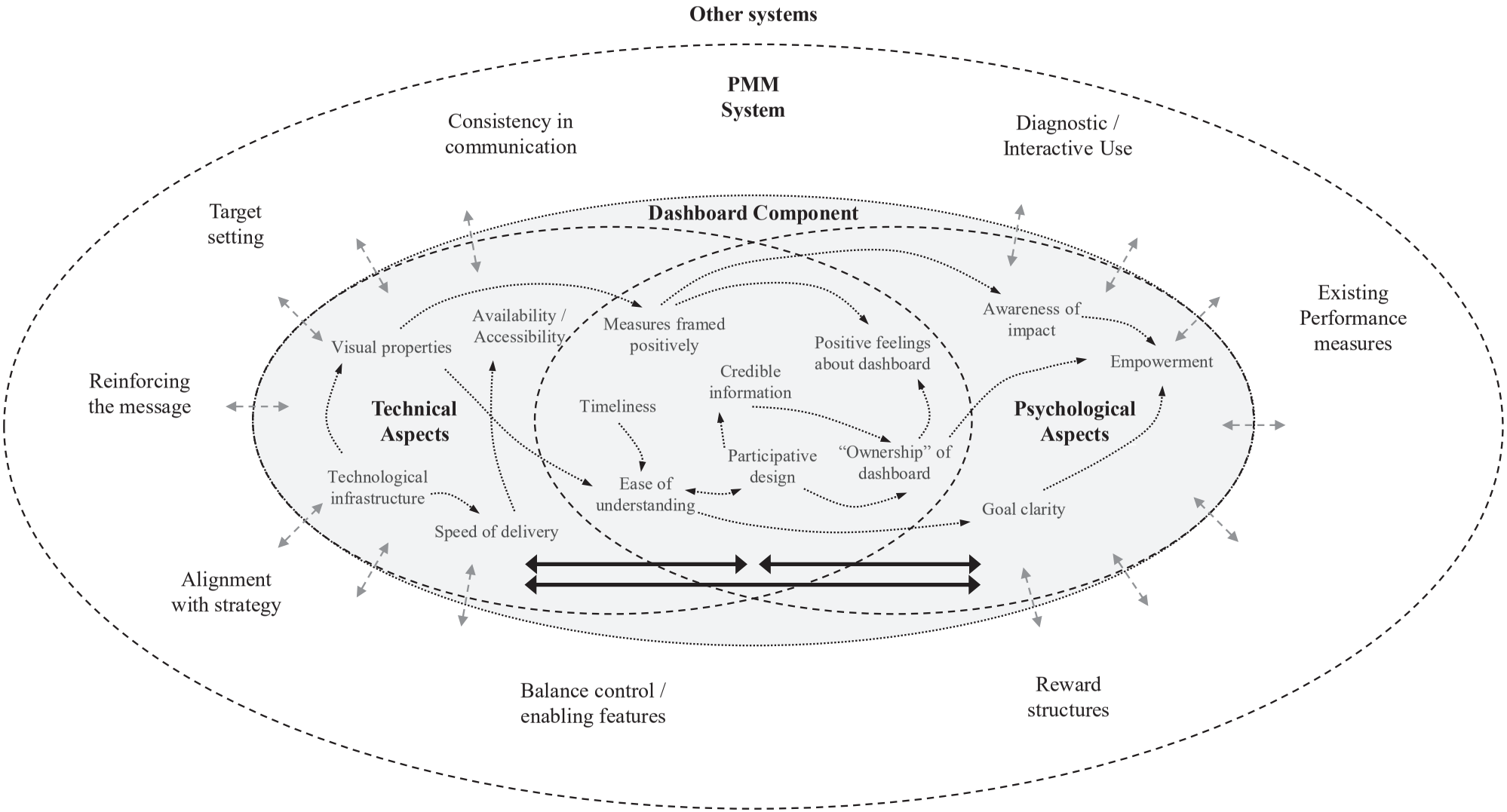
Other systems
PMM System
Consistency in communication
Diagnostic / Interactive Use
Target setting
Dashboard Component
Existing Performance measures
Reinforcing the message
Technical Aspects
Psychological Aspects
Visual properties
Availability / Accessibility
Measures framed positively
Positive feelings about dashboard
Awareness of impact
Empowerment
Credible information
Timeliness
Technological infrastructure
Ease of understanding
Participative design
"Ownership" of dashboard
Goal clarity
Speed of delivery
Alignment with strategy
Balance control / enabling features
Reward structures