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A decision theory perspective on complexity in performance measurement and management

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Abstract

Purpose – The purpose of this paper is to apply the aspects of decision theory (DT) to performance measurement and management (PMM), thereby enabling the theoretical elaboration of volatility, uncertainty, complexity and ambiguity in the business environment, which are identified as barriers to effective PMM.

Design/methodology/approach – A review of decision theory and PMM literature establishes the Cynefin framework as the basis for extending the performance alignment matrix. Case research with seven companies explores the relationship between two concepts under-examined in the performance alignment matrix – internal dominant logic (DL) as the attribute of organisational culture affecting decision making, and the external environment – in line with the concept of alignment or fit in PMM. A focus area is PMM related to sustainable operations and sustainable supply chain management.

Findings – Alignment between DL, external environment and PMM is found, as are instances of misalignment. The Cynefin framework offers a deeper theoretical explanation about the nature of this alignment. Other findings consider the nature of organisational ownership on DL.

Research limitations/implications – The cases are exploratory not exhaustive, and limited in number. Organisations showing contested logic were excluded.

Practical implications – Some organisations have cultures of predictability and control; others have cultures that recognise their external environment as fundamentally unpredictable, and hence there is a need for responsive, decentralised PMM. Some have sought to change their culture and PMM. Being attentive to how cultural logic affects decision making can help reduce the misalignment in PMM.

Originality/value – A novel contribution is made by applying decision theory to PMM, extending the theoretical depth of the subject.

Keywords Performance measurement, Sustainability, Supply chain management, Case study, Alignment, Decision processes

Paper type Research paper

Introduction: new theoretical perspectives on performance measurement and management (PMM)

The inevitability of change is a fundamental aspect of the modern business environment. Now, more than ever, such changes seem more significant and no less unpredictable. A volcanic eruption disrupts flight schedules, a stock market crashes, socio-political events like the UK's Brexit referendum, terrorist atrocities or even the rapid impact of disruptive technology on previously stable and mature markets are all issues that can require action by senior managers. Some of these issues may impact on the strategic direction of a business; others may just require flexible response, providing the organisation is sufficiently resilient.

How well an organisation conducts its PMM in relation to the external environment and strategic direction can be described in terms of the PMM system's "alignment" or "fit"

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(Kolehmainen, 2010; Melnyk *et al.*, 2010). If the external environment is stable and changes only slowly, this fit may be easier to establish than if the external environment is turbulent and unstable. Given these two different types of external context, how can PMM remain responsive to change both from outside the organisation and internally, as adjustments are made to the organisational strategy (Micheli and Manzoni, 2010)? Do organisations reformulate their PMM system in response to external changes? In a major review of PMM, Bititci *et al.* (2012) identify that the context in which PMM occurs is indeed changing and that commonly accepted PMM practices showed limited effectiveness due to the lack of a holistic approach that addresses potential external complexity.

Melnyk *et al.* (2014) follow this with a Delphi study including high-level practitioner input that highlighted manager's paradoxes in dealing with reformulation of business strategy and incorporating those adjustments in their PMM system when operating in a turbulent and fast-moving business environment. The research highlighted the need for a conditional, contingent response, given that this is not discussed in the current PMM literature. The study also reported on the lack of fit between business strategy, organisation culture and static PMM systems when faced with a complex and unpredictable external environment.

These two reviews of PMM contain common themes around the role of, on the one hand, complexity (defined by Nicolis and Prigogine (1977) as the unplanned creation of order from turbulence, also referred to as autopoiesis – meaning spontaneously self-organising), which is a form of unpredictability, and, on the other hand, simple, mechanistic, prescriptive guidance, centred on prediction and control. The latter is a core theme of management science since the work of Taylor (1911) and which was extended by Forrester (1958). Following calls for stronger theoretical foundations for PMM research (Richard *et al.*, 2009), this paper seeks to contribute insights into the former question of complexity and unpredictability affecting PMM by drawing on the literature within the field of decision theory (DT). PMM may be described as a form of decision support system, synonymous to a body's nervous system, that organisations put in place to connect with business strategy, improve effectiveness and achieve desired outputs (Melnyk *et al.*, 2014). The field of PMM may thus find deeper conceptual foundations by considering literature from the field of decision theory, especially that encompassing the topics of complexity, autopoiesis and resulting unpredictability.

PMM and decision theory in an age of complexity

One of the seminal works of decision theory is Simon (1947), "Administrative Behaviour: A study of decision-making processes in administrative organization". This broke with the prior scientific management approach of Taylor (1911) by showing that managers could not perfectly control organisations because they lacked perfect knowledge. In recent years, decision theorists (French, 2012; French *et al.*, 2009) have found the Cynefin framework (Kurtz and Snowden, 2003; Snowden, 2000; Snowden and Boone, 2007) to be a useful summary of the role of simplicity and complexity underlying organisational decision making. It is a sense-making framework that provides a typology of knowledge to assist managers in interpreting the nature of the context of various decision problems. The nature of the framework is shown in Figure 1 and Table I. Four domains are described where the level of knowledge about an external context is outlined, along with recommendations as to the appropriate way to respond.

Whilst applied in various fields from information technology to sociology (French, 2012; Herington *et al.*, 2015; Pelrine, 2011), no consideration of the Cynefin framework has been found in the PMM or wider operations management literature. However, a direct similarity is found with the performance alignment matrix of Melnyk *et al.* (2014), a guiding framework for managers to consider strategy alongside PMM when operating in turbulent and volatile external environments. To resolve the problems faced by managers in reformulating strategy and PMM, the performance alignment matrix addresses how organisations relate to their external environment and how well the internal PMM aligns with the strategic goals of the

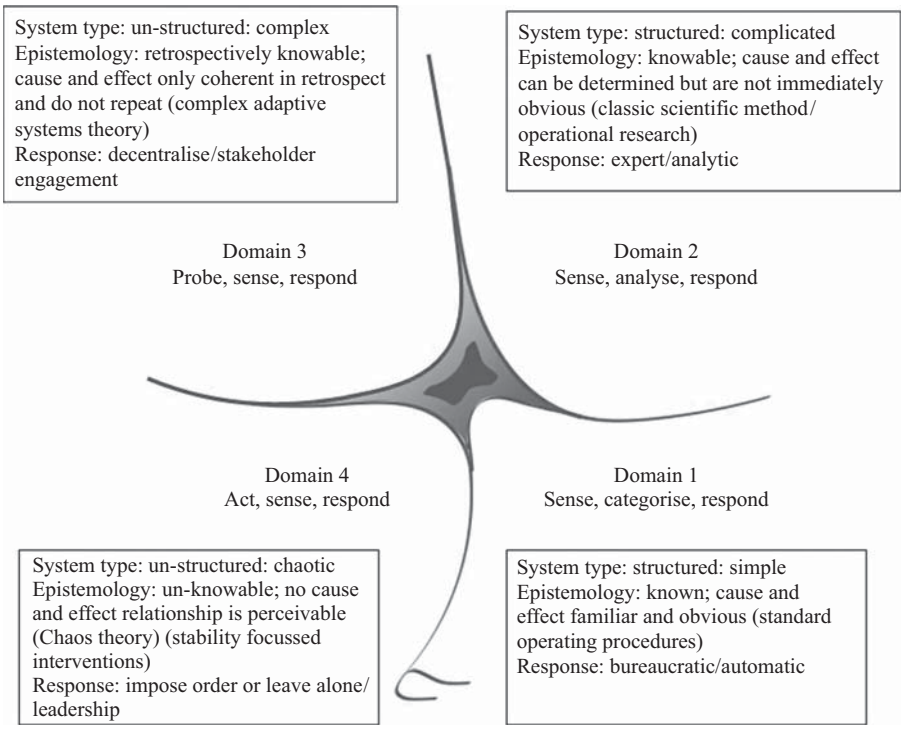

Figure 1.
The Cynefin framework based on Snowden and Boone (2007), adapted by the authors to incorporate labels

Decision theory	Structured		Unstructured		Simon (1977)
Cynefin framework and the model of decision hierarchy (Figure 2)	Cynefin Domain 1	Cynefin Domain 2	Cynefin Domain 3	Cynefin Domain 4	Snowden and Boone (2007)
	Simple	Complicated	Complex	Chaotic	
	Known	Knowable	Retrospective	Unknowable	
	Bureaucratic	Analytic	Emergent	Act or wait	
	Operational/ instinctive	Tactical/ operational	Strategic	Emergency response	French *et al.* (2009)
PMM Performance alignment matrix	Specific outcome – specific solution Measurement-driven management	Specific outcome – general solution Outcome-driven solutions	General outcome – specific solution Solution-driven outcome	General outcome – general solution Assessment-driven management	Melnyk *et al.* (2014)

Table I.
Conceptual mapping of the performance alignment matrix and the Cynefin framework

organisation, plus how well they respond to the external business environment. Further definition and exposition is provided in the background literature section below.

The performance alignment matrix is a framework regarding the use of measurement that acknowledges the nature of complexity in organisations "that have multiple levels of decision-making and diverse operating contexts" (Melnyk *et al.*, 2014, p. 182). Furthermore, Melnyk *et al.* (2014) describe one of the axes of the performance alignment matrix in

terms of certainty. Certainty means being able to give specific outcomes, but under conditions of turbulence or fluctuations in the external environment, uncertainty prompts a flexible approach, stating objectives in general terms, not specific ones.

Decision theory, and in particular the succinct summary of sense-making in diverse contexts provided by the Cynefin framework, addresses the influence of organisational hierarchy and operating context on decision making (Figure 2). The types of sense-making provided in the Cynefin framework are also distinguished on the basis of the certainty of the decision maker; what is certain or known (and thus formalised into standard or instinctive operational responses), through what is knowable (after investigation via classical scientific method or expert analysis), through to what is only retrospectively knowable, due to complexity, or unknowable, due to chaos, reflects a similar spectrum.

Furthermore, both the performance alignment matrix and Cynefin are concerned with the practical issues of decision making in real-world applications. The similarities between the two are thus readily apparent, and correspond closely (see Table I). Given that the academic origins of each are different, there is a potential for deepening the theoretical foundations of PMM via an attempted synthesis of the two, providing a novel contribution to the PMM field through elaborating the existing theory.

The research question is thus stated as:

RQ1. How do decision theory concepts such as the Cynefin framework help elaborate theory in PMM in order to better respond to challenges of unpredictability and complexity and subsequent problems of misalignment between organisational processes and the external environment?

The contributions of this paper are threefold. First, we bring the decision theory concepts to PMM, and from our literature searches it seems we are amongst the first to do so. Second, we scrutinise such concepts through an empirical study entailing multiple case studies, and find supporting evidence for the inclusion of decision theory in PMM. Finally, we illustrate the cases using the Cynefin framework, and show how this might assist practitioners in understanding and responding to unpredictable environments when they measure and manage performance in their organisations. The role of organisational culture, defined in terms of dominant logic (DL), is central to shaping this response.

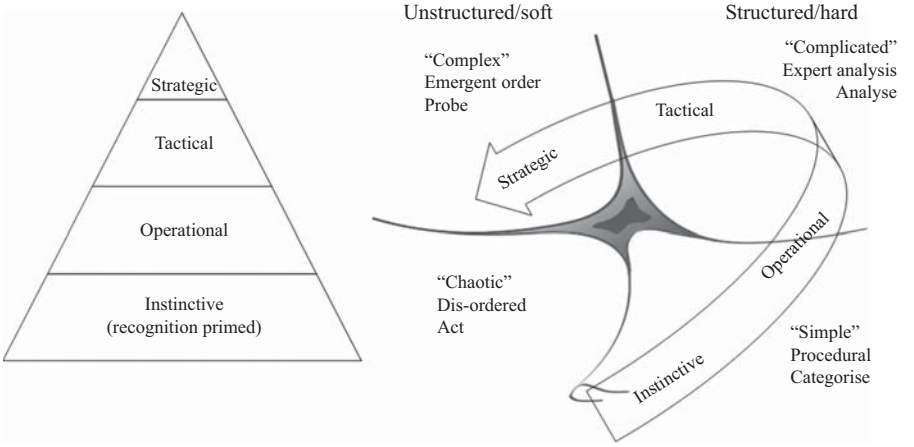

Figure 2.
Hierarchy of decisions and Cynefin framework. Adapted from French *et al.* (2009) to show additional characteristics

The structure of the paper is first to outline the various concepts being considered and provide clear definitions. A conceptual framework diagram is provided (Figure 3) that links the various elements. The research methodology and accompanying research design to explore the applications of PMM alignment using decision theory is then described. Findings and data analysis are then described, followed by a discussion of the findings and implications for future research and practical application.

Conceptual foundations

Challenges in existing PMM systems

Harkness and Bourne (2015) discuss complexity as a barrier to PMM in terms of two aspects, the first of which is the complexity of the external environment. This is described as dynamic not static and as an "open system" not a "closed system". Second, measuring performance is seen as being hampered by the factors including ambiguity, lack of control, unpredictability and unintended consequences. Acknowledging the presence of these as a challenge to PMM prompts deeper research into the origins of these concepts and hence an interdisciplinary bridge to equivalent discussions in the adjacent areas of study. This is referred to by Denyer *et al.* (2008) as "reciprocal synthesis".

By incorporating decision theory into PMM, a deeper understanding is possible. A relatively recent summary of the decision theory field and its historical development is provided by French *et al.* (2009). The barriers to effective PMM noted by Melnyk *et al.* (2014) echo the definition of bounded rationality established by one of the seminal figures in decision theory – Herbert Simon. Bounded rationality is an essential part of the theory of business administration, complementing and contrasting with neo-classical economic theory of rational decision making (e.g. Taylor, 1911), because in practice, decision makers in organisations find, "their decision making processes are molded by limits on their knowledge and computational capabilities" (Simon, 1947, p. 20).

For PMM, bounded rationality provides a constraint on performance measurement in terms of the accuracy, availability or relevance of data. Performance management may then be affected by bias, where the decision is affected by cognitive factors on the perception of data and what it means. One further effect, studied by agency theory (Ross, 1973), is that of gaming the metrics in

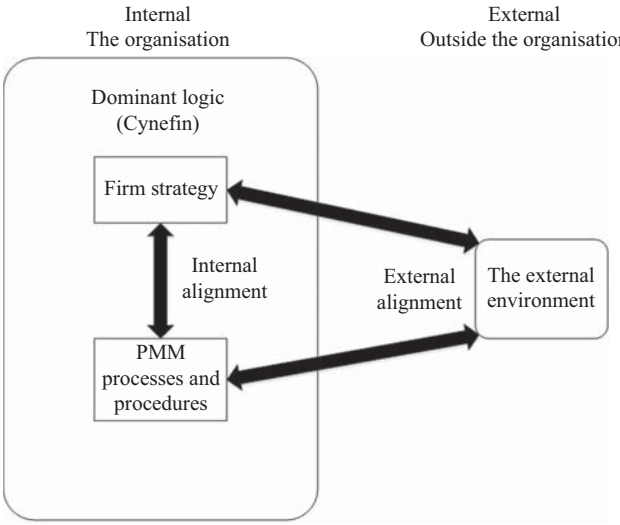

Figure 3.
Conceptual framework

order to manipulate rewards offered by management (Moynihan, 2008). In other words, manipulating the performance through metrics adjustments in a way that triggers rewards or prevents the triggering of punitive responses by management. The actions of employees can thus become motivated by working to the PMM and the structures it creates, rather than to the traditional goals or objectives of the organisation. This may result in creation of wrong behaviour and mind-sets in an organisation where employees over-perform or under-perform to meet the targets against the assigned metrics set by management. Tett (2009) provides an account of this phenomenon in major banks during the lead up to the 2008 financial crisis. Such issues are common topics in the study of behavioural decision making (French *et al.*, 2009).

The problem of too much focus on metrics in the approach to PMM (Bititci *et al.*, 2012) are analogous to those discussed in the literature on systems theory (Forrester, 1958; Kumar and Kumar, 2016), which is not referenced in the PMM literature, but that have become explicit in the decision theory literature (discussed below) and the operations and supply chain management literature. Notably, it is the divide between general systems theory, dating from Forrester in the 1940s, and that of complex adaptive systems (Choi *et al.*, 2001; Nair *et al.*, 2009; Pathak *et al.*, 2007), which is illustrated in the Cynefin framework. Rather than saying that everything is complex, Cynefin says that sometimes things are complex and sometimes they are not, and it is managerial sense-making of this context that is important.

One of the important question raised by PMM researchers (Bititci *et al.*, 2012; Kennerley and Neely, 2003; Kennerley *et al.*, 2003) was how to develop and maintain a dynamic PMM system over time in the climate of market volatility and turbulence. Kennerley *et al.* (2003) proposed a PMM maturity model that encapsulates the role of external factors such as market volatility and regulations, and internal factors such as culture, people and process in effectively managing and developing company's PMM system that truly represents the organisation's changing requirement. The paper addresses the "what" questions linked to dynamic PMM but had limited discussion on "how" to adapt and operationalise the new measures in a highly turbulent environment. However, this work could be considered as one of the early papers to debate the need for dynamic PMM.

Kolehmainen (2010) further picks up this theme to draw insights from a large telecommunication company and comments on the role of individual managers in adapting the PMM in a dynamic market environment. Flexible and strategically aligned PMM will allow different parts of the system to work together effectively and empower individual managers to adapt to turbulent market conditions. Such a system moves beyond command and control measures to measures that promote organisational learning (Kolehmainen, 2010; Micheli and Manzoni, 2010).

Pekkola *et al.* (2016) address the need for a dynamic PMM system called for in the literature (Bititci *et al.*, 2012; Garengo *et al.*, 2005; Kennerley and Neely, 2003; Melnyk *et al.*, 2014; Nudurupati *et al.*, 2011) by proposing a framework for flexible performance measurement system design for small to medium enterprises operating in a turbulent environment. Here, the core permanent measures of the framework are cost/profit centric and support measures aligned with the strategic goals. The supportive measures need to be flexible and dynamic to change as the organisation changes its strategic goals and vision when operating in the turbulent market conditions. However, this framework is too simplistic and lacks integration with decision theory, although it is a good starting point for small to medium enterprises to develop a flexible and robust PMM system.

As discussed by Melnyk *et al.* (2004, p. 212), the failure to respond to a dynamic environment causes stresses between the organisation, the external environment and the organisational strategy, which can become a source of conflicts between a firm and its customers or suppliers. The direct fit between environment and PMM has received less attention in the literature. Melnyk *et al.* (2014) address this by defining the "performance alignment matrix". This is a newly created framework that categorises specific and general

outcomes and specific and general solutions, which relate to the degree of certainty that defines management setting of outcomes (i.e. specific vs general outcomes) and specific approaches the organisation adopts to deliver the outcome (i.e. solutions).

Melnyk *et al.* (2014) classifies the performance alignment matrix as shown in Table I, above: measurement-driven management (specific outcome and solution), outcome-driven solutions (specific outcome and general solution), assessment-driven management (general outcome and solution) and solution-driven outcomes (general outcome and specific solution). The performance alignment matrix highlights that a failure to achieve alignment, or "fit", between the internal PMM system and the external environment is a major barrier to effective PMM. Whilst providing a strong response to issues of predictability and unpredictability in PMM, such ideas are also present in decision theory fields and in particular the Cynefin framework, which is discussed in the next sub-section.

Decision theory and Cynefin framework

As described below, decision theory is one relevant area of business and management studies to examine complexity, uncertainty and unpredictability, alongside strategic management (Mintzberg and Waters, 1985; Mintzberg and Westley, 2001). In their account of the different branches and the evolution of decision theory, French *et al.* (2009) highlight the Cynefin framework (Kurtz and Snowden, 2003; Snowden, 2000, 2002; Snowden and Boone, 2007) as a useful and effective summary model (see Figure 1). Cynefin is a Welsh word (pronounced ku-ne-vin) roughly meaning habitat, including social and cultural elements as well as environment. It "signifies the multiple factors in our environment and our experience that influence us in ways we can never understand" (Snowden and Boone, 2007, p. 71).

The framework thus concerns the subtle perception of a decision context and is a typology of knowledge in relation to decisions, based on the nature of their context (French, 2012; French *et al.*, 2009). It acknowledges the difference between the structured and predictable decision contexts, where managers can exert traditional command-and-control, and the unstructured and unpredictable decision contexts where they must either allow order to emerge from a group-oriented level, or attempt to impose order on apparent chaos. Figure 2, from French *et al.* (2009), links the epistemology of decision context shown in the Cynefin framework with the decision authority in a conventional organisational hierarchy (shown on the left side). PMM can sit at the level of tactical and operational decisions, ideally aligned with the higher level of strategic decision making.

The two sides of Cynefin (Figure 1) reflect a divide in epistemology (the philosophy of knowledge); the divide between rationality and bounded rationality defined by Simon (1947) in relation to management decision making, reflects this, and deliberately contrasts with Taylor (1911). As shown in Figures 1 and 2, the Cynefin framework consists of four domains, grouped into two halves of structured and unstructured domains. When a decision context is sufficiently structured and stable, it enables quantitative analysis. When it is characterised by dynamic change, plural and contested definitions, or non-linear complexity (Lorenz, 1963; Prigogine and Stengers, 1984), the space is unstructured (Kurtz and Snowden, 2003; Snowden, 2000). This offers a means to determine where it is possible to make rational decisions or where bounded rationality prevents this, and thus alternative methods are needed. The structured is further divided into simple and complicated domains, and the unstructured is divided into complex and chaotic domains.

Each domain suggests responses, detailed in Snowden and Boone (2007), that managers should take when faced with the different decision spaces defined by each domain. This responds to the concept of fit, concerning how well-aligned internal processes are to the external environment. The lines between each domain are curved to emphasise that the borders between the domains are contextual, and that the figure is not a graph with two axes marking quantitative variables. The Cynefin framework is effectively a typology of

knowledge management, called a social ecology of knowledge (Snowden, 2000), in order to consider different approaches to organisational knowledge.

The four domains are also intended to illustrate that misalignment can occur when the external context of a decision may shift from one domain to another in a potentially dynamic fashion. The shift from a simple-structured domain to an unstructured-chaotic domain is for instance illustrated by a line symbolising a breaking wave on Figure 1. A simple bureaucratic system may cease to function effectively if the underlying assumptions shift and the context becomes increasingly structured or that the structure starts to break down into turbulence. It may become gradually more complicated, as additional requirements are added to a project for instance. Increasing the numbers of stakeholders involved in a project can result in a breakdown of shared perception, and this divide can result in an otherwise stable and structured context becoming less structured. These correspond to the concept of fit and subsequent description of the performance alignment matrix in Melnyk *et al.* (2014), which states that how a PMM responds to change is affected by organisational culture. PMM is thus both "a technological process and a social one […]" (Melnyk *et al.*, 2014, p. 3).

Managerial sense-making and response is central to Cynefin and echoes the strategic management concept of dominant logic (DL) (Bettis and Prahalad, 1995; Prahalad and Bettis, 1986). This is described as the dominant mindset or view of the world possessed by top managers that shapes their decision making, and through their shaping of organisational culture, affects the decision making of others in the firm. DL is a schema based on the beliefs established as a result of employees' experience within given firms and industries. Prahalad and Bettis were concerned with the role that DL plays when a firm in one industry acquires a firm in another industry and misunderstandings result, leading to underperformance. The perceptual, cultural and sense-making aspects of DL relate to how decisions are made in practice. This is important to understanding the three aspects of strategy, PMM and organisational culture mentioned by Melnyk *et al.* (2014) in terms of fit. In this paper, the Cynefin domains are taken as descriptions of DL, providing a decision theory perspective on organisational culture, which can then be applied to the issue of PMM and fit. Figure 3 expresses a conceptual framework covering the relationship between these key concepts.

Awareness of an organisation's performance, captured via data, enables control, and as such the ability of managers to direct organisations towards meeting strategic requirements. Yet, if the context is unstructured as a result of unpredictability, then this approach is problematic. Cynefin suggests that under unstructured contexts, an approach based on responsiveness instead of forecasting, or emergence instead of control is required. PMM should reflect this dynamic, but the issue appears under-theorised in the literature, as noted by Melnyk *et al.* (2014) or Harkness and Bourne (2015), which address the role of complexity as a problem for PMM, but less so on how to respond to it based on the existing theory in this space.

Mapping the performance alignment matrix with the Cynefin framework

The performance alignment matrix framework is found to have a useful precursor in Snowden's Cynefin framework. Introducing this framework and its associated conceptual underpinning helps provide a greater theoretical depth to the topic of PMM. This answers recent calls for deeper understanding of the role of volatility, uncertainty, complexity and ambiguity (Bennett and Lemoine, 2014) and how they are addressed as aspects of the external business environment, interpreted (via sense-making) in different ways by the internal organisational culture.

As stated by Melnyk *et al.* (2014), "for PMM to be effective it has to fit the environment in which it operates" (p. 183). Similarly, the Cynefin framework is built on an empirical observation; "Wise executives tailor their approach to the complexity of the circumstances they face" (Snowden and Boone, 2007). A range of sources of unpredictability, including volatility, uncertainty, complexity and ambiguity, have long been recognised as characteristic of manager's perception of the external environment (Bennett and Lemoine, 2014; Simon, 1947).

However, the Cynefin framework offers valuable insights in showing that such unpredictability is not always present. Many circumstances are readily predictable, and hence the decision makers "approach" should be tailored to the circumstances of the external environment in order to be effective – there is no "one-size fits-all" approach.

The failure of sense-making (Browning and Boudès, 2005; Weick, 1995) in relation to changing circumstances described by Cynefin is again similar to what Melnyk *et al.* (2014) call a "lack of fit" or misalignment. Notably, in defining the performance alignment matrix as a framework to describe alignment between PMM and the external environment, the authors cite precursors in strategic management; Venkatraman and Camillus (1984) describe strategy in relation to organisation theory's open systems view where, "strategy [can] be conceptualised as a pattern or stream of decisions taken to achieve the most favourable match or alignment between the external environment and the organisation's structure and process" (Venkatraman and Camillus, 1984, p. 516). This alignment, or fit, is thus a phenomenon that has been conceptualised over time in the management literature, particularly in strategy (Chorn, 1991; Henderson and Venkatraman, 1993; Walter *et al.*, 2013). Both the Cynefin framework and the performance alignment matrix seek to conceptualise the phenomenon but do so from slightly different backgrounds: strategic management and organisational performance in the case of PMM, and knowledge management and decision making in the case of Cynefin.

The PMM concept of fit, as illustrated in the performance alignment matrix in Melnyk *et al.* (2014), can be elaborated using the more detailed explanations and managerial responses described in the Cynefin framework. Such decision theory concepts are empirically examined through case research into the implementation of corporate social and environmental responsibility practices via sustainable operations and supply chain management (SOSCM) and related PMM. Seven firms in different sectors are investigated to find how DL and the external environment are aligned and the subsequent alignment of PMM around SOSCM. The findings lend support to the adoption of the Cynefin framework as a useful means to understand how organisations should perceive and respond to the external environment. The next section provides more information about the method adopted for this research.

Research method: theory elaboration and synthesis

The initial approach of combining the performance alignment matrix with Cynefin is based on the work of Denyer *et al.* (2008) which describes various approaches to theoretical synthesis such as reciprocal synthesis (different descriptions of the same thing) or lines-of-argument synthesis (different descriptions of slightly different but connected things). However, as there has to date been no application of Cynefin within PMM or operations management, the research approach taken here was to consider theory alongside original empirical data collection using the methodology of Ketokivi and Choi (2014). Here case studies are used in tandem with a known middle-range theory (Soltani *et al.*, 2014) in order to explore "theory elaboration" (as contrasted with novel theory generation or large-n statistical theory testing). Multiple cases across different industries are used to consider how PMM is undertaken in different external contexts. Focussing on a specific area of PMM, firms' SOSCM performance practices are taken (as opposed to, say, PMM in human resources management). Bititci *et al.* (2012) note the rising importance of sustainability factors in PMM, and various papers cite problems of bounded rationality, such as plural and contested definitions in SOSCM (Hahn *et al.*, 2014; Preuss and Walker, 2011), or the temporal and physical distance between cause and effect often found in sustainability issues (French and Geldermann, 2005). A review of how such decision theory concepts are addressed in sustainable supply chain management research is provided by Alexander *et al.* (2014).

As discussed by Eisenhardt (1989), such case research uses theoretical sampling rather than statistical/random sampling. Cases are selected because they represent high variance in the relevant concepts, not high levels of comparability as with the matched-pairs approach (Yin, 1994). Novel ideas emerging from the empirical data enable theory to be modified to reflect these findings. Miles and Huberman (1994) define this as the balance between a tight design and a loose design. In the former, concepts are pre-specified, but in the latter, they are not well-defined in advance, enabling emergent ideas. As such, each case company was selected via a process of polar sampling of key variables, including those established via iteration and juxtaposition (Eisenhardt, 1989; Yin, 1994). This establishes a range of different internal and external characteristics from which to consider levels of fit. Triangulation as a means of verification and validation was conducted via the use of multiple data sources per case and across cases (Pauwels and Matthyssens, 2004).

The DL in the organisational culture and the external context are established through the data collected using critical realist abstraction from data to underlying concepts and causal mechanisms (Rotaru *et al.*, 2014). Dubois and Gibbert (2010) provide additional justification for this approach by highlighting the importance of alignment between theory and method. Given that the Cynefin framework concerns bounded rationality, and that the theoretical model of applying this to PMM is nascent, then a quantitative methodology would not be appropriate at this stage. Furthermore, as the conceptual model is nascent, exploratory work founded in empirical field research is preferred over theory testing, or pure conceptual work derived in the absence of practical application.

Empirical data were collected over a two-year period from seven UK-based international companies and their supply chains across different sectors (Table II) contacted via a variety of professional networks. All had adopted SOSCM policies and practices and all interviewees were centrally involved in them. The point of saturation (Eisenhardt, 1989) was seen as met in the seventh case, so further potential cases were not pursued. Data collection used the semi-structured elite interview technique (Vaughan, 2013), whereby researchers can interrogate deep into the topic whilst also maintaining flexibility to encourage new topics to emerge during discussion. In addition, meetings were observed to a gain deeper insight into how particular processes influenced decision making, including meetings between companies and their customers and suppliers, and between different departments and subsidiaries in a firm. All interviews were conducted under conditions of anonymity, enabling candid responses but requiring that information allowing firms to be identified has had to be kept from publication.

Examples of questions asked via semi-structured elite interview technique:

- Introductory questions: describe the company and where it is at presently. Describe your projects in relation to sustainability – both internally and in the supply chain.
- SOSCM and PMM questions: how do you measure performance in relation to sustainability – both in internal operations and in the supply chain?
- Decision theory questions: what processes for decision making are there in the organisation? Can managers act on their own intuition or do they need to follow clear rules and provide particular evidence before being able to act? Are PMM and SOSCM issues simple and easy to understand/involve lots of variables and expert analysis/are subject to unpredictability? Are there aspects of PMM and SOSCM that cause problems?

Around 52 hours of interview data were recorded, transcribed and coded using descriptive and conceptual coding (Saldaña, 2012). Recursive abstraction is used to derive codes from the *in vivo* data with consideration given to processes of establishing causal foundations from interview data in Rotaru *et al.* (2014). Coding was conducted via repeated re-reading of

Case (Standard Industry Code)	Description of case firm	No. of interviewees	Roles of interviewees	Corporate docs. analysed
1. Electronics Case (SIC 71.12/1)	Designer of components used in consumer electronics.	4	Socially responsible investment advisor, chief financial officer, corporate social responsibility manager, trade association sustainability director	5
2. FMCG Case (SIC 20.4)	Manufacturer of domestic products	3	Managing director, human resources consultant, director of sustainability	9
3. Restaurant Case (SIC 56.10)	High street restaurant chain	2	Corporate social responsibility manager, energy manager	4
4. Finance Case (SIC 64.19/1)	High street financial services firm (plus their logistics services supplier)	7	Regional director, health, safety and environment manager, supply chain director, sustainability director, supplier account manager, head of environment, policy manager	8
5. Contractor Case (SIC 41)	Construction services firm (plus client and architect)	5	Deputy director of estates, project manager, architect and environmental assessor, sustainability manager, regional director	7
6. Manufacturing Case (SIC 24)	Heavy manufacturer of construction products (plus major customer and electricity supplier)	10	Commercial director, operations and supply chain director, regional sales director, regional sales manager, energy buyer, operations manager, process manager, category buyer, sustainable supply chain management programme manager, account manager	12
(7) Chemicals Case (SIC 20.59)	Chemical processing services	2	Chairman of the board, director of communications	4
Total		33		49

Table II.
Summary of primary data collected

the interview transcripts to isolate the relevant concepts and variables. Two researchers independently coded transcripts and compared results to ensure accurate coverage and reach consensus to establish validity in the coding protocol.

The process for reliability and validity determined by Pauwels and Matthyssens (2004) was used, as outlined in Table III. This updates and extends the validity processes provided by Yin (1994), Miles and Huberman (1994) and Eisenhardt (1989).

Findings

Table IV shows the DL coding of each organisation, using the Cynefin domains from Figure 1. These are also plotted on Figure 4. Illustrative quotes from the data are also included in Table IV with references to sample quotes provided in brackets, cross-referencing data provided in Table AI. Having determined the DL for each firm, Table V then illustrates the alignment with the external environment under typical conditions, and then in relation to SOSCM issues, including instances of misalignment.

As noted in the strategic management literature cited above, alignment or fit is a concept about how the internal logic and process perceive the external environment. As a sense-making

Criteria for reliability and validity	Description and actions taken to meet the criteria
Theoretical sampling	Selecting informants on the basis of theoretical relevance Iterative polar sampling of relevant variables (sector, size, dominant logic for decision making, external context) (Eisenhardt, 1989)
Triangulation	Reduce potential for bias or error by: Elite interview technique (Vaughan, 2013) Synchronic primary data source triangulation (different respondents, same topic). Diachronic primary data source triangulation (same respondent, multiple occasions) Comparison of primary and secondary data (Pauwels and Matthyssens, 2004)
Pattern matching	Multiple, independent coding of transcripts *In vivo*, descriptive, conceptual and causation coding (Saldaña, 2012)
Analytical generalisation	Comparison to existing theory in tandem with data collection via progressive focussing (Ketokivi and Choi, 2014; Sinkovics and Alfoldi, 2012)
Validation	By juxtaposition and iteration (cross-case comparison) (Pauwels and Matthyssens, 2004)

Table III.
Criteria for reliability and validity in case research

Case	Description of organisational culture and strategy	Dominant Logic	Quote ref. (Table AI)
1.	Organisational culture shaped by majority of employees being electronic engineers. Rules-based decision making. Work is focussed on precise technical specifications. Low tolerance of ambiguity or uncertainty. Core strategy is high quality (not low cost)	Domain 2	Q1.1
2.	Organisational culture is shaped by strong ethical values. Principles-based decision making. Core firm strategy is serial innovation strategy based on driving improved ecological and ethical characteristics of products to align with customer values (this can be described as a quality strategy with eco and ethical elements regarded by customers as quality characteristics)	Domain 3	Q2.1
3.	Organisational culture centred around decentralised decision making and tolerance of uncertainty. Analytics not part of the organisational culture	Domain 3	Q3.1
4.	High level of rules-based analytic decision making, but introducing a decentralised decision-making approach	Domain 2, but introducing Domain 3	Q4.1
5.	Organisational culture shaped by high context specificity and variability of construction work, leading to high level of danger, requiring decentralised decision making responsibility	Domain 3	Q5.1
6.	Organisational culture typical of large engineering-based firm defined by regulated standards and customer-base similarly subject to regulation	Domain 2	Q6.1
7.	Core business of the firm is a low variation chemical engineering process requiring expert knowledge and operating in highly regulated, controlled conditions	Domain 2	Q7.1

Table IV.
Organisational dominant logic (DL) defined using Cynefin domains (1-4), plus references to representative data

framework, Cynefin, by definition, concerns the link between the internal and the external. A short narrative description of each case follows describing the DL using Cynefin domains (expressed in the text and Tables IV and V as Domain 1, Domain 2, etc.). The rich description includes the way in which SOSCM was incorporated into PMM. The next section then discusses the theory elaboration for PMM derived from the case data.

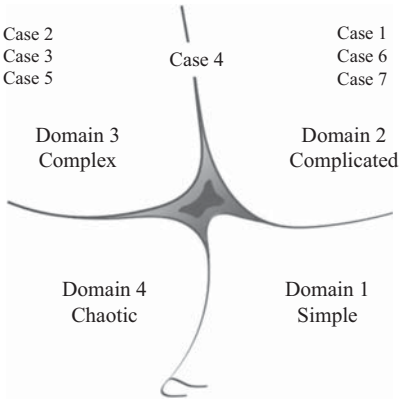

Figure 4.
Case DL and Cynefin domains. Case 4 is seeking a transition in DL

Case	DL	Typical external environment	External alignment	SOSCM example	Internal alignment
1.	Domain 2	Stable – mature market	Aligned	Supplier specifications (bureaucratic – Domain 1)	Misaligned to DL
2.	Domain 3	Stable – mature market	Misaligned	Integral to firm operations	Aligned to DL
3.	Domain 3	Unpredictable – at branch level	Aligned	Carbon tax SSCM resilience	Misaligned Domain 2 centralised function Aligned – success only retrospectively knowable
4.	Domain 2 into Domain 3	Unpredictable (Post 2008 crash)	Seeking realignment	SOSCM is well established in PMM across multiple applications but not integrated into firm strategy Eco-efficiency investments (affected by unexpected crash in oil price)	Aligned to PMM, but misaligned with strategy Misaligned to PMM
5.	Domain 3	Unpredictable – at site level (plus post 2008 volatility)	Aligned	BREEAM eco-design system	Misaligned to DL
6.	Domain 2	Stable	Aligned	Eco-efficiency LCA treated as Domain 1, but currently Domain 3	Aligned Misaligned to DL
7.	Domain 2	Stable	Aligned	SOSCM fully integrated into PMM and strategy. The most mature example of all cases	Aligned

Table V.
Alignment between DL, external environment, and PMM for SOSCM

Case 1: electronics firm

Case 1 is a leading designer of electronic components for popular consumer devices. The large majority of the firm's employees were engineers. The external environment was relatively stable and simple, with incremental improvements in product performance delivered year on year with little radical innovation. The DL was clearly structured and rules-based, shaped by scientific processes, so corresponding to Cynefin Domain 2.

SOSCM issues had become highlighted in the sector, with recent regulations imposed via the US Dodd-Frank Act. SOSCM issues had thus been introduced as a customer requirement. However, given the nature of the firm and its position in the supply chain, this was outside of the firm's expertise or ability to influence (Q1.2). It was not an element included in the technical specifications that they passed up the chain to their suppliers in manufacturing and assembly. Hence, the response to SOSCM at the time of the interviews was bureaucratic and procedural (Domain 1), focussed on the legal liability of disclosure, requiring suppliers to confirm compliance, but having no mechanism of auditing or enforcement. The regulation resulted in minor changes in specification that reduced the potential liability but did not engage in supplier capacity building, or extending their engineering expertise to consider SOSCM issues more fully (Q1.1-Q1.5). Under the performance alignment matrix (Table I), this approach represented "measurement-driven management (specific outcome and solution)".

Case 2: FMCG manufacturer

By contrast to Case 1, Case 2 had an SOSCM policy fundamental to the founding of the firm some 20 + years ago. The firm is an international manufacturer of ethical and ecological consumer goods. The interviews found a very strong organisational culture based around principles designed to maximise SOSCM performance in order to align with pro-ethical/pro-environmental customer values (hence, the strategic position of the firm). Notably, while Domain 2 processes existed in the lab and factory floor, the firm claimed insufficient resource for Domain 2 analytics in other aspects of management, including marketing and forecasting (Q2.3). Instead, the DL was clearly defined by Domain 3 logic (Q2.1, Q2.2). Characteristics of this were a decentralised approach to decision making inherent in PMM processes. A wide range of employees could be called in to work on decisions outside of their job roles via a principles-based approach to decision making (Q2.1, Q2.2, Q2.3). Firm strategy was essentially to align its performance with the ethical and ecological values of their consumers, establishing a form of quality strategy where exemplary SOSCM performance was fundamental to competitive advantage. Under the performance alignment matrix, this approach compared to the "assessment-driven management (generic outcome and solution)" domain where employees are given freedom to take decisions without too many constraints. However, while the DL was well-aligned to PMM, the firm stated that it lacked the resources to conduct Domain 2 analytics as some of its larger competitors did. Despite a niche position, because the sector of fast-moving consumer goods is mature and essentially stable, the Domain 3 position may be aligned to strategy, but misaligned to the external environment given the superior performance possible from a Domain 2 capability aligned with a stable competitive environment.

Case 3: restaurant chain

Case 3 is a large international restaurant chain with a strong, values-focussed culture intended to create the atmosphere of a family-owned restaurant despite a large size (Q3.1-Q3.2). The DL is Domain 3 as decentralised decision making and values of personal responsibility are central. With a strategic position of low cost but requirement for fresh produce (reducing the potential for inventory to smooth out variability in customer numbers) purchasing decisions were decentralised to the branch level. Local, granular knowledge and the instincts of branch managers were assumed to be required; knowing that a local sports team was playing on a particular day would prompt expectations of a busy day, rather than centralised ordering on the basis of forecasting via extensive Domain 2 data analytics.

Like Case 2, this firm lacked the Domain 2 analytic capability of a dedicated operational research department, and although it also had a principles-based, decentralised culture for

decision making, it had this for very different reasons to Case 2, based more on the nature of the external environment as being characterised by high variability, than on resource constraint and strategic need for customer values-alignment (beyond the atmosphere of restaurants).

Two issues of SOSCM were explored; the first was a plan to reduce vulnerability to supply chain disruption. This was prompted by the EU horsemeat contamination scandal of 2015 but then applied to vulnerability to future climate change impacts. The inherent unpredictability of future disruptions did not affect investment in such initiatives because the Domain 3 DL of the firm had a high tolerance of ambiguity as to the business case. Such initiatives were supported by the board on the basis that if it sounded like the right thing to do, then it should go ahead (Q3.2).

The second SOSCM issue was the introduction of government carbon taxes (via the Energy Savings Opportunity Scheme). This was addressed as a calculation from the accounts department where total spending on electricity and fuel was converted into the associated carbon footprint and related government levy. This is a low-level, Domain 2 analytic process, or advanced, Domain 1 bureaucratic process. The policy did not however prompt a reduction in organisational carbon pollution as perhaps intended as to do so would require the firm to have a detailed data architecture, recording the operational consumption of every different location of the business. The size of the levy did not warrant the cost of developing a PMM system to target cost-effective reductions in energy consumption. This would be a more sophisticated Domain 2 undertaking, requiring expert analysis of a large number of variables. Instead, the carbon tax was seen as a cost of doing business (Q3.3). Latter firms in this study maintained a similar position towards this scheme. Misalignment can thus be considered in the SOSCM PMM as this is imposed by the government, as a broadly Domain 1 bureaucratic undertaking with some expert analytic Domain 2 capability needed, whereas achieving improvement in carbon performance would require an extensive and costly Domain 2 analytic approach involving the creation and study of potentially large sets of data to determine optimum performance output balanced against particular types of energy efficiency intervention (Q3.3).

While both Cases 2 and 3 had conventional, cost-based performance measures, it is notable that both were tolerant of ambiguity in decision making. This relates to the definition of a Domain 3 DL regarding level of certainty, providing some empirical validation of the Cynefin framework.

Case 4: high street finance firm

Analytic sensitivity to profitability was seen in Case 4, a stock market-listed international finance firm. The firm exhibits a Domain 2 DL as decisions were typically made on the basis of a complicated series of internal policies and regulatory standards, requiring bureaucratic responses and levels of expert analysis (Q4.1). PMM around SOSCM were well implemented and had been for many years, showing alignment between this aspect of PMM and the DL. Strong alignment between PMM for SOSCM and some strategic objectives could be seen in, for instance, energy efficiency programmes helping to improve productivity and profitability by reducing waste of energy. Similarly, local sourcing helped with local economic development, which improved reputation.

One other major SOSCM initiative was impacted by unpredictable volatility. A clear belief by the firm and its suppliers of linear energy price inflation (Q4.2) was affected by a sudden, unexpected drop in the price of oil a few weeks after one interview. A purely economic rationale for carbon reduction expressed in the interview was then undermined by the impact of this energy price fall on the anticipated payback periods for investment in energy efficiency measures. This represents a Domain 2 analysis becoming misaligned to an unpredictably changing external environment. Such issues of price volatility are perhaps

inevitable factors of business, so alternative sense-making may have been cautious of such inevitability. In Case 3, the DL tolerated ambiguity about future paybacks, reinforced by the principles-based decision making. The key issue is not only how swiftly the firm responds, including how the PMM responds, but how the firm might anticipate such fluctuations and prepare accordingly.

A second key finding from Case 4 relates to a misalignment between customer perception of the business, the firm's strategic goals around profitability, and the implications for DL. The firm was selected on the basis of its large size, and sophistication of its PMM systems, as a polar contrast to the small size of the previous three firms (as required by principles of theoretical sampling for high variation). However, a serendipitous discovery raised unprompted during the interviews was that the firm sought increased responsiveness to customer needs by introducing an alternative DL (Q4.1). This aimed at shifting from a Domain 2 structured, rules-based approach to a decentralised, principles-based Domain 3 logic.

Targets imposed by the former PMM were considered responsible for rising levels of customer dissatisfaction, which undermined profit targets and associated long-term strategic goals. Loosening the PMM system by shifting to a Domain 3 logic meant allowing customer-facing staff more discretion over decisions on the basis of their intuition about possible reputational impacts, rather than the pressure to hit certain department level performance targets. At the time of the data collection, this change management programme in the DL was at an early stage. Future research could examine the success of this, given the potential challenges of changing an organisation's DL.

Case 5: construction contractor

Case 5 is a major contractor in the construction sector who showed a very strong Domain 3 DL, particularly in relation to project management and health and safety. Because construction sites are constantly changing on a daily basis and schedules and workflow are impacted by unpredictable issues like the weather, in ways that factory or office work is not, they require that project managers are able to respond to frequent change (Q5.1, Q5.3). They are also very dangerous places to work; from 2001-2011, 760 workers were killed on UK construction sites, compared with 448 British Army soldiers killed fighting overseas over the same period (HSE, 2016) (Q5.2). As such, a very strongly decentralised decision making culture had developed where people follow common sense principles instead of (blindly) following prescriptive rules.

The strength of this Domain 3 DL resulted in an unprompted account of the dangers of the balanced scorecard PMM system by major clients. Here, the misalignment between PMM and strategy resulted in serious problems for clients' real estate portfolios; purchasing of land (deemed a performance metric) continued when macro-scale demand declined very rapidly after the 2008 financial crash. The misalignment resulting from this volatility has had a lasting impact on the real estate sector and the performance of the firm and its competitors in the sector (Q5.5).

In terms of SOSCM, the misalignment with PMM systems was also seen with the adoption of a government-promoted eco-standard for building design. The Building Research Establishment Environmental Assessment Method (BREEAM) system had become a widespread extension of updated mandatory building regulations affecting the environmental performance of buildings. But whilst building regulations were a simple, procedural and scientific measure (requiring expert analysis and so a Domain 2 activity), the BREEAM system consisted of a wide range of potential environmental features assigned scores via a more simple, bureaucratic Domain 1 system. Architects and contractors had to work with this Domain 1 system, even though the act of designing and constructing a building included many Domain 2, and Domain 3 activities. This antagonism was addressed

in various ways, such as an architect firm becoming a certified BREEAM assessor so as to best balance the needs of the bureaucracy with the less mechanical and more aesthetic, qualitative or context-specific aspects of building design (Q5.4).

Theoretical implications of this are that while environmental performance of UK construction has been subject to substantial legislation for more than ten years, misalignment between prescriptive demands and the best-quality outcomes for buildings are clear. Future research could explore the nature of the misalignment in this sector in relation to BREEAM from the perspective of the Cynefin model of PMM described here.

Case 6: heavy manufacturer

Case 6 is a large, international manufacturer of construction products. SOSCM initiatives have become strongly aligned with the organisation's strategy and PMM systems. As an engineering-based firm, a Domain 2 logic was dominant (Q6.1) and two large projects in SOSCM were investigated. First was the attempt to adopt the widespread use of life cycle analysis (LCA) on products. This involved a process of auditing environmental performance to create environmental product declarations (EPDs), a formal certification scheme. Possessing an EPD was rewarded by a point on customer supplier selection processes (a bureaucratic, Domain 1 activity). Yet, problems were seen in creating Domain 2 analysis of a product's whole life cycle environmental impacts. With no regulatory or industry-level standard, the processes of LCA are highly variable. Furthermore, manufacturing a similar product out of different materials means highly non-comparable methodologies, assumptions and criteria. LCA is thus found to be a plural and contested Domain 3 undertaking (Q6.2).

Misalignment is thus found in the use of LCA as a PMM. Instead of becoming a Domain 2 system where an accurate and unambiguous analysis between two different suppliers is possible to determine which has the better environmental impact, LCA is in practice in a Domain 3 state. Meanwhile, in practice, because supplier selection processes award a point on the basis of having an EPD but not on any particular performance specified in the EPD, then LCA has become a Domain 1 undertaking. Establishing LCA as a Domain 2 system would require extensive regulatory standards and formal methodologies, independent assessment and auditing processes.

A second example of SOSCM in the PMM of the firm was on initiatives to reduce the carbon footprint of the firm. Two factors in the external environment impacted on this. First, international competition meant a strong downward cost pressure (Q6.3), meaning that energy efficiency measures were encouraged provided that they had a net cost reduction over a short payback time. Therefore, sustainability (implemented via SOSCM practices) as part of a strategic position of quality was problematic. Without such aspects being assisted by mandatory performance measures possible given the globalisation of the market and role of existing technical performance standards (that did not mandate environmental or social performance), the company's competitive position had to adopt a strategy of low cost.

It was clear from customer tendering processes and weightings given to product specifications against cost, that price was the main decider, not sustainability criteria (or even issues such as product longevity or additional benefits such as service agreements) (Q6.3). This raises many questions for internal and external alignment. The practice of the firm suggested that PMM had become aligned to the new strategy to advance sustainability performance, but this strategy was becoming misaligned with the external competitive environment, and so the PMM for SOSCM refocused around the now better aligned strategy of low cost.

An additional instance of misalignment around SOSCM was found in discussions on the potential for changes to energy supply to low carbon alternatives. The highly unpredictable nature of the UK Government's policy on this at the time was seen as undermining any potential for justifying investment in certain types of new plant (Q6.4). This contrasts with

the example in Case 4, where there was an assumption of a predictable growth in energy price justifying investment over a given payback period. In Case 6, the larger scale of the energy consumption (given a manufacturing rather than services firm) meant the need for more substantial investment, more sensitive to government energy policies. However, anticipated unpredictability in this policy (rather than anticipated predictability in commodity price) prevented capital investment. Taken as a Domain 4 context, the responses to this unpredictable context in Cynefin are to either wait to see if order reappears over time or to try to impose order (Domain 4 left alone to Domain 3, or imposed to Domain 1). An example of trying to impose order may have been to lobby government to set clear new rules in place (Domain 4 to Domain 1 or 2). In practice, the firm waited without making a decision, delaying progress on this aspect of environmental performance.

Case 7: chemical processing

Finally, Case 7 is an engineering firm involved in the large-scale chemical processing of materials. The firm ostensibly operates as a services firm rather than manufacturer as its clients retain ownership of the materials undergoing processing. The firm described its activity as essentially very simple, albeit still in an expert area of chemical engineering and so is determined to have a Domain 2 DL (Q7.1). It only provides a small range of services but does so at a large volume, providing to a substantial share of global markets. SOSCM practices and associated PMM are regulated by government in environmental terms but extended into areas of corporate responsibility via investor requirements such as Global Reporting Initiative standards. As such, SOSCM is well established into key performance indicators (KPI) and embedded into PMM (Q7.2, Q7.3). In contrast to Case 1, this was also a strong engineering firm, and operated according to a clear Domain 2 logic, but it was one that had fully implemented SOSCM into its PMM processes. Two instances of alignment were also found. First, that an accident affecting a major customer impacted global inventory levels, as the production slowed, available supply of materials increased and so demand for their core product was reduced. This unpredictable event meant a change in the external environment, impacting firm strategy by reducing the market price. However, the PMM in relation to SOSCM was not affected, although there were strategic implications for the firm.

Second, when building new facilities, the firm's stakeholder engagement capability needed to align with the local community concerns. This is a Domain 3 undertaking, and the approach taken of full transparency and open days at existing facilities is designed to improve the general public's understanding of the business and its operations. This can be theorised as an example of enabling community sense-making so as to move the decision context of the community from Domain 3 plural interpretations (such as whether or not the factories had a risk of pollution or accident) to a common understanding of the high standards for safety and environmental management. This case was deemed the final one as a point of saturation seemed to be reached.

Discussion: fit between DL, external environment, strategy and PMM

Many of the cases have a good fit between the DL, the PMM and the external environment. As described in the previous section, some of the case organisations occupy inherently complex environments; specifically, Case 3, the restaurant chain, and Case 5, the construction contractor. These have a DL that explicitly addresses this context, and so represents a strong fit between the DL and the external environment. Similarly, Cases 1 and 7 occupy stable environments and have a DL that is a strong fit with this.

In other cases there are examples of lack of fit, but it is notable that in the Cynefin literature, such as Snowden and Boone (2007), such misalignments result in either

ineffective operations or attempts to resolve them quickly. Drawing on the work of Melnyk *et al.* (2014), where such lack of fit causes a problem, it is because the PMM does not adapt quickly enough to the changing context. Firms that fail to adapt may suffer and so this may demonstrate an instance of bad management. Case 2 had a Domain 3 DL that may be thought of as misaligned with its stable external environment, and hence contributing to a weak competitive position against rivals that did have a Domain 2 DL. However, the Domain 3 DL was thought of as important for aligning with the customer values, which was an important part of the firm's strategy. Meanwhile, Case 4 showed an example of a Domain 2 DL misaligned with customer values and hence undermining the firm's strategy. Here, the shift was from a Domain 2 DL to a Domain 3 DL. Alignment with customer values as an aspect of firm strategy may thus be a useful avenue for future research.

A central issue for PMM scholars and practitioners is thus to gain better understanding of the nature of lack of fit between DL, PMM and external environment, and the nature of change. In particular, it is the external environment that is most likely to change, and hence the ability of a firm to reflect this. The Cynefin framework provides useful insight into this process for PMM. Evidence from the data provides an initial empirical validation of the Cynefin framework in this way; however elaboration of the theory is also prompted by the data.

During the course of the investigation, there were clear instances of unpredictable change affecting many of the businesses. The responses to this depend on the underlying assumptions of linearity. Energy efficiency as an instance of PMM (applied in manufacturing production, in offices and retail operation, in vehicle fleets and construction projects) was commonly framed as a driver of cost saving, alongside a common assertion (across cases) that energy prices would only rise. This was an argument that improving environmental performance by investing in means to reduce consumption was going to be competitively advantageous. However, the sudden fall in energy costs (IEA, 2015) undermined the costs of implementing such measures. The examples in Cases 3, 4 and 5 all saw a justification of the cost of implementing these efficiency measures on the basis of an assumed linear increase in the cost of energy. Hence, sense-making around SOSCM and related PMM was clearly that this was a predictable, structured decision problem.

This assumption for a linear trend is common but unfounded. Energy prices have experienced volatility over many decades. A similar example of SOSCM is also seen in Case 6, the construction products manufacturer, where having LCA fails as a process to drive improved ecological performance due to inherent complexity. However, merely having a certificate scores a point as a Domain 1 activity in supplier selection decision processes. Despite trying to generate accurate data, in practice no Domain 2 structured-complicated decision analysis could be developed to establish a clear, rational calculation of the benefit of one product over another, despite this appearing as an assumption among LCA advocates.

While such a contradiction may appear damaging, in this case it is merely the misalignment between an external environment of regulation and the realities of the proposed PMM. In practice, the reaction appeared to be one of resigned indifference. In the case of regulations regarding investments in low carbon electricity generation, the level of unpredictability in the associated policies was so high as to create paralysis in the company, so more a case of exasperation. Both cases highlight that the external economic and political environment is critical and one that firms can either choose to engage in or not. Investors crave predictability, and in its absence investment stalls, highlighting the value of a stable context. The importance of political and macro-economic stability may thus be seen as all important. As discussed by Christopher and Holweg (2017), periods of external stability and linear economic growth can persist for some time, but be punctured by periods of instability and no net growth.

A further important issue to emerge clearly from the data is that ensuring a good fit between strategy and PMM is not in itself necessarily sufficient to maintain long-term survival. A number of cases demonstrate that a firm's strategy still may not succeed. The competitive context is always changing and, as the Cynefin framework tries to demonstrate, a stable, linear context can swiftly evolve into an unstable, non-linear context. The medium sized fast-moving consumer goods firm, Case 2, was once a pioneer in establishing new product characteristics, but is now faced by the rising levels of competition from incumbents and new entrants copying its approach. The heavy manufacturer, Case 6, faces global macro-economic pressures that influence its competitiveness. This competition from emerging economy markets can provide standardised product to world markets but not provide the same environmental or social sustainability performance criteria required by the regulatory context or consumer values in the West. This means that unless there is a standardising of ecological or social criteria across global markets, such measures can add to bottom line costs, undermining competitiveness.

This returns to the early debate on the alignment developed within the strategic management field, which concerns the link between strategy and the external environment (Henderson and Venkatraman, 1993; Venkatraman and Camillus, 1984). The conclusion from this is that internal alignment or fit for the PMM does not necessarily ensure success. It may be a necessary condition of organisational longevity, but it is not a sufficient condition. If the PMM is not well-aligned, the performance will be suboptimal at best. Hence, PMM must still align with strategy, while strategy aligns with the external environment. The lines of alignment shown in Figure 3 are validated by the research.

SOSCM and PMM

SOSCM as PMM is a new undertaking for many organisations and a relevant area for future research in its own right. This study has focussed on SOSCM as an implementation of PMM primarily from the decision theory perspective via the Cynefin framework. One general proposition to emerge is that by virtue of its novelty to many organisations, SOSCM represents a challenge for both PMM and strategy.

Focussing on the PMM aspects, a failure of strategic alignment, or lack of fit, can be found in terms of internal alignment. This concerns the extent to which there is a disconnect between the strategic direction of a firm sought by senior management, and the ability of operational-level PMM processes to align. Strategy is a case of external alignment. Here there is a challenge faced by many organisations as to how ecological and ethical issues are aligned or misaligned with their core strategy. For some businesses, external environmental changes in customer expectations or legislative change can challenge the core strategy. Firms dependent on fossil fuel extraction for instance, or changing attitudes to commodities such as palm oil, may need a change to the strategy of the business, or resistance to the new demands being exerted, commonly via lobbying against regulation or the rhetorical communications work of greenwash.

An additional finding from the data was in relation to DL, SOSCM and ownership type. In Cases 2 and 3, different ownership types placed less pressure to have clear and unambiguous economic Domain 2 justification for any SOSCM activity. Case 4 by contrast used a clear quantitative economic rationale to justify carbon reduction measures, but the volatility of oil price undermined this economic argument shortly after the interviews were conducted. This may mean that economic decision making for issues such as reducing carbon emissions are misplaced, and instead moral decision making is more appropriate.

Both firms in this study practicing this form of decision making as part of their DL (Cases 2 and 3) were privately owned, not publicly listed on stock markets. This prompts a future research question on the influence of ownership type on DL. The hypothesis would be that firms under private ownership may find it easier to establish values-based DL than

those listed on major stock markets. Given the latter's need for quantitative, Domain 2 accountability to unknown investors challenges to this form of DL may represent a barrier to addressing the issues of sustainable and responsible business.

The nature of knowledge – the extent to which something is known or certain – is central to both Cynefin and the performance alignment matrix (as shown in Table I). Various aspects of decision theory (indeed, various decision theories), including the nature of advanced quantitative analytics – "big data" or "artificial intelligence" – have been subject to extensive consideration in academic literature dating back several decades. So too has the area of ethical decision making, and the role of judgement, intuition and moral principles. One core message of decision theory is that any form of decision support system, model, set of principles or rule of thumb, is merely a tool that the decision maker uses to help guide or inform them; the responsibility for the decision taken still remains with the decision maker/s.

Seen as a framework within decision theory, Cynefin places greater attention on the role of perception, and the significance of organisational culture as a shaper of that perception for decision-making via its DL. The performance alignment matrix, by contrast, addresses "outcomes and solutions" as problems to be solved rather than as decisions to be made. By examining the real-world case studies, a body of empirical data has been collected that seeks to understand how organisations relate to their external environment and how their PMM and strategy align. As Cynefin is a sense-making framework that addresses both predictable external contexts and unpredictable ones characterised by complexity and volatility (where cause and effect cannot be determined in advance), it also offers insight into the issue of complexity in PMM.

Looking at the use of PMM systems that concern the application of SOSCM into organisations, the experience of changes in PMM, changes in strategy and changes in external environment have been subject to context-rich, in-depth exploration. Theoretical explanation of this can then be stated in terms of the Cynefin framework. Underlying assumptions of linearity or predictability are the key. For instance, the performance of energy consumption as part of programmes to improve energy efficiency is an instance of PMM. This was commonly framed as a driver of cost saving on the basis of a common assertion (found in interviews in Cases 4-6) that energy prices would only rise.

A similar example of SOSCM is also seen in Case 6 where LCA fails as a process to drive improved ecological performance. Merely having a certificate scores a point as a Domain 1 activity in supplier selection decision processes. Despite trying to generate accurate data, in practice no Domain 2 structured-complicated decision analysis could be developed to establish a clear, rational calculation of the benefit of one product over another. Instead, the process is actually a Domain 3 context, where there is a high level of ambiguity and context specificity. To make LCA amenable to structured decision making, such as supplier selection decisions based on environmental performance, would require a greater structuring via standardization of methodologies, as well as other means of determining valid comparability, that may not be possible (Q6.2).

By contrast with the performance alignment matrix, the Cynefin framework makes the different contrasts more explicit and provides deeper explanation as to why in terms of knowledge management and sense-making. It thus provides an extension or alternative perspective on the same phenomenon and categories described in the performance alignment matrix.

The main contribution provided by the research presented in this paper is illustrating the role of awareness of an organization's context. Conditions of volatility, uncertainty, complexity and ambiguity can mean that strategy is forced to change quickly, and that PMM must then change equally fast at strategic, tactical and operational levels. The example of a client making write-downs because of the impact of the balanced scorecard

as a PMM in Case 5 (again, ultimately caused by volatility in real estate, post 2008), demonstrates the huge and negative strategic impact that can result from a brittle PMM that fractures in relation to strategy and environment. Organizational awareness, attention, or sense-making are central to this.

While this paper has used the Cynefin framework to elaborate existing theory in PMM, notably the performance alignment matrix in the work of Melnyk *et al.* (2014), the wider academic field of decision theory, related to the themes in both Cynefin and the performance alignment matrix, provides deep foundations from which to further develop theory. Returning to development of the alignment concept in strategic management (Chorn, 1991; Henderson and Venkatraman, 1993; Venkatraman, 1989; Venkatraman and Camillus, 1984) provides further opportunities to elaborate the theory of fit in PMM, potentially revisiting the roots of the debate in contingency theory (Hickson *et al.*, 1971).

Conceptual synthesis (Denyer *et al.*, 2008; Tranfield *et al.*, 2003) may extend beyond the exploration of Cynefin and the performance alignment matrix here. The concept of dynamic capabilities, for instance, maintains that changing core capabilities in a swift and responsive manner is vital for strategic success (Eisenhardt and Martin, 2000; Teece *et al.*, 1997). In the operations and supply chain management context, the hybrid concept of "leagile" refers to the balance between lean and agile where the former suits stable, regular process flows in mass production, against the operational flexibility required for dynamic capabilities to stay responsive to changing customer needs and other external forces (Purvis *et al.*, 2014). These parallels and precursors further validate the concept of balance between different contexts (suddenly changeable and unpredictable, requiring responsiveness, or stable and predictable, and hence mathematically optimisable such as via statistical process analysis).

This distinction echoes longstanding discussions in business and management scholarship. These include the development of decision theory by Herbert Simon (1947, 1957, 1959, 1960, 1962, 1972, 1977, 1978); also, the critique of classical management science and general systems theory by Checkland (1972, 1980, 1983, 2000), where structured contexts are referred to as hard systems, and unstructured are soft systems (Figure 2), characterised by an inability to determine the variables; similarly, the concepts of tame problems, messy problems and wicked problems (Rith and Dubberly, 2007; Rittel and Webber, 1973) address the distinction later defined in terms of predictable, ordered simplicity and unpredictable complexity in Cynefin. Similar precursors also exist in the philosophy of science, such as Weaver (1948) "*Science and Complexity*" and Popper (1965) "*Of Clouds and Clocks*". These precursors are examples of reciprocal synthesis, where the same phenomena are conceptualised using different terminology and from different scholarly perspectives. This range of literature helps to validate the nature of the Snowden's Cynefin framework (and indeed Melnyk's performance alignment matrix and Chorn's typologies for strategic alignment).

Implications for research and practice

As the first paper to consider the Cynefin framework in relation to operations management and PMM, it has provided insight into the link between organisational culture (the DL) and sense-making. This answers the call of Melnyk *et al.* (2014) on the need for greater understanding of social factors, organisational culture, complexity, autopoiesis and uncertainty in PMM theory, and the call for this special issue. In addition, the relatively nascent area of SOSCM and PMM has been explored, the newness of which is a clear driver of potential misalignment with existing PMM systems and strategic objectives.

Making appropriate adjustments to PMM over time based on turbulent and variable external environments and shifting between four domains of the Cynefin framework

could prove an effective way of reformulating the organisation strategy, promoting intended behaviour and organisational learning. An organisation that is aware of the different DLs presented in Cynefin may be better prepared for change. Yet, if an organisation is in a stable environment, such investment may appear as a suboptimal use of resources. A broader point is that the mind-set of managers and their organisational culture (their institutional schema for sense-making) is often very strong; the definition of what Cynefin is, "a Welsh word that signifies the multiple factors in our environment and our experience that influence us in ways we can never understand" (Snowden and Boone, 2007).

Whilst strong and committed leadership may be essential for reshaping organisational culture in preparation of diverse and turbulent environment (as in Domains 3 and 4), expectations about the locus of control are central to this theory. To advance theory around Domain 3 PMM as a means to address emergence and complexity, an open source approach to PMM might need to be considered. This is suggested in part by continuous improvement (Slack *et al.*, 2009) where a bottom-up approach to change is taken. It is also formalised in the theory of positive deviance or anonymous employee feedback systems (Spreitzer and Sonenshein, 2004). These may suggest new, more responsive approaches to PMM, recognising bounded rationality as an issue for centralised authority, and capturing the wisdom of crowds as a form of decentralised emergence.

Combining decision theory with the topic of PMM draws attention to where decision making should lie. The acquiring of performance data is intended to enable managers in positions of authority to make decisions. Under the traditional model of organisational authority, the command-and-control approach, it is the senior management who acquire the data and then push the decisions downwards through a rigid hierarchy, where middle management are empowered to make decisions on the basis of analytic justifications, and "shop floor" decision making is standardised. However, this model does not reflect the need for emergence to address responsiveness under conditions of complexity. The Cynefin framework provides a means to map these different types of context and their responses for decision makers. However, the next stage for developing PMM would be how to develop emergent performance measurement and management processes.

This relates to how PMM connects to internal organisational structure in order to produce better run organisations. Organisations applying an integrated Cynefin-aware PMM system may have a dynamic policy/strategy deployment process in place where changes in the external environment can be swiftly reflected internally in the organisation. Reflecting these changes in the organisational strategy at the business level would involve interaction with the PMM system at tactical and operational levels. Such an organisation would promote empowerment, flexibility, skill development at every level and at the same time have people able to probe, sense and respond to external uncertainty. Examples of organisations that are exemplars in dynamic capabilities, or who combine both lean and agile characteristics may provide significant cases for future research. Where lean tools are capable of driving improved performance in a stable environment, organisations that can dynamically combine lean with agile when faced with unpredictable change, or persistent uncertainty in the external environment, provide valuable examples of how managers cope with what is knowable or unknowable. How managers best respond as a result, including how the organisation as a whole responds, through organisational culture, strategy formulation and PMM processes, are the central questions.

The data gathered here have encountered instances of organisations with different types of culture and PMM processes. The concept of DL is a useful way to extend theory around organisational culture into the PMM literature, particularly with regard to how the topic of changing a DL is recognised as a major challenge (Case 4). Furthermore, using Cynefin as a

way to deeper the theoretical concept of DL is a helpful way to understand the relationship between organisational culture and the mindset of people within a given industry, and the potential ways in which this helps deepen understanding of the organisational culture in relation to PMM. Clearly, the limitations to this research exist in terms of the scope of the cases studied and the limited number of industrial sectors included. Further conceptual development is possible, and the bridges to previous work in business and management scholarship suggest that deeper conceptual reviews of the literature in parallel fields such as strategic management may be beneficial.

Future research is needed to highlight how the DL of different industries can be translated into more responsive PMM. For example, the restaurateur culture in Case 3 was deliberately created in a multi-national enterprise, in contrast to a more mechanised, analytic-driven culture that may typically be seen in the fast food sector. Similarly, the principles-based culture developed for the construction site is a marked contrast to that of organisations operating in the controlled and stable conditions of a manufacturing plant. To what extent are these cases typical of their sector, or was their alignment fortuitous?

What the research presented here has shown, are the instances where these DLs have encountered instances of misalignment with PMM systems. In line with the processes presented in the works of Eisenhardt (1989) and Ketokivi and Choi (2014), the purpose of such a method is to better understand the concepts under investigation by deep engagement with organisational practice. Decision theory and the Cynefin framework is thus found to elaborate existing conceptualisations of unpredictability and complexity and subsequent problems of misalignment in PMM. New research is thus needed to further investigate the potential for bringing PMM and decision theory together in order to better understand how to improve the performance of organisations operating in an increasingly fast-changing and unpredictable world.

References

Alexander, A., Walker, H. and Naim, M. (2014), "Decision theory in sustainable supply chain management: a literature review", *Supply Chain Management: An International Journal*, Vol. 19 Nos 5/6, pp. 504-522.

Bennett, N. and Lemoine, J. (2014), "What VUCA really means for you", *Harvard Business Review*, Vol. 92 Nos 1/2, p. 27.

Bettis, R.A. and Prahalad, C.K. (1995), "The dominant logic: retrospective and extension", *Strategic Management Journal*, Vol. 16 No. 1, pp. 5-14.

Bititci, U., Garengo, P., Dörfler, V. and Nudurupati, S. (2012), "Performance measurement: challenges for tomorrow", *International Journal of Management Reviews*, Vol. 14 No. 3, pp. 305-327.

Browning, L. and Boudès, T. (2005), "The use of narrative to understand and respond to complexity: a comparative analysis of the Cynefin and Weickian models", *Emergence: Complexity and Organization*, Vol. 7 Nos 3/4, pp. 32-39.

Checkland, P. (1983), "O.R. and the systems movement: mappings and conflicts", *Journal of the Operational Research Society*, Vol. 34 No. 8, pp. 661-675.

Checkland, P. (2000), "Soft systems methodology: a 30-year retrospective", *Systems Research and Behavioural Science*, Vol. 17 No. 1, pp. 11-58.

Checkland, P.B. (1972), "Towards a systems-based methodology for real-world problem solving", *Journal of Systems Engineering*, Vol. 3 No. 2, pp. 87-116.

Checkland, P.B. (1980), "The systems movement and the 'failure' of management science", *Cybernetics and Systems*, Vol. 11 No. 4, pp. 317-324.

Choi, T.Y., Dooley, K.J. and Rungtusanatham, M. (2001), "Supply networks and complex adaptive systems: control versus emergence", *Journal of Operations Management*, Vol. 19 No. 3, pp. 351-366.

Chorn, N.H. (1991), "The 'alignment' theory: creating strategic fit", *Management Decision*, Vol. 29 No. 1, pp. 20-28.

Christopher, M. and Holweg, M. (2017), "Supply Chain 2.0 revisited: a framework for managing volatility-induced risk in the supply chain", *International Journal of Physical Distribution & Logistics Management*, Vol. 47 No. 1, pp. 2-17.

Denyer, D., Tranfield, D. and Van Aken, J.E. (2008), "Developing design propositions through research synthesis", *Organization Studies*, Vol. 29 No. 3, pp. 393-413.

Dubois, A. and Gibbert, M. (2010), "From complexity to transparency: managing the interplay between theory, method and empirical phenomena in IMM case studies", *Industrial Marketing Management*, Vol. 39 No. 1, pp. 129-136.

Eisenhardt, K. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14 No. 4, pp. 532-550.

Eisenhardt, K.M. and Martin, J.A. (2000), "Dynamic capabilities: what are they?", *Strategic Management Journal*, Vol. 21 Nos 10/11, pp. 1105-1121.

Forrester, J.W. (1958), "Industrial dynamics: a major breakthrough for decision makers", *Harvard Business Review*, Vol. 36 No. 4, pp. 37-66.

French, S. (2012), "Cynefin, statistics and decision analysis", *Journal of the Operational Research Society*, Vol. 64 No. 4, pp. 547-561.

French, S. and Geldermann, J. (2005), "The varied contexts of environmental decision problems and their implications for decision support", *Environmental Science & Policy*, Vol. 8 No. 4, pp. 378-391.

French, S., Maule, J. and Papamichail, N. (2009), *Decision Behaviour, Analysis and Support*, Cambridge University Press, Cambridge.

Garengo, P., Biazzo, S. and Bititci, U.S. (2005), "Performance measurement systems in SMEs: a review for a research agenda", *International Journal of Management Reviews*, Vol. 7 No. 1, pp. 25-47.

Hahn, T., Preuss, L., Pinkse, J. and Figge, F. (2014), "Cognitive frames in corporate sustainability: managerial sensemaking with paradoxical and business case frames", *Academy of Management Review*, Vol. 39 No. 4, pp. 463-487.

Harkness, M. and Bourne, M. (2015), "Is complexity a barrier to effective performance measurement?", paper presented at the Proceedings of the PMAA, Auckland.

Henderson, J.C. and Venkatraman, N. (1993), "Strategic alignment: leveraging information technology for transforming organizations", *IBM Systems Journal*, Vol. 32 No. 1, pp. 472-484.

Herington, C., Dadich, A., Fulop, L., Ditton, M., Campbell, S., Curry, J. and Smyth, A. (2015), "Finding brilliance using positive organizational scholarship in healthcare", *Journal of Health Organization and Management*, Vol. 29 No. 6, pp. 750-777.

Hickson, D.J., Hinings, C.R., Lee, C.A., Schneck, R.E. and Pennings, J.M. (1971), "A strategic contingencies' theory of intraorganizational power", *Administrative Science Quarterly*, Vol. 16 No. 2, pp. 216-229.

HSE (2016), "UK government, health & safety executive, construction sector data", available at: www.hse.gov.uk/statistics/industry/construction/ (accessed 13 January 2016).

IEA (2015), *World Energy Outlook 2015*, International Energy Agency, Paris.

Kennerley, M. and Neely, A. (2003), "Measuring performance in a changing business environment", *International Journal of Operations & Production Management*, Vol. 23 No. 2, pp. 213-229.

Kennerley, M., Neely, A. and Adams, C. (2003), "Survival of the fittest: measuring performance in a changing business environment", *Measuring Business Excellence*, Vol. 7 No. 4, pp. 37-43.

Ketokivi, M. and Choi, T. (2014), "Renaissance of case research as a scientific method", *Journal of Operations Management*, Vol. 32 No. 5, pp. 232-240.

Kolehmainen, K. (2010), "Dynamic strategic performance measurement systems: balancing empowerment and alignment", *Long Range Planning*, Vol. 43 No. 4, pp. 527-554.

Kumar, M. and Kumar, N. (2016), "Three dimensions of service recovery: examining relationship and impact", *Supply Chain Management: An International Journal*, Vol. 21 No. 2, pp. 273-286.

Kurtz, C.F. and Snowden, D.J. (2003), "The new dynamics of strategy: sense-making in a complex and complicated world", *IBM Systems Journal*, Vol. 42 No. 3, pp. 462-483.

Lorenz, E.N. (1963), "Deterministic nonperiodic flow", *Journal of the Atmospheric Sciences*, Vol. 20 No. 2, pp. 130-141.

Melnyk, S.A., Hanson, J.D. and Calantone, R.J. (2010), "Hitting the target … but missing the point: resolving the paradox of strategic transition", *Long Range Planning*, Vol. 43 No. 4, pp. 555-574.

Melnyk, S.A., Stewart, D.M. and Swink, M. (2004), "Metrics and performance measurement in operations management: dealing with the metrics maze", *Journal of Operations Management*, Vol. 22 No. 3, pp. 209-218.

Melnyk, S.A., Bititci, U., Platts, K., Tobias, J. and Andersen, B. (2014), "Is performance measurement and management fit for the future?", *Management Accounting Research*, Vol. 25 No. 2, pp. 173-186.

Micheli, P. and Manzoni, J.-F. (2010), "Strategic performance measurement: benefits, limitations and paradoxes", *Long Range Planning*, Vol. 43 No. 4, pp. 465-476.

Miles, M.B. and Huberman, A.M. (1994), *Qualitative Data Analysis: An Expanded Sourcebook*, Sage, London.

Mintzberg, H. and Waters, J.A. (1985), "Of strategies, deliberate and emergent", *Strategic Management Journal*, Vol. 6 No. 3, pp. 257-272.

Mintzberg, H. and Westley, F. (2001), "Decision making: it's not what you think", *MIT Sloan Management Review*, Vol. 42 No. 3, pp. 89-93.

Moynihan, D.P. (2008), *The Dynamics of Performance Management: Constructing Information and Reform*, Georgetown University Press, Washington, DC.

Nair, A., Narasimhan, R. and Choi, T.Y. (2009), "Supply networks as a complex adaptive system: toward simulation-based theory building on evolutionary decision making", *Decision Sciences*, Vol. 40 No. 4, pp. 783-815.

Nicolis, G. and Prigogine, I. (1977), *Self-Organization in Nonequilibrium Systems*, Wiley, New York, NY.

Nudurupati, S.S., Bititci, U.S., Kumar, V. and Chan, F.T. (2011), "State of the art literature review on performance measurement", *Computers & Industrial Engineering*, Vol. 60 No. 2, pp. 279-290.

Pathak, S.D., Day, J.M., Nair, A., Sawaya, W.J. and Kristal, M.M. (2007), "Complexity and adaptivity in supply networks: building supply network theory using a complex adaptive systems perspective", *Decision Sciences*, Vol. 38 No. 4, pp. 547-580.

Pauwels, P. and Matthyssens, P. (2004), "The architecture of multiple case study research in international business", in Marschan-Piekkari, R. and Welch, C. (Eds), *Handbook of Qualitative Research Methods for International Business*, Edward Elgar Publishing, Cheltenham, pp. 125-143.

Pekkola, S., Pekkola, S., Saunila, M., Saunila, M., Rantanen, H. and Rantanen, H. (2016), "Performance measurement system implementation in a turbulent operating environment", *International Journal of Productivity and Performance Management*, Vol. 65 No. 7, pp. 947-958.

Pelrine, J. (2011), "On understanding software agility: a social complexity point of view", *Emergence: Complexity and Organization*, Vol. 13 Nos 1/2, pp. 26-37.

Popper, K.R. (1965), *Of Clouds and Clocks; an Approach to the Problem of Rationality and the Freedom of Man*, Washington University, Press, Washington, DC.

Prahalad, C.K. and Bettis, R. (1986), "The dominant logic: a new linkage between diversity and performance", *Strategic Management Journal*, Vol. 7 No. 6, pp. 485-501.

Preuss, L. and Walker, H. (2011), "Psychological barriers in the road to sustainable development: evidence from public sector procurement", *Public Administration*, Vol. 89 No. 2, pp. 493-521.

Prigogine, I. and Stengers, I. (1984), *Order Out of Chaos*, Bantam Books, Toronto; New York, NY, London and Sydney.

Purvis, L., Gosling, J. and Naim, M.M. (2014), "The development of a lean, agile and leagile supply network taxonomy based on differing types of flexibility", *International Journal of Production Economics*, Vol. 151, May, pp. 100-111.

Richard, P.J., Devinney, T.M., Yip, G.S. and Johnson, G. (2009), "Measuring organizational performance: towards methodological best practice", *Journal of Management*, Vol. 35 No. 3, pp. 718-804.

Rith, C. and Dubberly, H. (2007), "Why Horst WJ Rittel matters", *Design Issues*, Vol. 23 No. 1, pp. 72-91.

Rittel, H.W. and Webber, M.M. (1973), "Dilemmas in a general theory of planning", *Policy Sciences*, Vol. 4 No. 2, pp. 155-169.

Ross, S.A. (1973), "The economic theory of agency: the principal's problem", *The American Economic Review*, Vol. 63 No. 2, pp. 134-139.

Rotaru, K., Churilov, L. and Flitman, A. (2014), "Can critical realism enable a journey from description to understanding in operations and supply chain management?", *Supply Chain Management: An International Journal*, Vol. 19 No. 2, pp. 117-125.

Saldaña, J. (2012), *The Coding Manual for Qualitative Researchers*, Sage, London.

Simon, H.A. (1947), *Administrative Behavior. A Study of Decision-Making Processes in Administrative Organization*, Macmillan, New York, NY.

Simon, H.A. (1957), *Models of Man; Social and Rational*, John Wiley and Sons, Inc., New York, NY.

Simon, H.A. (1959), "Theories of decision-making in economics and behavioral science", *The American Economic Review*, Vol. 49 No. 3, pp. 253-283.

Simon, H.A. (1960), *The New Science of Management Decision*, Harper and Row, New York, NY.

Simon, H.A. (1962), "The architecture of complexity", *Proceedings of the American Philosophical Society*, Vol. 106 No. 6, pp. 467-482.

Simon, H.A. (1972), "Theories of bounded rationality", *Decision and Organization*, Vol. 1 No. 1, pp. 161-176.

Simon, H.A. (1977), "The structure of ill-structured problems", *Models of Discovery and Other Topics in the Methods of Science*, Chapter 17, Springer, Cambridge, MA, pp. 304-325.

Simon, H.A. (1978), "Rationality as process and as product of thought", *The American Economic Review*, Vol. 68 No. 2, pp. 1-16.

Sinkovics, R.R. and Alfoldi, E.A. (2012), "Progressive focusing and trustworthiness in qualitative research", *Management International Review*, Vol. 52 No. 6, pp. 817-845.

Slack, N., Chambers, S., Johnston, R. and Betts, A. (2009), *Operations and Process Management: Principles and Practice for Strategic Impact*, Pearson Education, London.

Snowden, D. (2000), "The social ecology of knowledge management", in Despres, C. and Chauvel, D. (Eds), *Knowledge Horizons: The Present and the Promise of Knowledge Management*, Butterworth-Heinemann, Woburn, MA, pp. 237-265.

Snowden, D. (2002), "Complex acts of knowing: paradox and descriptive self-awareness", *Journal of Knowledge Management*, Vol. 6 No. 2, pp. 100-111.

Snowden, D. and Boone, M. (2007), "A leader's framework for decision making", *Harvard Business Review*, November, pp. 68-78.

Soltani, E., Ahmed, K., Ying Liao, P.Y. and Anosike, U.P. (2014), "Qualitative middle-range research in operations management: the need for theory-driven empirical inquiry", *International Journal of Operations & Production Management*, Vol. 34 No. 8, pp. 1003-1027.

Spreitzer, G.M. and Sonenshein, S. (2004), "Toward the construct definition of positive deviance", *American Behavioral Scientist*, Vol. 47 No. 6, pp. 828-847.

Taylor, F. (1911), *The Principles of Scientific Management*, Harper & Brothers, New York, NY.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.

Tett, G. (2009), *Fool's Gold: How the Bold Dream of a Small Tribe at JP Morgan was Corrupted by Wall Street Greed and Unleashed a Catastrophe*, Free Press, Simon and Schuster, New York, NY.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", *British Journal of Management*, Vol. 14 No. 3, pp. 207-222.

Vaughan, S. (2013), "Elite and elite-lite interviewing: managing our industrial legacy", in Franklin, A. and Blyton, P. (Eds), *Researching Sustainability: A Guide to Social Science Methods, Practice and Engagement*, Earthscan, Abingdon, pp. 105-119.

Venkatraman, N. (1989), "The concept of fit in strategy research: toward verbal and statistical correspondence", *Academy of Management Review*, Vol. 14 No. 3, pp. 423-444.

Venkatraman, N. and Camillus, J.C. (1984), "Exploring the concept of 'fit' in strategic management", *Academy of Management Review*, Vol. 9 No. 3, pp. 513-525.

Walter, J., Kellermanns, F.W., Floyd, S.W., Veiga, J.F. and Matherne, C. (2013), "Strategic alignment: a missing link in the relationship between strategic consensus and organizational performance", *Strategic Organization*, Vol. 11 No. 3, pp. 304-328.

Weaver, W. (1948), "Science and complexity", *American Scientist*, Vol. 36 No. 4, pp. 536-544.

Weick, K.E. (1995), *Sensemaking in Organizations*, Vol. 3, Sage.

Yin, R.K. (1994), *Case Study Research: Design and Methods*, International Educational and Professional Publisher, Thousand Oaks, CA.

Further reading

Che, Z.-H., Chiang, T.-A., Tu, C. and Chiang, C.-J. (2010), "A supplier selection model for product design changes", *International Journal of Electronic Business Management*, Vol. 8 No. 1, pp. 20-30.

Christopher, M. and Holweg, M. (2011), "'Supply Chain 2.0': managing supply chains in the era of turbulence", *International Journal of Physical Distribution & Logistics Management*, Vol. 41 No. 1, pp. 63-82.

Williams, R. (2006), "Narratives of knowledge and intelligence … beyond the tacit and explicit", *Journal of Knowledge Management*, Vol. 10 No. 4, pp. 81-99.

Appendix

Ref. no.	Representative quote
Q1.1	"We are an engineering company. We are more focussed on quality and assurance, and that's how we deal with our suppliers […]. There's not a lot of revolution […]. The rate of revolution is very low" (Financial director)
Q1.2	"We wouldn't have any say on the components that were used to give us the product. We have no input there […]. I would say we have zero influence to be absolutely clean. We have zero influence as to the material they are going to be using and the process they are going to be using" (Financial director)
Q1.3	"In the process we use a lot of chemicals […] harmful […] to the planet. The difference is how well you control that process […]. Quality, performance and service should be driving that anyway. If they are very good in quality, service and availability, they are most likely to be efficient in maintaining the equipment, therefore they should have less wastage" (Financial director)
Q1.4	"One issue that I've got is when I look at my organisation, it's not in the DNA to do CSR. Of the group or the individual" (Financial director)
Q1.5	"people understand the words sustainability and corporate responsibility now […]. They get the fact that we need to be cleaner technology. They get some stuff around carbon goals […] but don't forget we are an engineering firm so people are very linear in their thinking. Whether they are a design engineer or one of the quality guys […] people are incredibly linear and don't necessarily get off their islands […] they're not used to doing that" (Corporate social responsibility manager)
Q2.1	"As a values-based business, we recruit on the basis of 'will people be able to fit in and […] adopt and support our values […]. We have a [regular] review session that checks-in on how are the values living in the office […] we deliberately don't have a leader on each of the values as the idea is that everyone in the team is fostering, and working to drive, those values." (Managing director)
Q2.2	The way the values come out day-to-day is that […] you'll hear people use them […]. When we've got a problem or an opportunity, rather than say […]" get the sales team together" and say, "there's a retail opportunity", actually, "who's around who can help input". Whether that's the team PA, the supply chain manager, the marketeers, the finance person, or the [retailer] account manager" (Managing director)
Q2.3	"it's the whole David vs. Goliath thing, that we don't have the same resource as [rival firm #1] and [rival firm #2] and [rival firm #3] have, so we're going to have to be fast and nimble and use the resources we do have to maximum effect" (Managing director)
Q3.1	"The culture takes a bit of getting used to […]. It's a big company where it's got a very small company feel […] there's the mindset for a start. You don't have to go in and battle different people for different reasons. You don't have to go and battle with the FD because he's got a different outlook, about money, or the Ops Director […] it's just accepted that I'm doing it because it's the right thing to do […] they will try things and it's ok to fail. But you don't know until you try" (Energy manager)
Q3.2	"No one is saying to me, 'where's your compliance monitoring'. No one is saying, 'we need to go through loads more boring processes, that move us extremely slowly and just gets us a figure at the end of a year's work' - and then we don't know what to do with that figure […]. if I get an idea that's got legs, they'll go for it. But if I start giving them formal structures, and say 'this is where we are at on these formal structures, we almost slow our own progress […] I remember one of the regional managing directors, who at the time I thought was just a hard-nosed operator […] said, "I just want to be able to sleep easy in my bed at night" (CSR manager)
Q3.3	"We get clobbered with everything. CRC [Govt 'Carbon Reduction Commitment' scheme], ESOS [Govt 'Energy Savings Opportunity Scheme'], which is coming in this year […]. We have to report on our annual consumption of gas and electricity, then we have to pay an amount per ton of CO_2 emitted […] we have to audit […] and produce reports and that's it really" (Energy manager)

Table AI.
Interview data

(*continued*)

Ref. no.	Representative quote
Q4.1	"[…] we have all sorts of delegated levels of authority within [the company]. We have more risk process checkers, checkers checking checkers than you would believe […] really risk averse internally […] it all went very control focused […] and we are reaching a situation where this very risk-averse position is unsustainable. So we need to rebalance and it's that rebalancing, I think, that's led to a more principles and values-based approach […]. It's not a compliance-based, you must follow this set of rules. It's about equipping people with the principles that they need and the values to make that decision independently, without having to rely on a system of rules […] the more rules you put in place, the less independent thinking there is within an organisation" (Supply Chain Director)
Q4.2	"Our fuel costs are second behind payroll […] we run a huge fleet of vehicles […] we've got to think outside the box because fuel costs will continue to rise […] and it's not just the fuel costs of the fleet, you know, we spend a lot of money on utility costs - gas, electric heating oil; it's a huge spend for the business […] let's stretch our thinking on this because energy costs ain't gonna be dropping". (Logistics supplier, Head of environment)
Q5.1	"[Construction] projects are a series of problems that are to be solved. If it was easy to build them, you wouldn't need a principal contractor, because you just tell the subbies [sub-contractors] to turn up and send them a little list and when they should turn up. They are complex and they are one-off and that's difficult […]. We've got a really good PM [project manager] who's done jobs like this before, and will do jobs like this again, but on every one of his jobs he's got a massive learning curve […] That can't be under-estimated. The learning curve is dramatic in each project […]" (Regional director)
Q5.2	"Health and safety drives it. Construction kills a lot of people every year - an awful lot of people. And that's just not good enough. We are going to build things. We don't want to kill people doing it. So that's the driver" (Contractor, Regional director)
Q5.3	"The guys that manage these sort of projects, they're just fantastic to watch - to see them do their job. They can juggle hundreds of things at the same time, and they've almost built this a hundred times in their head. They've got to get that deep into it, so when a sub-contractor comes in and asks them the silly question, they can answer them straight away and push them back out the door" (Sustainability manager)
Q5.4	"BREEAM is only a tool and there's various tools out there for various different things. It's just a tick box. Things like BREEAM actually are quite misguided as well. Building regs tend to be more solid and drive performance to be what we want to get from places. BREEAM is a little bit more airy fairy to be honest". (Regional director)
Q5.5	"We have a set of KPIs we use, but to be honest, they are in and out a little bit. The balanced scorecard is a pretty impressive thing, but it is a pretty impressive thing when you are doing the same thing […] when it is aligned. It's more difficult when you are dealing with a series of unique projects […]" (Regional director)
Q6.1	"It's high spec, specialist [engineering] where I have a team of engineers working for me who do the calculations. They rock up and, say I want an architectural facade on this, and he and his team would tell you exactly what you needed – calculate it all out. There are various models […] and all that stuff" (Commercial director)
Q6.2	"We don't use [life cycle analysis] as a tool for improvement at the moment. We use it in terms of [external auditing]. We are struggling to understand the definitions, particularly when our customers will define life cycle analysis to suit their own need and then use that as a comparison […]. Our competitors […] they've got a life cycle that is based on slightly different starting points, slightly different definitions to make their system advantageous over ours. So, it's difficult to compare like with like. I think our customers would love to be able to use life cycle analysis as a selection tool as part of their discussions. Until we actually define what the full standards of that are and the initial unit of measured definitions that go into that, it becomes a little bit difficult to do like for like comparisons. I guess there's a need for standardization" (Operations and supply chain director)
Q6.3	"[…] within a tender process […] the price dominates. So you can be high in technical […] highly sustainable and still lose out or not get a fair value for that because there is a lot of emphasis on price" (Commercial director)

(*continued*)

Table AI.

Ref. no.	Representative quote
Q6.4	"It is so very difficult to make a long term decision […]. The changeable nature of the market is very difficult to deal with at the moment. It's almost paralyzing […]. You ask any energy buyers across the country and they'll say the biggest problem is legislation changes. We don't know where we are. How can we make a decision on legislation that could change tomorrow on a moment's notice" (Energy buyer)
Q7.1	"[what we do is] very simple and very standard". (Communications director)
Q7.2	"When we went through the KPIs and we analysed each and every one trying to clearly understand exactly what we were trying to measure […] what we came up with was a detailed list of KPIs that whether you had a sustainability program or not, it would be the right things to monitor, measure and focus on because it's the right way to run a business". (Chairman)
Q7.3	"[…] the governance around it basically is quite structured. We have our sustainability agenda that's governed by our board committee […]. Then we have sponsored group champions, and site champions which work with the group champions, to deliver on the KPIs; and underlying all that is the non-financial KPIs" (Communications director)"

Table AI.

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