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Performance measurement systems: A consensual analysis of their roles

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ABSTRACT

Competitive pressures and advances in product and process technologies challenge performance management systems in terms of their design and their strategic and operational use. Understanding the roles of such systems is a first step in developing and employing the appropriate system capabilities and functions. This paper first identifies the roles a performance measurement system can perform. A synthesis is then used to capture expert views through interviews and a Delphi exercise. Twenty international operations management experts participated in the study—eleven academics and nine industry professionals. The study resulted in a refined list of proposed roles of performance measurement systems from the existing operations literature. The findings from the study show that continuous improvement, organisational learning and change management are new elements that characterise the refined measurement system roles, and that the appropriate PMS roles are contingent on design recommendations. The study provides insights for the design, management and use of PMS in organisations.

1. Introduction

Competitive pressures and advances in product and processes technologies are forcing enterprises to revise their strategies and redesign their operations management systems. Developing the necessary position, process and trajectory may provide operations management systems with a more dynamic strategic management capability (Wibe, 2008; Kathuria et al., 2007; Binder and Clegg, 2007; Fernandes et al., 2006; Neely, 2005; Marr and Schiuma, 2003; Teece et al., 1997). Particularly, organisations are paying close attention to the changing nature of operations performance to the point that Operations Strategic Management Systems used for managing performance is a main focus of many redesign projects (Gomes et al., 2004). The belief is that there will be a positive impact on overall organisational performance if the performance management system is designed, or redesigned, appropriately.

However, a body of research suggests that there is no causal link between such redesign initiatives and overall improvements in performance. (Vergidis et al., 2008; Pinheiro de Lima et al., 2008; Bourne et al., 2005, 1999). Research does suggest that for improved performance, strategic management systems should be employed enterprise-wide, instead of narrowly constrained to the performance measurement system. Such systems should be dynamic rather than static and facilitate capabilities to cope with organisational change (Neely, 2005).

Understanding the role of a Performance Measurement System (PMS) is a first step in defining system capabilities and functions that that will support such strategic management system (Pinheiro de Lima et al., 2008). Authors such as Phusavat et al. (2009), Tan and Platts (2009), Folan et al. (2007) and Franco-Santos et al. (2007) explore the theoretical fundamentals of PMS. They highlight the importance of establishing causal links between business strategy and PMS design, and suggest there are theoretical constructions that mediate the relationship between strategy and performance measures and that these links should be studied in terms of their structural and dynamics characteristics. These mediating elements should be stated in terms of system roles, capabilities and design recommendations.

The research reported in this paper seeks to advance understanding of PMS design and use in general terms, and of qualified measure choice to include in PMS design in particular. The study identifies PMS roles as a mediating construct for strategy development and design. It also explores the roles a performance measurement system should perform as part of an operations strategic management system. Neely (2005) has noted that

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research in performance measurement and performance management has evolved. The theoretical models were developed about two decades ago. Content or structural and process frameworks guided design and implementation of performance measurement systems during the following 10 years, leaving a knowledge gap in the application of PMS and the validation or reassessment of the existing theoretical constructs. This contemporary challenge is addressed in this study. Moreover, Slack et al. (2004) discuss a dialectic process between theory and practice that defines operations management as an academic discipline, commenting that operations managers' decision models are tested on a day-to-day basis.

This study uses these premises to explore the use of performance measures based on expert perceptions that represent the continuous interchange between theory and practice. The study uses a Delphi exercise to capture the views of academic and industry professionals on the roles of PMS in contemporary practice. The experts were chosen for their contribution and experience in performance management. The academic group have researched performance management topics, while the industry professionals have substantial experience in PMS implementation and management. The study provides a synthesis of various PMS roles based on existing literature and the experts' perceptions. These PMS roles could be used to define PMS capabilities, which could form a set of design recommendations. Although some of the findings relating PMS roles to continuous improvement, organisational learning and change management capabilities appear to be a natural consequence of theoretical development, it is important to understand the experts' perceptions of actual PMS roles.

The study's approach is influenced by the process framework proposed by Folan and Browne (2005), and work by Chenhall (2005) on the function of operation management. The study also complements research by Neely et al. (2000) and Acur and Bititci (2004) in identifying PMS roles for operations strategic management system implementation and management. The study provides an overview of the evolutionary element of performance measurement and management. Neely (2005) states that concepts, processes and methods proposed in the 1980s and 1990s are both tested and challenged by actual application. Studies by Bourne (2005), Bourne et al. (2005), Franco-Santos et al. (2007), Franco-Santos and Bourne (2003), Herzog et al. (2009), Kathuria et al. (2007), Kennerley and Neely (2003, 2002), and Neely (2005), Nenadal (2008), Nudurupati et al. (2011), and Verbeeten and Boons (2009) focus on empirical evidence related to the theme 'managing through measures'. Popova and Sharpanskykh (2010), Phusavat et al. (2009), Tan and Platts (2009), and Taticchi and Balachandran (2008) identify the need for research that assesses and discusses practical and theoretical implications of performance information use. The study reported in this paper adds to the PMS discourse by further exploring performance measurement roles and their conceptual and empirical implications.

The paper is structured as follows. In Section 2, a theoretical set of assumptions for studying PMS is presented. Three fundamental visions characterize PMS theoretical foundations in terms of PMS content, PMS process and PMS strategic context. In Section 3 the research methodology is discussed and justified, defined by the adopted research approach, research strategy choices and research planning. In Section 4, results from the Delphi exercise are presented and discussed. Finally, results are synthesised into a consensual list of strategic PMS roles.

2. Theoretical foundations

This section on theoretical foundations of the study covers three main domains: PMS content, process and strategic context. This follows guidelines proposed by Pettigrew et al. (1989) for studying organisational and management systems.

2.1. Performance management system content

Conceptually, PMS lacks an agreed established definition. According to Amaratunga and Baldry (2002), a strategic performance management system is a system that uses information on performance to produce a positive change in organisational culture, systems and processes. Similarly, Zu et al. (2010) add that there is an embedded role for PMS as part of Operations Strategic Management Systems. Folan et al. (2007) even note that PMS is responsible for the management of operations strategy implementation.

Performance measurement recommendations provide the building blocks for initiatives that materialize within a given PMS. These recommendations define measures, their content and structure, which provide a framework to inform the PMS design (Folan and Browne, 2005). Content definition, structure and subsequent selection and organisation of measures for PMS are strongly linked to their utility. The focal point is the process of selecting PMS measures. A framework for their selection process may be found in manufacturing or service operations competitive dimensions, as these should help to define overall performance dimensions organised around competitive patterns, such as price (cost/operational efficiency), quality (process and product), time (dependability and agility), flexibility (process and product) and innovation (process and product) (Verbeeten and Boons, 2009; Pinheiro de Lima et al., 2009; Platts, 1995; Leong et al., 1990; Slack, 1987).

Having defined basic PMS roles in the context of a strategic management system, its associated core functionalities are identified next. Pinheiro de Lima et al. (2008) notes that causality links can be established by relating PMS roles to functions and capabilities. The performance criteria of Globerson (1985) define system functionalities as strategic orientation, whereby performance criteria are chosen from organisational objectives, organisational control over performance criteria evaluated, and performance criteria resulting from stakeholder participation. There is a strategic realisation function, as performance criteria follow organisational objectives. PMS characteristics emerge from management definitions. Systems should have a participative conception process and facilitate control over the evaluated organisational unit (Colledani and Tolio, 2009). Maskell (1991) developed relevant principles for PMS design that cover the dynamic nature of measures—measures as part of a fast feedback subsystem, and measures designed to stimulate continuous improvement capability rather than simply monitoring the ongoing operations strategy. While a strategic management function is identified by the performance measures implemented, its important role in developing continuous improvement capabilities is evidenced by Popova and Sharpanskykh (2010), Li and Tang (2009), Herzog et al. (2009), Alegre and Chiva (2008), Olsen et al. (2007) and Wu and Chen (2006).

Blenkinsop and Davis (1991) expand functional definitions of measurement systems by identifying properties that the system should have, especially when related to organisational integration and differentiation. These properties cover management system integration and improvements differentiation in both horizontal and vertical dimensions of organisational structure. They also emphasise the importance of covering long, medium and short-term perspectives of an organisation life cycle in PMS design. This explores systemic properties of management systems design as defined by Pinheiro de Lima et al. (2008), Folan et al. (2007), Binder and Clegg (2007) and Gargeya (2005). Following Gomes et al. (2004), PMS should have several characteristics:

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- Involve relevant non-financial information based on key business success factors (Clarke, 1995);
- Articulate strategy and monitor business results (Grady, 1991);
- Measures and related systems are based on organisational objectives, critical success factors, have a customer orientation and monitor both financial and non-financial results (Manoochehri, 1999);
- Dynamically follow strategy (Bhimani, 1993);
- Long-term oriented, and simple to understand and implement (Santori and Anderson, 1987);
- Link to reward systems (Tsang et al., 1999); and
- Cover financial and non-financial set of measures that are coherent and consistent with the strategic framework (Drucker, 1990; McNair and Mosconi, 1987).

The analysis by Gomes et al. (2004) indicates that there is a dynamic element in performance system design and management. PMS should be integrated with the business strategy to assess and to monitor its financial and non-financial performance dimensions. A similar PMS content definition is advocated by Franco-Santos et al. (2007). They define business PMS roles as the ability to measure performance, follow manage a given strategy, and facilitate communication, learning and improvement. As such, PMS is an integrative management system that inter-relates business performance dimensions to functional strategies (e.g., operations, human resources, technology and innovation, marketing and finance).

2.2. Performance management systems—A process view

A process view constitutes an important element in the integration of performance information into strategic management systems. Adopting a PMS process view shows how PMS roles can be mobilised in operations systems or networks. There are specific capabilities that are associated with the process view, such as continuous improvement, organisational learning and change management. Similar to continuous system redesign, there are four main processes related to performance measurement: design, implementation, use and refreshing (Bourne et al., 2005; Neely et al., 2000; Bourne et al., 2000). Kaplan and Norton (1992) developed a procedural framework to manage organisational strategy through these four processes, covering vision translation, communication, business planning, and learning.

PMS is an important part of the strategic management system as it affects the dynamics of the entire system. Franco-Santos and Bourne (2003) list several factors that impact on the way organisations manage through measures. Similarly, Bourne (2005) organises the factors that influence PMS implementation in three main categories; purpose, structure and culture. The categories can be further divided into a wide covering of the business management system, or a more narrow focus on measurement system improvements.

Several studies have explored why performance measurement initiatives fail to identify the roles of PMS and the development of a strategic management system (Henry, 2006; Bourne, 2005; Neely, 2005; Kaplan and Norton, 1992). The implementation process highlights the importance of dynamic enablers, especially those related to changes in culture, systems and processes. A PMS may lose its effectiveness over time if it is not redesigned to better attend new environmental and organisational demands. Three of the processes presented by Neely et al. (2000) – design, implementation and refreshing processes – deal directly with changes in the measurement system. Such management through measures to develop and implement a role related to change management in performance measurement systems is advocated by both Bourne et al. (2005) and Franco-Santos and Bourne (2005).

Strategically managing employed PMS enables organisations to develop continuous improvement and organisational learning

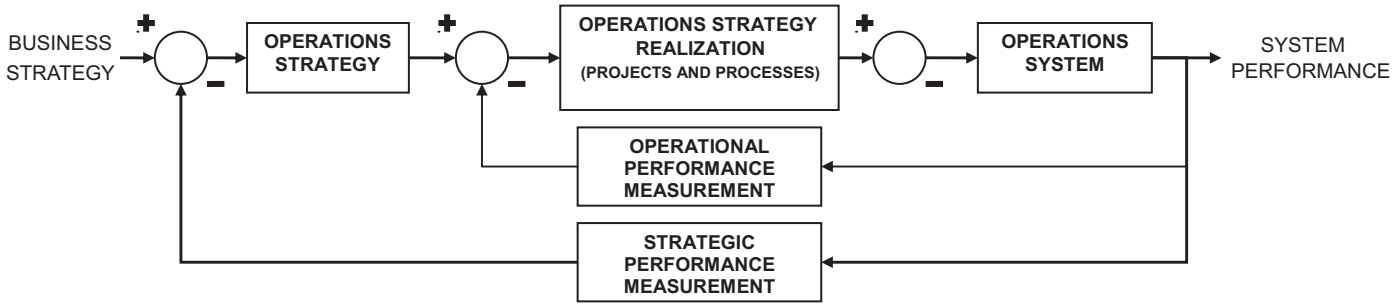

Fig. 1. The operations strategic management system.

Table 1
The strategic performance evolutionary process.

Phase	Description
1	The performance measurement matrix integrates different dimensions of performance, employing the generic terms 'internal', 'external', 'cost' and 'non-cost'. The matrix enhances the perspective to external factors (Keegan et al., 1989).
2	The strategic measurement, analysis, and reporting technique – SMART – developed by Lynch and Cross (1989) uses a hierarchic, performance pyramid structure to represent the integration between organisational vision and operations actions. There is interplay between external and internal orientations to improve the internal efficiency and the external efficacy.
3	The performance measurement model proposed by Fitzgerald et al. (1991) integrates determinants and results of the operations systems performance, exploring causalities between them. Measures are related to results (competitive position, financial performance) or are focused on the determinants of the results (e.g., cost, quality, flexibility).
4	The Balanced Scorecard (BSC), proposed by Kaplan and Norton (1992) constitute a multidimensional framework, based on financial, customer, internal processes and learning and growth dimensions, which integrates structural and procedural frameworks for designing a strategic management system.
5	The integrated dynamic performance measurement system – IDPMS – conceived by Ghalayini et al. (1997) incorporates the performance the dynamic features and the integrative properties. The integration process involves the management function, process improvement teams and the factory shop floor. The system creates a dynamic behaviour that articulates its specification and the reporting process.
6	The dynamics features are presented in Neely et al. (2002) performance prism. This is a scorecard based system for measuring and managing stakeholder relationships. The framework is conceived to cover stakeholder satisfaction, strategies, processes, capabilities, stakeholder contribution dimensions. The main objective of the strategic management system is to deliver stakeholder value.

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capabilities, and thereby organisational and individual competences (Kennerley, 2002 and Neely, 2003; Kennerley and Neely, 2002; Johnston et al., 2002; Kaplan and Norton, 2001; Neely et al., 2000; Manoochehri, 1999; Ghalayini and Noble, 1996). This refreshing process may be the embedded functionality of a strategic management system, with the main role of coordinating PMS redesign, including dynamic behaviour, causal links, evolutionary properties, competencies development and maturity levels.

2.3. Performance management systems—Strategic context

Measurement systems are part of a wider system, which includes goal setting, feedback loops, and reward functions (Neely et al., 2005).

Table 3
Strategic performance measurement system refined roles.

Performance measurement systems should ….
Produce positive change in organisational culture.
Produce positive change in organisational systems and processes.
Provide a closer understanding of market needs to create a perceived value for customers.
Implement strategic management functionality in the strategic operations management system, providing the system with the jointly improvement of operational efficiency and overall business effectiveness.
Develop a continuous improvement capability through implementation and management of an integrated operations strategic management system.
Show how the system design requirements lead to desirable results.
Be responsible for articulating strategy and monitoring business results.
Comply with external requirements, not directly managed by organisation.

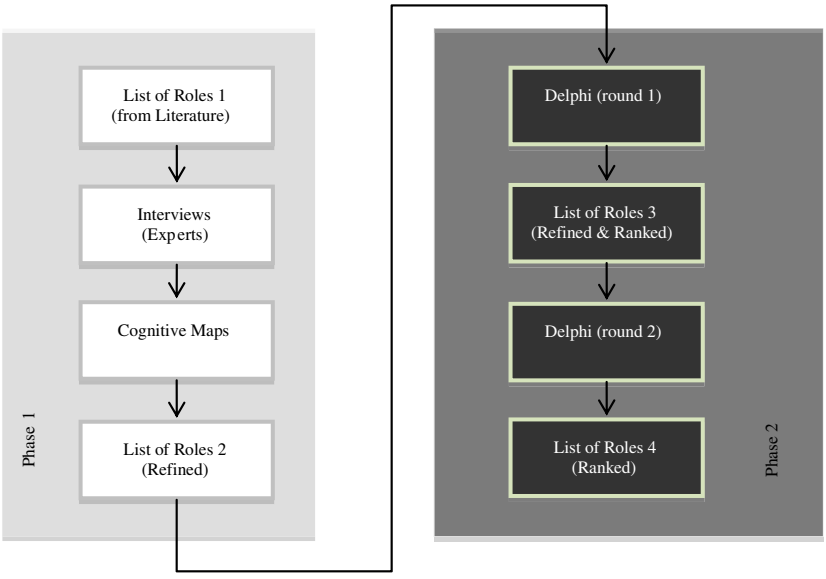


Fig. 2. The research process.

Table 2
Experts profile.

Interviewee	**Expertise area**
Academic 1	Operations and technology strategy, innovative and lean/agile operations across supply/value chain, human factors.
Academic 2	Performance and capability in the public sector; corporate performance management; performance measurement beyond the balanced scorecard.
Academic 3	Manufacturing and supply chain planning and control; advanced technology in manufacturing and supply chains; supply management and sourcing; process disruptions and maintenance management; and performance management.
Academic 4	Business, operations and information strategy; performance measurement and management.
Academic 5	Performance measurement and organisational processes; micro finance for development; international comparisons of management accounting and control; organisational ethnography and culture; practice theory.
Academic 6	Evaluating the impact of performance measurement systems; investigation of the way in which measurement systems change over time; performance prism framework.
Academic 7	Applied economic/econometric modelling; performance measurement/management related research; manufacturing company survival; manufacturing company performance, manufacturing company practices and causal relationships between these factors; capacity/supply/demand planning and management; project management; supply chain and risk management.
Academic 8	Understand and improve the way strategic choices are made, how plans are developed and implemented, and how performance is measured and achieved.
Academic 9	Operations strategy formulation methods; operations flexibility; performance measurement; management of design and development networks.
Academic 10	Service process design; process improvement; quality management; performance measurement in service organisations; workforce scheduling; health service management.
Academic 11	Operations strategy formulation methods; operations flexibility; performance measurement; management of design and development networks.
Practioner 1	Product development; design; performance measurement; aerospace industry; waste analysis; cost reduction; quality improvement; lead-time reduction; value.
Practioner 2	Business strategy; service strategy customer relationship management—CRM.
Practioner 3	Lean production; total quality management—TQM.
Practioner 4	Enterprise engineering, systems dynamics; lean production; performance measurement systems.
Practioner 5	Performance management; quality management; health care.
Practioner 6	Business plan; operations planning systems; operations system performance indicators.
Practioner 7	Lean manufacturing; Total quality management; total productive maintenance; production management integrated systems.
Practioner 8	Strategic performance management systems; knowledge intensive environments.
Practioner 9	World class manufacturing; lean manufacturing; best practices; benchmarking.

Table 4
Delphi experiment analysis.

	Question 1					Question 2					Question 3					Question 4					Question 5					Question 6					Question 7					Question 8				
	VRV	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**
ACADEMICS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Academic 1	–	–	–	1	–	–	–	1	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–
Academic 2	1	–	–	–	–	–	1	–	–	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	1	–	–
Academic 3	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–
Academic 4	1	–	–	–	–	1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1
Academic 5	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	–	–
Academic 6	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–
Academic 7	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–
Academic 8	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–
Academic 9	–	1	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–
Academic 10	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	1	–	–
Academic 11	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–
	4	2	3	2	0	4	4	3	0	0	3	4	2	1	1	5	5	0	1	0	6	2	2	1	0	3	6	1	1	0	5	4	2	0	0	1	2	6	1	1
RANKING	**6**	**4**	**7**	**1**	**3**	**5**	**2**	**8**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
RANKING POINTS VRV = 3, RV = 2, Q = 1, NRV = 0, RT = −1,	**19**	**23**	**18**	**25**	**24**	**22**	**25**	**12**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

	Question 1					Question 2					Question 3					Question 4					Question 5					Question 6					Question 7					Question 8				
	VRV	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**	**VRV**	**RV**	**Q**	**NRV**	**RT**
PRACTIONERS	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Professional 1	1	–	–	–	–	–	–	–	1	–	–	1	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–
Professional 2	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	1
Professional 3	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–
Professional 4	–	–	1	–	–	–	–	1	–	–	1	–	–	–	–	–	–	1	–	–	–	–	1	–	–	1	–	–	–	–	–	1	–	–	–	1	–	–	–
Professional 5	–	–	1	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1	–	–
Professional 6	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	1	–	–	–	–	–	–	–	1
Professional 7	–	–	1	–	–	–	–	1	–	–	1	–	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	1	–	–	–	–	1	–	–	–	–	–	–	1
Professional 8	–	1	–	–	–	–	1	–	–	–	–	–	1	–	–	1	–	–	–	–	1	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–	–	–	–	1
Professional 9	1	–	–	–	–	1	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	1	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	1
	5	1	3	0	0	4	2	2	1	0	3	4	1	0	1	3	4	2	0	0	4	0	4	1	0	2	1	4	1	1	5	0	3	1	0	1	1	1	1	5
RANKING	**1**	**4**	**5**	**2**	**6**	**7**	**3**	**8**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**
RANKING POINTS VRV = 3, RV = 2, Q = 1, NRV = 0, RT = −1	**20**	**18**	**17**	**19**	**16**	**11**	**18**	**1**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**		**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**	**–**

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Question 8
GLOBAL RANKING (ACAD+PRACT)	**5**	**3**	**6**	**1**	**4**	**7**	**2**	**8**
RANKING POINTS VRV = 3, RV = 2, Q = 1, NRV = 0, RT = −1,	**39**	**41**	**35**	**44**	**40**	**33**	**43**	**13**

VRV—**Very relevant:** necessary and sufficient condition.
RV—**Relevant:** sufficient condition.
Q—**Qualifying factor:** necessary condition.
NRV—**Not relevant:** indifferent or neutral.
RT—**Restrictive factor:** in certain conditions could contribute negatively.

Strategic control means that performance measurements and feedback loops guide management action. The performance measurement processes are elements of a strategic control system and can be used to influence behaviour (Pinheiro de Lima et al., 2009; Olsen et al., 2007; van Veen-Dirks, 2005; Neely et al., 2005; Ketokivi and Schroeder, 2004). Hence, such operations strategic management system is an integrative part of PMS. Fig. 1 shows operations strategic management system architecture, and identifies its subsystems. The plant (or other selected unit) is the operations system, strategically managed by operations strategy, planning and performance measurement subsystems. Double feedback loops represent monitoring (operational feedback loop) and refreshing (strategic feedback loop) functions and processes (Pinheiro de Lima et al., 2008; Pilkington and Fitzgerald, 2006; Nilsson and Olve, 2001).

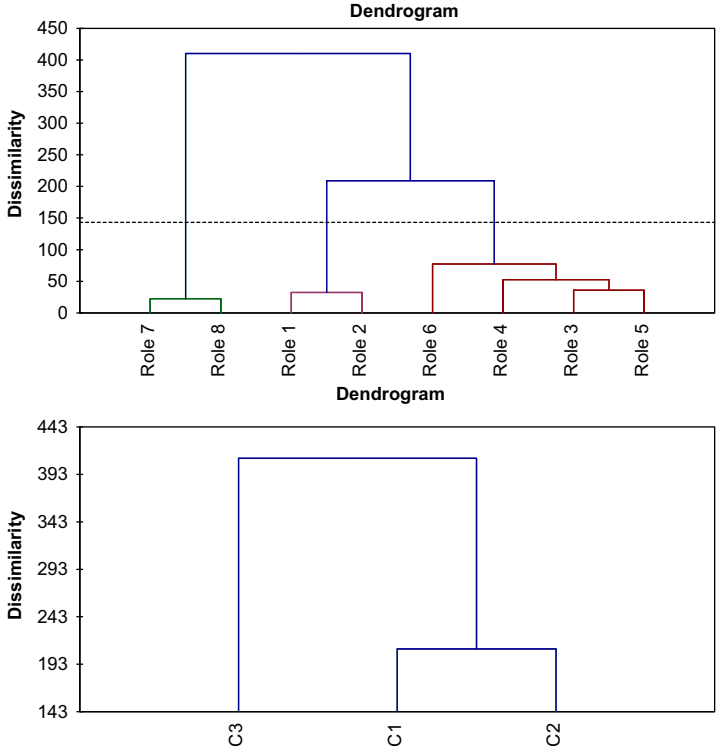
Table 5
PMS refined roles Delphi exercise round 1.

Rank	Performance measurement systems could ….
1	Implement strategic management functionality in the strategic operations management system, providing the system with the jointly improvement of operational efficiency and overall business effectiveness.
2	Be responsible for articulating strategy and monitoring business results.
3	Produce positive change in organisational systems and processes.
4	Develop a continuous improvement capability through implementation and management of an integrated operations strategic management system.
5	Produce positive change in organisational culture.
6	Provide a closer understanding of market needs to create a perceived value for customers.
7	Show how the system design requirements lead to desirable results.
8	Comply with external requirements, not directly managed by organisation.

Kaplan and Norton's (1992) well-known 'Balanced Scorecard' provides a planning technique and performance measurement framework within the same management system. It acts as a strategic management framework since it integrates strategic mapping processes with the various performance dimensions. The system creates customer-focused value through improvement actions and business processes development, and has developed into an integrated performance measurement framework. Table 1 shows the characteristics that define such evolutionary or life cycle models for strategic management and performance measurement systems.

Studies on strategic control of measurement systems by Henry (2006), Chenhall (2005) and Simons (1991) have found two behavioural management patterns: diagnostic simple feedback control and interactive control. Bourne et al. (2005) compare results of average- and high-performing business units. In the former, the strategic management system logic adheres to simple feedback control. In the latter, strategic management systems are based on both interactive and simple feedback control approaches. This raises two questions. First, why rely on feedback control systems to strategically manage an operations system? Second, does this not fall back to a mechanistic management system view, which excludes the dynamic nature of strategy view and considers operations systems as closed loop systems? To answer these questions it is necessary to explore the complementary nature of the diagnostic and integrative roles identified by Bourne et al. (2005). Such structural and process views of PMS as part of an operations strategic management system may have many roles, as summarised in Appendix A, Table A1. Thus, the operations strategic management system is an amalgam of resources, capabilities and competencies defining architecture for managing operations processes. It is the locus of refreshing, diagnostic simple feedback control and interactive control activities that leads to evolution for operations management practices.

Having identified the PMS roles discussed in the literature, these constructions are used as a guide for further refinement through a Delphi exercise.



Results by class:

Class	1	2	3
Objects	2	4	2
Sum of weights	2	4	2
Within-class variance	32.500	55.333	22.500
Minimum distance to centroid	4.031	5.874	3.354
Average distance to centroid	4.031	6.403	3.354
Maximum distance to centroid	4.031	7.616	3.354
	Role 1 Role 2	Role 3 Role 4 Role 5 Role 6	Role 7 Role 8

Results by object:

Observation	Class
Role 1	1
Role 2	1
Role 3	2
Role 4	2
Role 5	2
Role 6	2
Role 7	3
Role 8	3

Fig. 3. Roles rank groups.

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3. Research methodology

The study seeks to generate a consensual set of PMS roles delimited by the operations strategy context. The consensus is established between experts, both academics and industry professionals. Focus and understanding of PMS roles has changed over time, having moved from structural and process frameworks to an emphasis on implementation and use.

The research method is based on the qualitative nature of the experts' perceptions on PMS use. The research strategy is based on two techniques: expert individual interviews followed by a Delphi panel. The expert interviews are synthesised in cognitive maps and generate inputs to the Delphi panel exercise as an initial list of PMS roles.

The research was conducted in two main phases. First semi-structured interviews refined the proposed PMS roles that were derived from an extensive literature review. Theoretical assumptions were based on PMS content definitions, process and strategic management views. These assumptions were used as guidelines for developing a semi-structured interview protocol. Interviews conducted then constitute the information base for the construction of cognitive maps. Cognitive maps analysis and synthesis exercises were then used to generate a refined list of PMS roles to be used as an input for the Delphi exercise.

A second phase was employed to establish consensus on PMS roles and to identify relative importance among the various roles using a Delphi panel. Fig. 2 shows phase activities, results from the experts' interviews and the analysis of PMS roles.

Kolkman et al. (2005) use the term cognitive map for the external representation of mental models or conceptual maps. As noted by Kiewiet et al. (2005), cognitive maps are representations defined by mental or conceptual models that show what individuals perceive or have learnt about specific problems. The cognitive map construction process follows several steps. It first defines a central question and identifies relevant fundamental concepts. Model structures and dynamics are then discussed, causal relationships are defined and necessary and sufficient conditions that mediate relationships between means and ends are represented (Scavarda et al., 2006; Ensslin et al., 2001; Lee et al., 1992).

Cossette (2002) observes that when developing a cognitive map, researchers must use their schemas for studying a problem and not be removed from the studied situation. It cannot be assumed that there is a strict correspondence between mental models of experts and cognitive map of researchers'. According to Kwong and Lee (2009) cognitive maps are frequently applied when conducting interviews by visualising interviewees' mental models, used to structure complex problems and as a tool for recording interview transcripts.

The Delphi exercise enables the emergence of a consensual agreement on perceived PMS roles, as suggested by Flynn et al. (1990) and Linstone and Turoff (2002). Melnyk et al. (2006) lists several key characteristics of the Delphi technique:

- Use of a panel of "experts" for obtaining data;
- Participants that do not meet in face-to-face discussions, with a guaranteed anonymity of responses;
- Use of sequential questionnaires and/or interviews with systematic emergence of a concurrence of judgment/opinion;
- Use of frequency distributions to identify patterns of agreement; and
- Use of two or more rounds between which summarised results of the previous round is communicated to and evaluated by panel members.

Nevo and Chan (2007) emphasise that Delphi studies involve brainstorming and ranking, with expert analysis used to refine and explore the results. Hence, according to Akkermans et al. (2003) one important criteria of Delphi studies is having a sample size of at least 20 respondents to overcome risks of individual biases contaminating the aggregate response.

Operations management literature has some good examples of designing and applying Delphi exercises, as seen in studies by Gray et al. (2011), Mäkitalo and Hilmola (2010) and MacCarthy and Atthirawong (2003). Combining techniques as face-to-face interviews and Delphi panels is not unusual; interviews could be settled before running a Delphi experiment as mentioned in the research work of Rajesh et al. (in press), Laakso et al. (2012) and Bradley and Stewart (2003); or after running a Delphi panel as could be seen in the works of Nevo and Chan (2007) and Henchion and McIntyre (2005). Hasson and Keeney (2011) call these hybrid methodologies 'Modified Delphi experiments'.

Gupta and Clarke (1996) observe that different variations of Delphi techniques have evolved over time. A modified Delphi exercise was developed based on the interactive process involving 20 experts in operations strategy, performance measurement system design, operations and production management, covering both manufacturing and services.

4. Results from the interviews and Delphi panel

The interviews and Delphi panel employed in this study utilised academic experts from Brazil, China, England, Germany, Scotland, Wales, Sweden, and Taiwan, and industry professionals from multinationals companies headquartered in Brazil, England, France, Germany, USA, and Taiwan. The study was carried out between 2007 and 2008.

Academic and industry professionals were chosen as interviewees based on their expertise in performance measurement and management. This expertise covered manufacturing and service companies and a broad set of topics bounded by the operations management academic area. Table 2 shows the experts' profiles.

The interviews were documented though cognitive maps and synthesised as a list of PMS roles. The interview protocol is shown in Table B1 of Appendix B. The interviews were documented, represented and analysed through cognitive maps. These show that the roles proposed in Table A1 of Appendix A could be synthesised and reorganised, representing a refined understanding about PMS roles. Figs. C1 and C2 in Appendix C present a representation of how experts build their mental models that relate PMS requirements and functionalities and then mobilise them in a synthetic role statement. Note that these cognitive maps synthesise interviews with industry professionals and academics and are used for the generation shown in Table 3. The table is a refined set of performance measurement system roles used for the Delphi exercise input in Phase 2. The role statements were refined through individual expert interviews, as suggested by Flynn et al. (1990). Note that roles presented in Table 3 were initially proposed as a normative set, assuming PMS should perform a set of predefined roles.

Table 3 shows the input of the Delphi panel and their agreed roles PMS may have. Results from the first round of the Delphi experiment are shown in Table 4, denoting agreement levels around performance measurement levels proposed by Table 3. The respondents used a five point Likert scale to mark their degree of approval of the proposed statements as PMS roles.

None of the proposed roles were disregarded, although the number of items or questions defined by the eight PMS roles and

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the number of respondents are insufficient for a quantitative reliability test such as Cronbach *alpha* or Spearman–Brown prophecy formula (Hinkin, 1995). Note that the number of academics and industry professionals are not the same and limited to eleven and nine, respectively. Consequently the consensus results on PMS are only used speculatively. The list in Table 5 evolved from the consensual analysis of the Round 1 Delphi exercise. A score was generated for each of the proposed roles using weightings from −1 to 3 on the five-point Likert scale.

The second round of the Delphi process tested the rank of established PMS roles. The 20 experts were asked to adjust or leave unaltered the proposed hierarchy of roles, thereby allowing assessment of their collective perception of PMS roles. The results show that the proposed order remains largely unchallenged. Distance between the proposed order and corrections made by the participants were evaluated by ranking errors. The distance mean −0.15, and the standard deviation 0.91—indicate participant support of the proposed ranking. Furthermore, group clusters emerged from the ranking analysis. To confirm group formation, the Ward method was applied and a dendrogram was plotted as seen in Fig. 3 (Hair et al., 2009). The grouping is coherent with the proposed PMS roles rank. Roles 1 and 2, Roles 3–6, and Roles 7 and 8 form three interchangeable groups. Additional investigation is required to define rank order inside the groups. The formed groups represent different consensual levels, and their range shows there is greater consensus in Groups one and three than in Group two, even though Group three is a lower ranked group.

PMS design is contingent on its environment, and selected roles should follow this assumption creating a coherent set of design propositions. This suggests that a performance measurement system may employ its own set of roles to perform as long as it falls within the boundaries shown in Table 5, and contingent on the adopted strategy. The results can be used to inform the PMS behavioural modes proposed by Bourne et al. (2005) on the strategic and operational use of performance information. The perceptions of academics and industry professionals show that companies may change their PMS focus for strategic purposes, particularly those related to operations strategy and the operations management function. Group one clearly identified classical roles attributed to PMS that have a high consensus among the experts on strategy deployment and performance control.

Strategic control management systems, as studied by Simons (1991) and further discussed by Chenhall (2005) and Henry (2006), open new possibilities for structuring decision making models for OM managers so that they are able to continuously re-establish their assessment of the required organisational performance. Group two formed by Roles 3–6 shows this particular aspect of PMS roles, integrating continuous improvement, change management and customer orientation capabilities. There is a perception that these capabilities will be important for future PMS developments. The results of Group three indicate that design causality and external contingencies could be better understood. Folan and Browne (2005) and Folan et al. (2007) point out the importance of framing the structure and process of PMS design for improving organisational capabilities. Meanwhile, Acur and Bititci (2004) and Tan and Platts (2009) identify important elements for strategy development, particularly relating planning and implementation activities. The results reinforce the findings by Franco-Santos et al. (2007) as Role 2 relates to 'measure performance', Roles 1 and 2 to 'strategy management', Roles 2 and 5 to 'communication', Roles 3, 5, 7 and 8 to 'influence behaviour' and Roles 1 and 4 to 'learning and improvement'. Although organisational learning is not explicit in the PMS roles statement, it could be treated as basic capability that supports operations strategic management system development.

5. Discussion an managerial implications

The process of performance measurement creation and management can be related to a life cycle model that interplays design, implementation and use, so the management systems should integrate long- and short-term perspectives, defined respectively by the whole cycle and by its phases.

The strategic control system architecture should also represent various dimensions of operations performance. Moreover, it is important to manage the hierarchy that is established between the various business performance dimensions according to competitive patterns normatively established by operations strategy. A predictive vision of strategy development influences PMS roles content definition and their selection according to PMS design. A dynamic vision of PMS roles selection should consider positions, processes, paths and trajectories, as defined by Teece et al. (1997), when studying strategic evolution.

The identification of PMS roles in contemporary practice is an important contribution of this study. It has organised proposed roles found in the literature of operations strategy and performance measurement and refined them according to expert evaluations. This should be seen as a first step in the process of PMS design and review. The refined PMS roles are given in terms of management roles that define the system and strategy process implementation, change management capabilities, and stakeholder orientation. These categories are used in assessing PMS design and in defining content scope.

In terms of testing operations management theory, the study provides empirical data to explore PMS models. In this sense, an evolutionary research cycle could improve the proposed and tested theoretical models. The identification of PMS roles embeds strategic issues and a systemic view of the management processes. Although these PMS roles are presented in the current literature on performance measurement, it is their perceived importance by PMS experts that has been the main focus of this paper. The role statements were refined by expert interviews and evaluated through a Delphi exercise and this sequence of activities highlighted their importance and definition.

Operations managers can use PMS role statements in a contingency approach to design a company's measurement systems, observing their integration to the operations strategic management system, with appropriate PMS roles selected for a given situation or for a desired future in a selected trajectory. The roles are then implemented through processes that link current and future positions. This approach accords with the dynamic capabilities as stated by Teece et al. (1997) and further developed by Tidd et al. (2001) in terms of strategic issues.

6. Conclusion

In the study, PMS roles were identified through three refining parts, incorporating theoretical assumptions refined by experts and further tests through two Delphi rounds. The study explored the importance of PMS roles and provided practical insights for designing such performance systems. For studies on operations strategic management system behaviour, a comprehensive understanding of PMS roles is essential. PMS roles, acting as a medium for assessing actual operations strategy or as an enabler for strategic management is a cornerstone of organisational learning and operations management evolution.

Experts consensually created a cognitive framework of PMS roles. They confirmed the existence of a set of PMS roles related to the traditional view of command and control behaviour, which could be observed in PMS Roles '1' and '2'.The first role was "Implement strategic management functionality in the strategic

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operations management system, providing the system with the jointly improvement of operational efficiency and overall business effectiveness", and the second roles was to "Be responsible for articulating strategy and monitoring business results". However, the experts also identified a consolidated vision of performance strategic management that could be observed in PMS Roles '3' to '6', covering "Produce positive change in organisational systems and processes", "Develop a continuous improvement capability through implementation and management of an integrated operations strategic management system", "Produce positive change in organisational culture", and "Provide a closer understanding of market needs to create a perceived value for customers". Finally, PMS Roles '7' and '8', "Show how the system design requirements lead to desirable results" and "Comply with external requirements, not directly managed by organisation" were categorised as less important, but showing a growing maturity in defining dynamic capabilities for PMS design.

Limitations of the study can be noted in theoretical, methodological and practical terms. Theoretically, the research boundaries are limited by structural and process aspects of PMS use, and by the context established by the given operations strategy. The research strategy is based on expert perceptions on PMS use based on their experience and understanding, which limits the included uses of PMS. The study is also somewhat limited in its accessibility to experts.

For future research the operational definition of PMS roles can be explored further with emphasis on PMS use. Identifying this use can also be externally validated through survey research. Moreover, roles are a first order construct for generating PMS design, requiring to be linked to a specific set of capabilities. While the Delphi exercise has proved a powerful method for reaching role consensus, the resulting list of PMS roles could be explored further in measurement systems design.

Acknowledgements

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Appendix A

See Table A1 here.

Table A1
Strategic performance measurement system roles.

Role	Perspective	Author
Produce positive change in organisational culture, systems and processes, in order to contribute to the strategic vision realisation	Strategic performance management system definition	Li and Tang (2009), Phusavat et al. (2009), Chiesa et al. (2008), Neely and Al Najjar (2006), Kwak and Anbari (2006), Jonker et al. (2006), Brown and Fai (2006), Bourne et al. (2005), Neely (2005), Amaratunga and Baldry (2002), Manoochehri (1999), Bhimani (1993), Blenkinsop and Davis (1991)
Performance measurement system should provide a closer understanding of customer needs, in order to create a perceived value for customers	Customer driven strategy	Molina-Castillo and Munuera-Alemán (2009), Herzog et al. (2009), Neely et al. (2005), Bourne et al. (2005), Kennerley and Neely (2003), Neely et al. (2002), Kennerley and Neely (2002), Johnston et al. (2002), Kaplan and Norton (2001), Neely et al. (2000), Manoochehri (1999), Ghalayini and Noble (1996), Kaplan and Norton (1992), Globerson (1985)
Implement strategic management functionality in the strategic operations management system, providing the system with the jointly improvement of operational efficiency and overall business effectiveness	Strategic management function	Quezada et al. (2009), Taticchi and Balachandran (2008), Yusuf et al. (2006), Kling (2006), Henry (2006), Neely (2005), Bourne (2005), Gomes et al. (2004), Joshi et al. (2003), Kaplan and Norton (1992), Globerson (1985)
Develop a continuous improvement capability through implementation and management of an integrated operations strategic management system	Continuous improvement capability development	Li and Tang (2009), Herzog et al. (2009), Wibe (2008), Nenadal (2008), Alegre and Chiva (2008), Wu and Chen (2006), Kling (2006), Neely (2005), Gomes et al. (2004), Kennerley and Neely (2003), Kennerley and Neely (2002), Johnston et al. (2002), Kaplan and Norton (2001), Neely et al. (2000), Medori and Steeple (2000), Noci (1995), Ghalayini and Noble (1996), Lynch and Cross (1991), Maskell (1991), Johnson and Kaplan (1987)
Ensure that the performance management system covers long, medium and short term perspectives	Life cycle orientation for performance system design	Molina-Castillo and Munuera-Alemán (2009), Kumar et al. (2008), Kathuria et al. (2007), Henry (2006), Neely et al. (2005), Chenhall (2005), Bourne et al. (2005), Flynn and Flynn (2004), Gomes et al. (2004), Slack et al. (2004), Acur and Bititci (2004), Maslen and Platts (2000), Flynn et al. (1999), Simons (1991); Blenkinsop and Davis (1991)
Performance measurement system result of measures definitions and performance frameworks recommendations (this assumption explain the performance measurement design process role)	The systemic and hierarchical approach	Pinheiro de Lima et al. (2008), Folan et al. (2007), Binder and Clegg (2007), Gargeya (2005), Folan and Browne (2005), Gomes et al. (2004), Blenkinsop and Davis (1991), Maskell (1991), Globerson (1985)
Performance responsible for articulating strategy and monitoring business results	Strategy realisation through the monitoring of the organisation's results	Pinheiro de Lima et al. (2009), Colledani and Tolio (2009), Neely et al. (2005), Gomes et al. (2004), Nilsson and Olve (2001), Bhimani (1993), Kaplan and Norton (1992), Blenkinsop and Davis (1991), Grady (1991), Santori and Anderson (1987)
Measurement of business results implemented using financial and non-financial aspects of business performance (in fact, the performance design should guarantee)	Financial and non-financial nature of the organisation's performance	Verbeeten and Boons (2009), Gomes et al. (2004), Ketokivi and Schroeder (2004), Devaraj et al. (2004), Neely et al. (2002), Manoochehri (1999), Clarke (1995), Kaplan and Norton (1992), Blenkinsop and Davis (1991), Drucker (1990), Maskell (1991), McNair and Mosconi (1987)

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Appendix B

See Table B1 here.

Table B1
Interview script.

	Question
Introductory questions	How is the operations strategy realized (or implemented)? What are the management components of the realisation (or implementation) process?
–	Does the operations function develop its own strategic management system? Explain
–	Do you agree that the performance measurement system is part of a strategic management system? Why?
–	Is the performance measurement system a necessary condition for companies' operations function management?
–	Is it sufficient condition, having a performance measurement system assessing the operations system results, in order to manage and control the production processes?
–	Does the performance measurement system use produce any kind of 'override' in the management processes? What are the impact on organisational learning and continuous improvement?
Specific questions	Are there short and long term perspectives in the operations strategy?
–	Is it possible to identify specific functions for the performance measurement systems in the short and long term perspectives of the operations strategy?
–	What are the main features or characteristics of the performance measurement systems, when operating in the short-term perspectives?
–	What are the main features or characteristics of the performance measurement systems, when operating in the long-term perspectives?
–	Representing the operations strategy in its market-oriented mode, how can its development be assessed? What are the performance measurement roles?
–	How the market-oriented mode is related to the operations strategy perspectives?
–	Representing the operations strategy in its resource-based mode, how can its development be assessed? What are the performance measurement roles?
–	How the resource-based mode is related to the operations strategy perspectives?
–	Could you identify feedback or control loops in the operations strategic management system?
–	What are the relationships between the control loops and the performance measurement system? Explain
–	Is it possible to establish relationships between the operations strategy perspectives, modes and the operations strategic management control loops? Comment
–	Is it possible to establish a vision for the operations strategy? What are its main components?
–	How can it be assessed the vision development (construction)? Does the performance measurement system play any role?
–	Does the performance measurement system 'control' the operations' development?
–	Is it possible to establish relationships between the operations strategy perspectives, modes and the operations vision development? Comment
–	Are the control and vision assessment functions complementary? Explain
General questions	Is it possible to identify relationships between the performance measurement system and change management processes? Comment
–	How a performance measurement system can contribute to a customer oriented strategy?
–	Is it possible to identify general performance drivers, features or characteristics? How a performance measurement system should address these elements?
–	Could you explain what a balanced measurement system is?
–	Could you explain what an integrated measurement system is?
–	Could you establish a causal line using the concepts of continuous improvement, organisational learning and the performance measurement system? Explain.
–	Could you summarise the content and the design process of a performance measurement system? What are the main structure and logic?
Final question	How do you define an appropriate use of a performance measurement system? (The PMS system belongs to a strategic management system and it is running at operations function level)

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Appendix C

See Figs. C1 and C2 here.

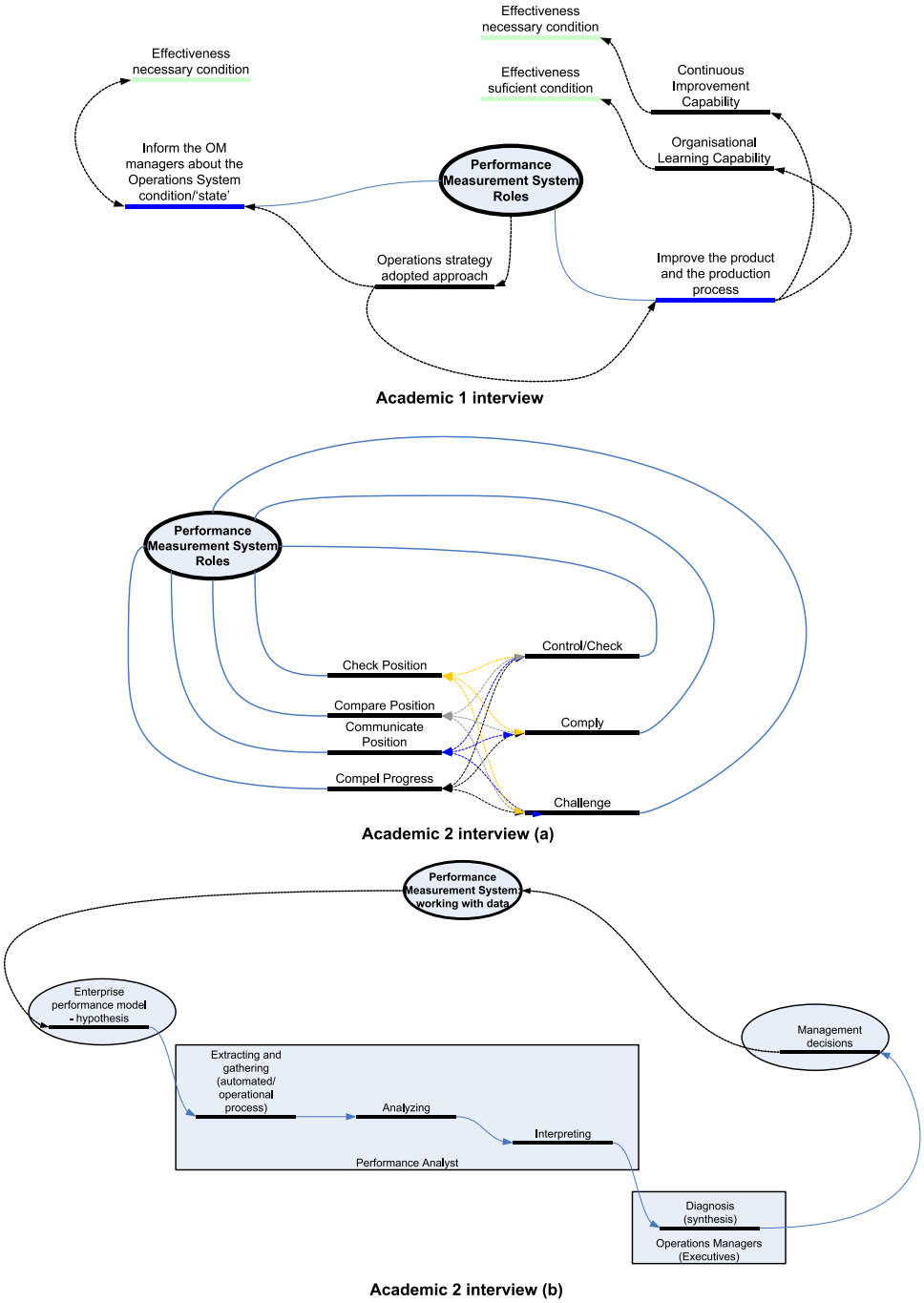
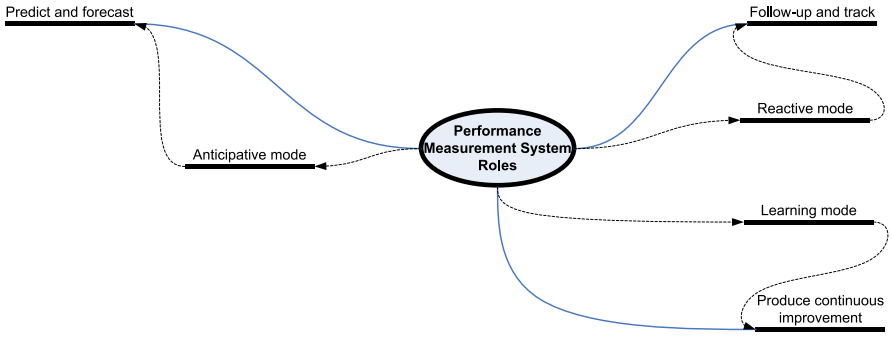
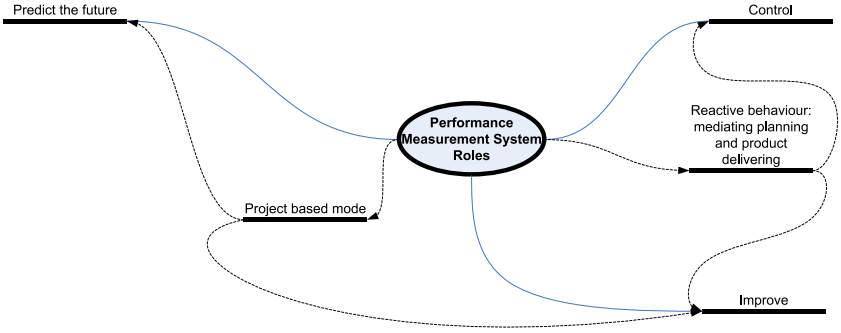


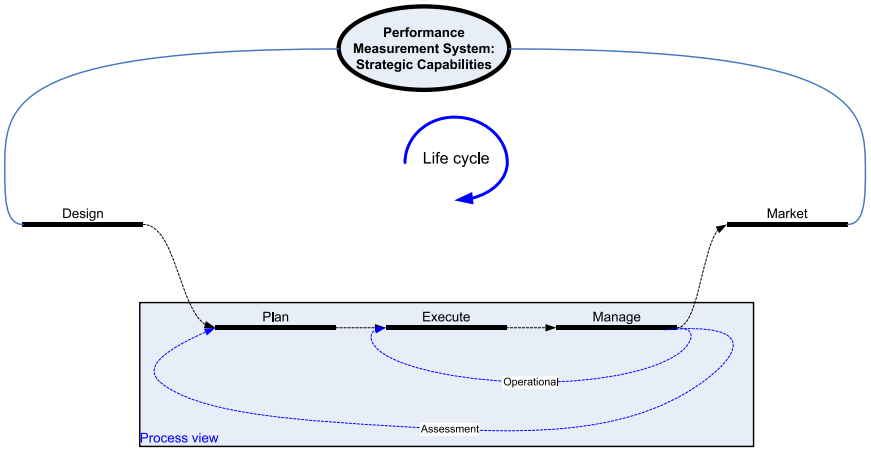
Fig. C1. Academic interviews' cognitive maps.



Academic 3 interview



Academic 4 interview (a)



Academic 4 interview (b)

Fig. C1. (*continued*)

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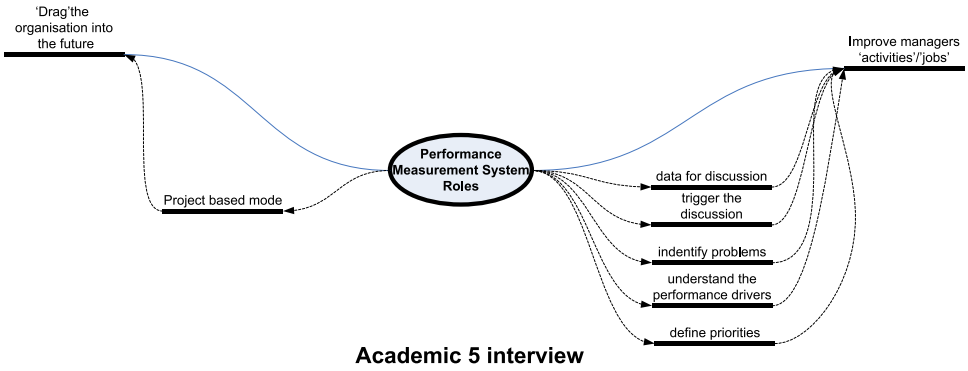
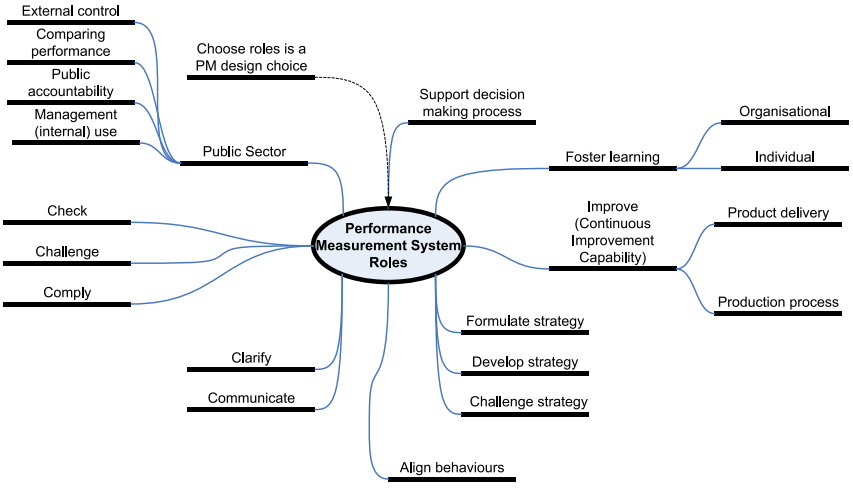
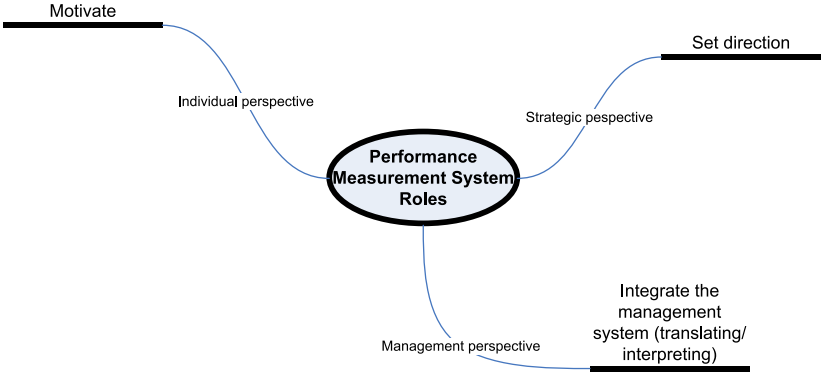


Academic 5 interview



Academic 6 interview



Academic 7 interview

Fig. C1. (*continued*)

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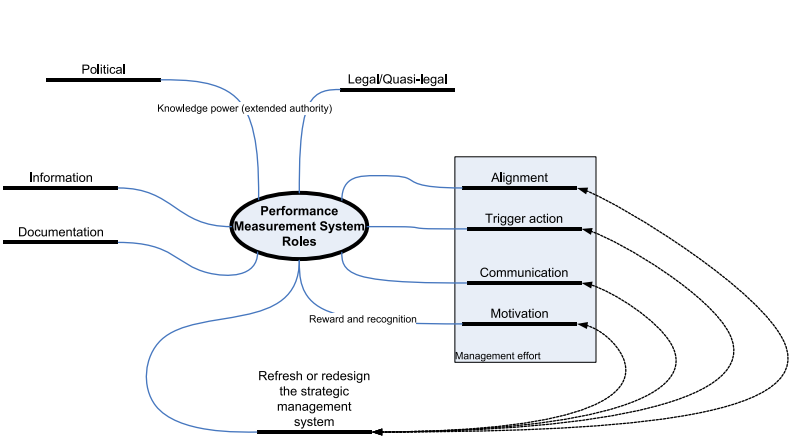
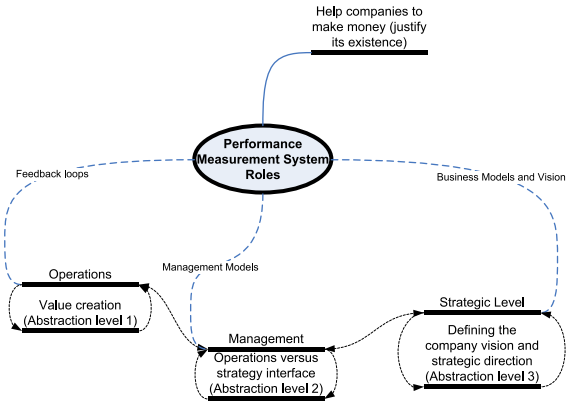
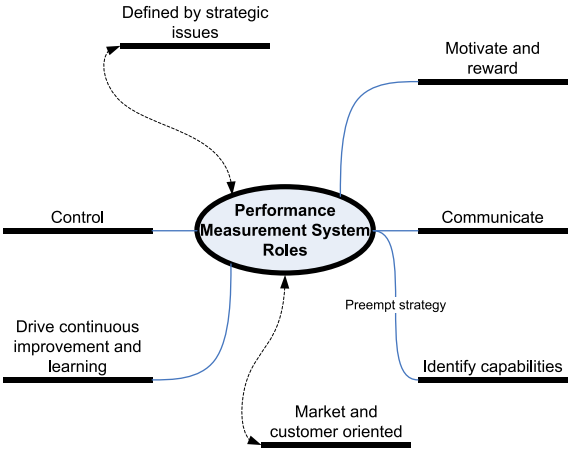


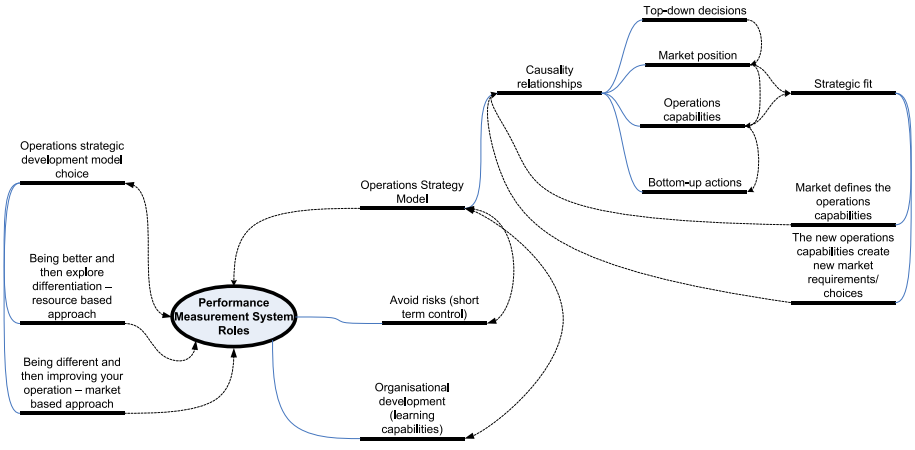
Academic 8 interview



Academic 9 interview



Academic 10 interview



Academic 11 interview

Fig. C1. (*continued*)

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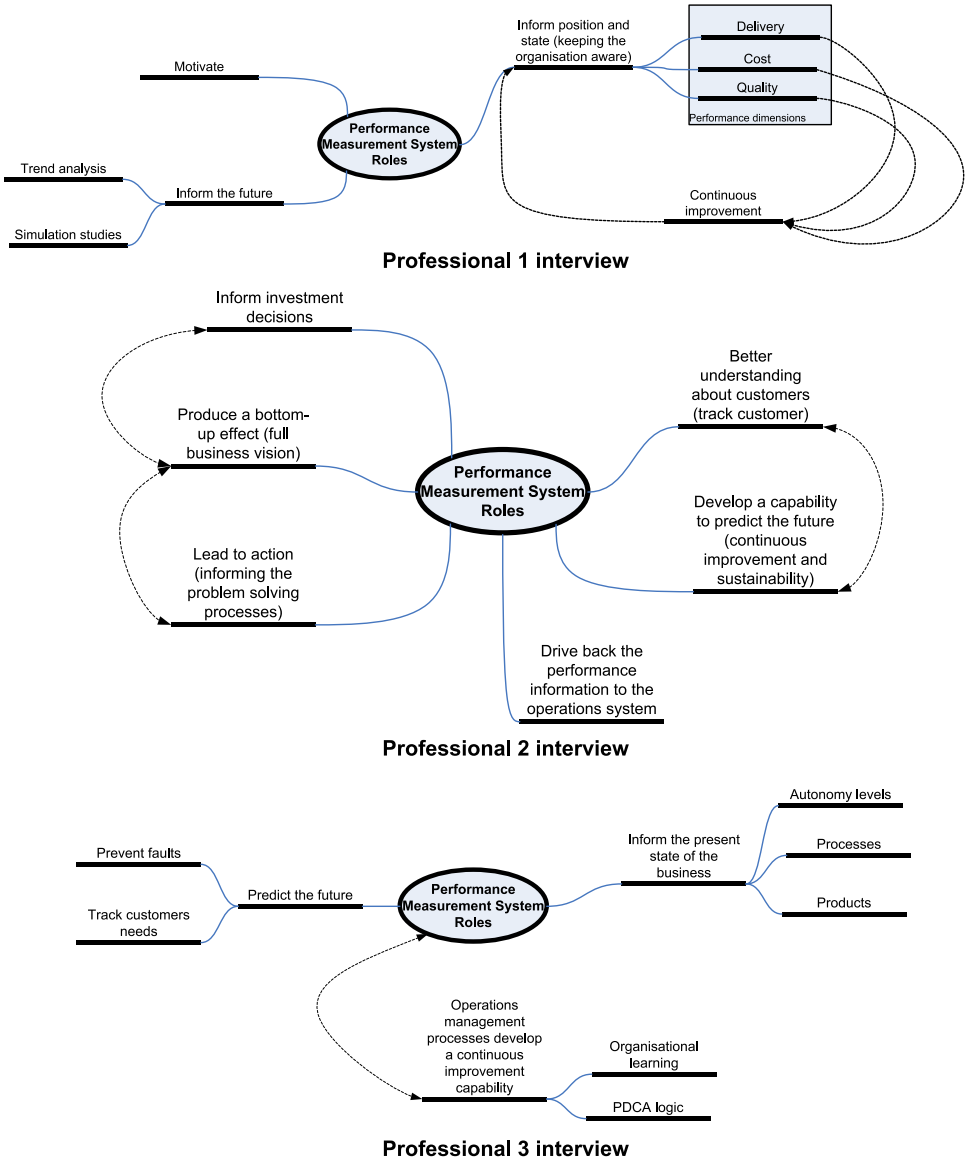

Fig. C2. Industry professional interviews' cognitive maps.

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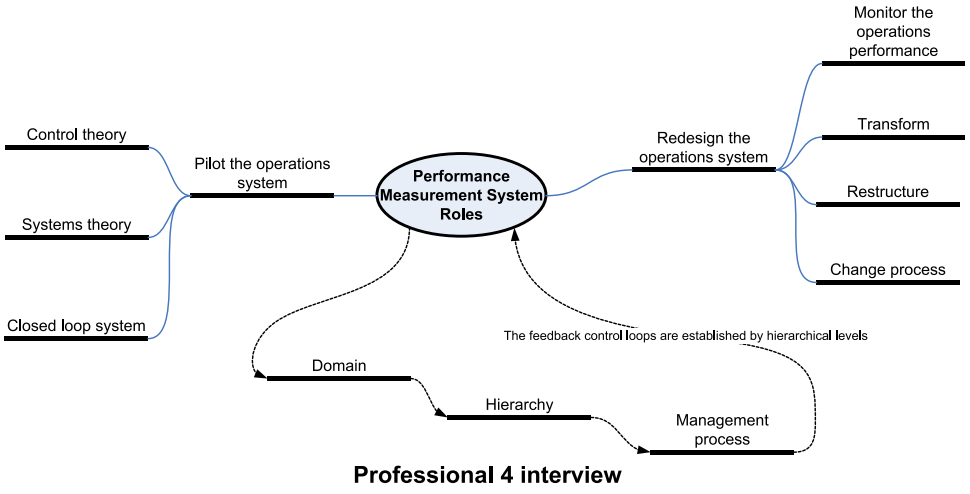
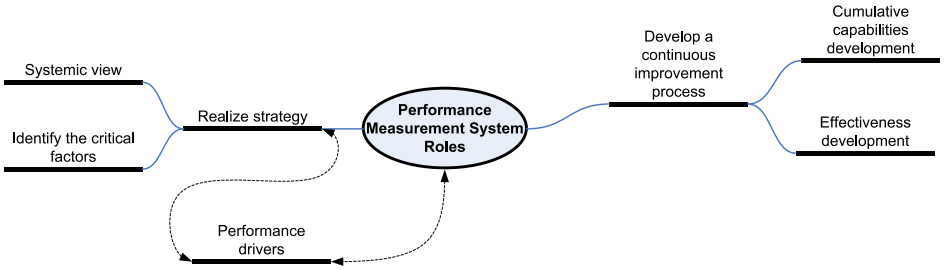
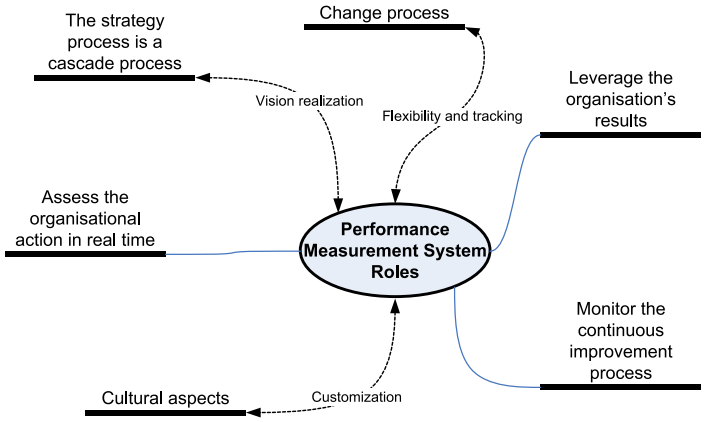


Professional 4 interview



Professional 5 interview



Professional 6 interview

Fig. C2. (*continued*)

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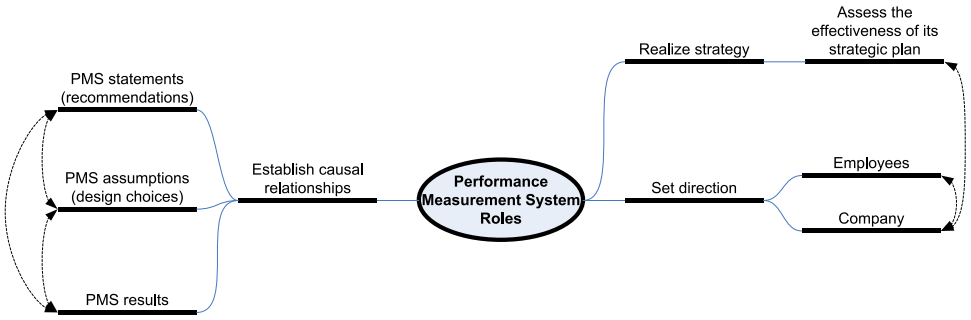
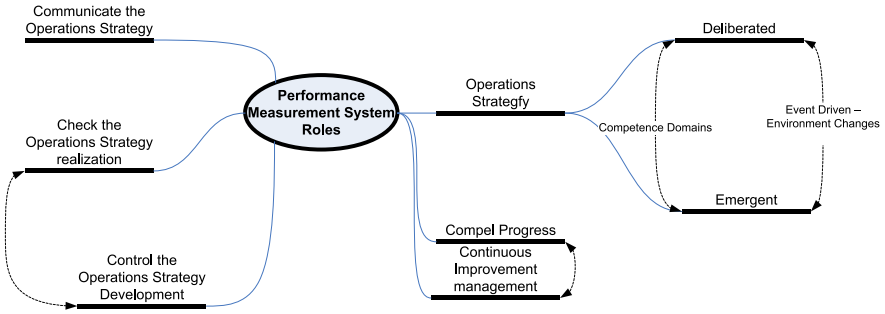
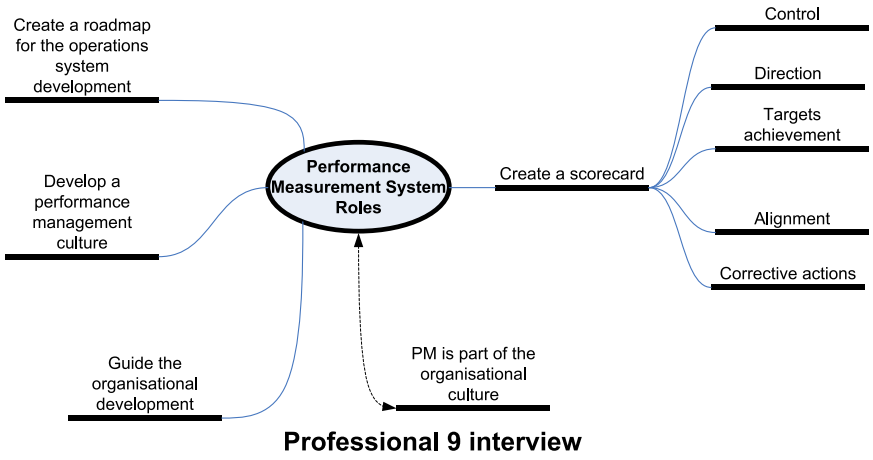


Professional 7 interview



Professional 8 interview



Professional 9 interview

Fig. C2. (*continued*)

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