

Special Issue Editorial
Performance measurement and management in a VUCA world
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Introduction

It is widely recognised that performance measurement systems (PMS) are important for the management of a factory, business enterprise or public sector organisation. However, the case can be made that the development of PMS and organisational forms are inextricably linked. As the economic, technical and trading environment evolves, organisations need to adapt, and so do the measurement and management systems.

In this editorial, we will retrace the history of PMS from early factory costing systems through to the multi-dimensional approaches widely used today. As the world evolves, organisations and PMSs need to evolve too with the papers in this special issue reflecting this. These papers lead us to reconsider the future of PMS as climate change, the internet of things (IoT) and new technology drive us forward towards a complex and uncertain future.

A brief history of Performance Measurement Systems

If we look back to the history and origins of management accounting, Johnson's (1981) work explains how management accounting tools evolved to enable trade and the development of both vertically integrated and diverse manufacturing firms.

For example, in the late 13th century, double entry bookkeeping became necessary as a means of managing complex trading arrangements. Johnson, (1981, page 512) cites the Medici accounts as an excellent example of how a pre-industrial organisation could maintain a good account of external transactions and stock without recourse to higher level techniques, such as cost accounting.

This situation persisted until the birth of the modern factory in the early 19th century. Prior to the industrial revolution, merchant entrepreneurs used a domestic system for manufacturing goods such as textiles. This involved the merchant buying raw materials in the open market and coordinating their conversion into 'manufactured' items through consigning the goods to independent households (Johnson 1981). The households then took complete responsibility for production and quality selling back completed products. Therefore, all the transactions were market based, so simple accounting was perfectly adequate.

The development in accounting practice came in the United States with two major structural changes in the management of production (Johnson, 1981). Firstly, piece work payment systems were replaced by wages and, secondly, factories developed from single to multiple operations. The transition from piece work payments to a wage payment meant that managers in the early textile mills could no longer know the cost of a product without understanding the relationship between production and wages paid. There was also an additional problem. Without a piecework rate, "they (the workers) had no automatic incentive to pursue the same goal when being paid wages" (Johnson, 1981, page 514) so employees' performance had to be measured and monitored for control purposes.

Moving from single to multi-operation production also makes an understanding of costs much more important. The development of integrated mills in the USA necessitated management cost accounting systems. In the UK, Johnson (1981) argues, mills didn't have these cost management tools so couldn't develop beyond single processes relying on efficient market institutions to coordinate different production processes rather than creating vertical integrated firms. Thus, we see the emergence of early cost accounting systems for internal control around 1850 in an integrated New England textile mill (Johnson, 1972). These were used to facilitate control of productivity and understand the costs of different processes, whilst in the UK the absence of such processes held back the development of integrated mills.

The next major development in management accounting coincides with companies trying to progress from managing a single (although multi-operation) production plant to the management of multiple plants as occurred at E. I. du Pont de Nemours Powder Company (Johnson, 1975). In this new multi-site manufacturing environment, we see the need to coordinate activities, which were originally

mediated through the market. Top management also needed to relinquish day to day control of the business to allow them time to plan for the future. Johnson (1975) argues that "the cost of integrating and coordinating internal activities is the main factor limiting the size of a unitary form organisation" (page 204).

The solution developed at du Pont between 1903 and 1912 was very similar in character to a modern standard management accounting solution. The only real difference was in the allocation of overhead (the allocation only being made to finished goods and not to work in progress). Standards were set for production and cost reporting which allowed comparisons of performance between different sites. Systems were also in place to motivate the sales force to pursue profitable sales, monitor changes in demand, coordinate sales, production and purchasing, and forecast cash flow. A further innovative approach was the introduction of Return on Capital Employed as a key ratio for measuring the success of past investments and as a basis for guiding future investment decisions.

Chandler (1962) argues that when companies such as du Pont, Sears Roebuck and General Motors diversified after the First World War, they discovered that sophisticated management accounting systems were fundamental to the coordination of multi-divisional organisations. Johnson (1978) argues that Durant's attempt to consolidate autonomous car and automotive part manufacturers into one giant firm, General Motors, failed because:

"In short, he did not have the administrative system that could direct the activities of each operating unit towards common goals" (page 492).

Whereas the system at General Motors implemented by his immediate successor, Pierre du Pont, and Donaldson Brown (another former du Pont executive) did allow top management to coordinate performance. Financial policy, sales reporting and flexible budgeting indicated promptly when deviation from plan required divisional managers to take action and allowed top management to allocate resources and executive compensation.

This is the premiss for Johnson (1981) arguing that entrepreneurs responding to market forces were forced to search for alternative forms of trading and organisation. These organisations had to be managed and controlled and consequently the development of modern firms and accounting techniques are inextricably entwined. These new organisational forms could not be managed without the new techniques developed and the techniques had no relevance outside the new structures. In fact, in the six intervening decades between 1925 and the publication in 1987 of "Relevance Lost: the rise and fall of management accounting", Johnson & Kaplan (1987, page 125) argue that no progress was made in the development of management accounting.

The logical conclusion of this argument is that the development of management accounting and performance measurement systems is driven by changes in the economic, trading and business environment and it has been argued (Wilcox & Bourne 2000) that more recent developments in accounting and performance measurement can also be traced to changes in the business environment.

The 1980s saw the emergence of a management accounting crisis in the West. At the time, traditional measurement was financially based, internally focused, backward looking and more concerned with local departmental performance than with the overall health or performance of the business (Johnson & Kaplan, 1987; Keegan et al, 1989; Neely et al, 1995; Olve et al, 1999). In response to Japanese competition, the 1980s also saw the implementation of manufacturing techniques in the USA, such as JIT, TQM and Kaizen. Kaplan (1986) conducted a preliminary study of four companies introducing these modern manufacturing techniques and concluded that manufacturing industry was changing, but the cost accounting system was failing to keep up. Costing systems were not able to cope with the demise of direct labour as a significant cost, the need to cost increasing automation and the resultant growth in overheads. The consequence of this crisis was the creation of non-financial performance measures and the design, implementation and use of what today are known as performance measurement systems (Neely et al, 1995). This enabled manufacturing companies to move beyond a cost focus by measuring and managing important competitive elements for the firm such as quality, speed and agility. Again, the evolution of the management system is intertwined with the need to respond to changes in the economic, technical and trading environment.

The period from the late 1980s to the mid-2000s was probably a golden age for the development of performance measurement. This started with the creation of a series of multi-dimensional performance measurement frameworks, such as the Supportive Performance Measurement Framework (Keegan et al 1989), the Results Determinants Framework (Fitzgerald et al, 1991) and the SMART pyramid (Strategic Measurement and Analysis Reporting Technique) developed in Wang laboratories (Lynch & Cross, 1991) all of which preceded the Balanced Scorecard, developed in Analogue Devices (Schneiderman, 1999) and widely popularised by Kaplan & Norton (1992). Multi-dimensional frameworks help managers look beyond the financial numbers and focus on issues that were important for the competitiveness of an enterprise, ushering in a new era. But choosing the measures to populate a framework or scorecard isn't a trivial matter; it requires translating the firm's intent into a series of measures that communicate direction throughout the organisation and aligning the business with the environment in which it is operating.

In the 1990s, the focus moved from frameworks to more practical problems of how to choose, implement and use performance measures in measurement systems that guided the business as a whole.

By the end of the first decade of the 21st century, there were a whole raft of techniques available to those implementing performance measurement systems, some were audit based (Bititci et al, 1998), some were process based (Neely et al, 1996, and techniques such as strategy mapping (Olve et al, 1999, Kaplan & Norton, 2000), or success mapping (Neely et al 2002, Bourne & Bourne, 2007) were widely being promoted as facilitated approaches to aligning PMS with strategic intent. There was also research focusing on the use of measures to manage organisations (Martinez et al, 2010, Pavlov & Bourne, 2011), but this begged the question as to whether it could be shown that the use of performance measurement to manage organisations improved the performance of the organisations in which it was being used? The meta-analysis completed by Franco-Santos et al in 2012 was inconclusive on this point. There was strong evidence through case studies and at the level of application that PMS had a positive impact, but organisational level studies didn't support this result. One possible interpretation from this is that although PMS are beneficial, they also are costly to implement, manage and keep up to date, with this cost balancing the benefit. Speed of adapting the PMS to strategy and changes in the environment was also identified as an issue (Melnik et al, 2014) as outdated measures can be an impediment to an organisation moving forward.

Most recently, the issues of adaption to an ever-changing environment have again come to the fore. Three themes are of particular significance. First, there is the concept of the technical and social aspects of PMSs (Bititci et al, 2018), second, the proposition that using PMS to control is problematic (Franco-Santos & Otley, 2018), and third that there is benefit in looking at PMS as 'systems of systems' (Bourne et al, 2018).

Three themes in contemporary PMS

Firstly, there is the issue of the theoretical basis for thinking about PMS. PMS sit at the intersection of many disciplines making theory building more problematic than for other areas of academic research. However, Bititci et al (2018) identified one important common feature.

"A common feature of these works is the recognition of two different types of organisational control, i.e. technical control and social control (Cardinal, 2001; Cardinal et al, 2004; Child 1973; Ouchi, 1979). Technical controls are the rational, planned, bureaucratic and structural elements of the organisation, and include business planning, measuring performance, setting targets, policies and procedures, reviews and rewards. Social controls focus on emergent, cultural and behavioural aspects of the organisation and include factors such as shared values, collaboration, participatory decision-making, open information-sharing and keeping promises" (Bititci et al, 2018, page 654).

Conceptually, it is possible to look at PMS in purely technical terms, or in purely social terms, but the field greatly benefits from looking at both aspects together.

Secondly, the undesirable consequences of PMS have been recognised for decades, but more recently the focus has been on the issues associated with using PMS for what management accountants call "management control". The Franco-Santos & Otley (2018) paper reviewed the literature and concluded

that “Directive PMS” (systems that were designed to control performance) promoted many undesirable consequences. These included, gaming, misinterpreted, misrepresented or reclassified to enable performance requirements to appear to be reached; create selective attention, quantified measures and targets overshadow those that are not; illusion of control, PMS actually accurately represents performance, particularly bad in complex environments; Promotes a transactional relationship, undermines trust. They argued for “Enabling PMSs” that facilitated performance rather than controlling it.

Thirdly, Bourne et al (2018) proposed that a system of systems lens would be useful for thinking about PMS in the current environment. They highlighted the key characteristics as being:

- Structure - those parts of the system are fully functional systems in own right
- Autonomy - parts of the system have the ability to set and pursue own goals
- Connectivity – loosely connected evolves as parts belong to it but also can leave it
- Diversity - heterogeneity in a system of systems makes it resilient
- Dynamic - so there is emergent, and properties can't be causally linked to constituent parts

Taking a system of systems view of PMSs would suggest there would be benefits from moving from monitoring and control to learning and adaption and shifting from focusing on the design of a PMS to keeping the PMS under continuous review. In a system of systems world, it is the information flows that are important, with multiple inputs into decision making creating multi versions of the truth as a result of having equivocal information. Finally, Bourne et al (2018) recommended that rewards should tied to the system level performance and not that of its parts or subsystems.

There is a great deal of similarity between these three recent publications, the most prominent of which is the problems associated with using PMSs to control people and organisations in a volatile, complex evolving environment. In stable environments, controlling may have some use, but with environmental change impacting on factories, businesses and wider supply chains so quickly, people need to act more freely than traditional control systems allowed. The proposed solution is to use PMSs as enablers of learning to facilitate decision making, which takes us on to the five papers in this special issue.

Emerging themes in this special issue

In this section we will introduce the five papers presented later in this issue. All five papers are considering the use PMSs in an evolving trading, economic and ecological environment.

The 2021 noble prize for physics went to Syukuro Manabe for his work on climate change science, but we need to also look to how climate change is going to impact on our factories and supply chains. Kara, Ghadge & Bititci's (2022) paper does this by modelling the impact of climate change risk on supply chain performance. This study combines three phases of research to develop a quantitative model to evaluate the impact of climate change on supply chain risks. A cognitive map of the interactions was created by a group of experts. The causal relationships from the cognitive map were then developed further by surveying practitioners to ask them about the most important factors that they believe will influence supply chain performance. In the third phase of this research this information is combined to create a systems dynamics model to model the effects. The paper concludes by highlighting the consequences in terms of reduction in availability of natural resources, capacity issues, stock outs, bottlenecks and the wider consequential disruptions to the supply chain.

One of the related consequences of climate change is our response to reducing carbon emissions. In the automotive industry, this has recently resulted in new models, autonomous vehicles, electric cars, self-charging hybrids and plug-in hybrids. All of this impacts on OEMs and they endeavour to manage this widening product mix within existing production systems. Causing instability. Müller Lehmann & Kuhn's (2022) paper focuses on measuring sequence stability in automotive production lines. Being able to manage this variety requires companies to measure and manage their production system stability to ensure they remain efficient. The study attempts to identify measures that are useful for decision makers over different time horizons and emphasises the need to have accurate and up to date information available to manage. High stability is required to ensure that the costs of instability are minimised and the paper

Zhou, Peia, Liua, Fua & Pardalos (2022) explain how virtual enterprises (VE) have developed as a paradigm to pursue competitive advantages in dynamic markets when faced with the need to respond to low cost, high quality and quick response. These virtual enterprises have to work together, coordinating their activities and sharing resources and this can be supported by advances in technology through the Internet of Things (IoT). But to be successful, resource occupation and delegated decision making are critical. Resource occupation refers to the quality and quantity of assets and capabilities that are embedded in organisational routines to support task implementation. These assets and capabilities can be enhanced through using the IoT to support rapidly shared accurate information between collaborating companies making up the VE. This paper provides specific guidance for IoT VE companies looking to acquire and cultivate specific resources and allocate decision making authority reasonably for effective resource utilisation and collaboration.

Over the years, World Class Manufacturing (WCM) has come to mean many things, but in this increasingly VUCA world (volatile, uncertain, complex and ambiguous) WCM has to include situational understanding so that companies can seize opportunities and react quickly to threats. de Andrade, de Gusmao & Silva's (2022) paper develops a model for evaluating the maturity of WCM from the literature and the opinions of WCM experts. The instrument developed was then tested in four manufacturing companies and demonstrated the feasibility and useability of approach. This paper helps us better understand how to evaluate the performance of production systems from a WCM perspective especially in the current VUCA climate.

In the final paper, Liu, Love, Le Ma & Sing (2022) develop a multi-dimensional paradigm for predicting performance in an infrastructure construction company operating in a dynamic, uncertain and complex environment. Prediction is important for organisations to thrive and survive and this paper argues that this has been previously largely overlooked in evaluation. The paradigm was tested using real production data and the managerial implications of taking such an approach were presented and discussed.

All five papers presented here are looking at the need to evolve PMS as the wider trading, economic and ecological environment evolves. When launching this special issue we expected papers to be addressing how organisations can adjust to these changes, but what we have here are applications of PMS in very novel environments as well. This may lead us to having to rethink PMS research again for the future.

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