ON THE DESIGN OF A SUSTAINABLE PERFORMANCE MEASUREMENT SYSTEM (PMS) IN A TURBULENT ENVIRONMENT

Sérgio Sousa, University of Minho, Portugal, sds@dps.uminho.pt
Eusébio Nunes, University of Minho, Portugal, enunes@dps.uminho.pt

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INTRODUCTION

In order to achieve and maintain a competitive edge in the world marketplace, companies must produce high quality products at low cost with increasing variety, over shorter lead times [1]. To achieve these objectives many companies are adopting the recently developed management, production, and quality philosophies such as TQM, just-in-time, computer integrated manufacturing, optimised production technology, global supply chain [2], rapid product realisation, and are adopting new information technologies [3] and automation. To assess organisation's success when adopting these philosophies, that is to assess organisational performance, companies use measures. The problem is not only to find the best set of performance measures (PMs) to use, and how, where, when, by whom, etc. but also to develop a PMS congruent with business excellence.

Performance measurement systems (PMSs) are receiving increasing attention from academics and practitioners particularly after the development of the Balanced Scorecard (BSC) [4], and many PMSs are available nowadays [5]. Nevertheless, this subject is not new and, for example, quality gurus such as Crosby, Feigenbaum, or Deming recognized the importance of performance measurement as an activity within quality control, quality improvement or quality management. Recently, there are many publications on the design of PMSs, (developed for industries, services, SMEs, public services, non-for profit organizations) and about their implementation and use, however there is a lack of investigation on PMSs specifically adequate for organizations operating on turbulent environments.

According to Verweire and Berghe [6] integrated performance measurement needs both strategic and maturity alignment. The performance measurement system (PMS) should not be static but should be frequently questioned or reviewed. Its purpose is to contribute to both the goals and the sustainability of the organisation.

The development of an integrated framework for performance measurement recognises that performance appraisal encompasses a multitude of processes and tools, requiring a systems view that may not be managed through a single framework focused solely on performance measurement. However, it can be achieved through an open system that recognises dynamic flows between various organisational levels, in which both micro and macro views are addressed ranging from control models to broader evaluation perspectives appropriate to stakeholder requirements and organisations' purposes [7]. This open system would provide flexibility to allow organisations to survive and prosper in turbulent and unpredictable environments.

This work starts from Business Excellence Models (BEMs) and PMSs to identify factors to take in consideration when designing a PMS in turbulent environments. It is part of ongoing research, which is being carried out on world-class organisations and subsequently will study these factors through longitudinal case studies to ascertain their validity (even if the generalisation of the findings is not possible, it will suggest research directions on the design of PMSs in turbulent environments).

Motivation

The motivation for this work was twofold. The first was the recent developments in performance measurement mainly due to the use of benchmarking, balanced scorecards, the ISO 9001:2000 quality standard and the ISO 9004 guidelines, which are now closer to excellence models. The second was that the dynamic nature of the environment in which organisations operate is changing faster than ever.

Many of the principles behind models of excellence put emphasis on the performance measurement of key indicators of an organisation. The hypothesis is that organisations on turbulent
The objective which compels an organisation to adopt change in its normal operations may be internal or external. An organisation will benefit from the adoption of a PMS if its contribution to achieve its objectives is positive, i.e. its costs (often hard to identify and consequently hard to measure) are less significant than the benefits. Overall, a strategy for designing PMS based on TQM principles and tailored to organizations on turbulent environments will be proposed.

LITERATURE REVIEW

Background on TQM principles and Business Excellence

There is a plethora of quality improvement paradigms to help organisations improve their products or services [8]. Based on the principles of TQM models, implementation guidelines can be grouped into three types [9]:

1. prescriptive teachings from quality experts or practitioners such as Juran, Deming and Crosby - have proposed a number of different implementation models, each based on their own knowledge and interests resulting in a diversity of philosophies, principles and methods. The gurus commonly declare their interest in managing people in their philosophies, but offer few tangible principles and virtually no usable methods. According to a survey carried out by Claver and Tari [10], the human aspects were those least implemented. If the success claimed by these quality experts is a result of implementing their methodologies, then it confirms the idea that there is not one best solution but a set of solutions that will improve organisational performance.

2. quality certifications from international organisations such as the ISO 9000 series of standards and quality awards, such as the Deming Prize in Japan, the Malcolm Baldrige Quality Award in the USA and the EFQM in Europe - provide recognition of the adoption of quality practices, and are based on TQM principles. Self-assessments against these models are widely considered to be more advantageous in respect of the actual value added for clients and businesses in general [11]. Overall, business excellence is replacing the narrow objective of meeting customer specifications; the focus is on the performance of the whole system, and not just the outputs.

3. scholarly academic research that strives to conceptually and empirically extract the components of quality management and their linkages to performance, such as the balanced scorecard [4], the performance prism [12] and Kanji’s business excellence model [13] - focus on two main areas, the technical needs of quality control and the human dimension of quality management. Technical needs of prediction and control are catered for largely by statistical and quantitative methods.

Prajogo and Sohal [14] strongly argue that despite the decline in TQM popularity, it will remain an essential part of developing and maintaining a competitive advantage for organisations. TQM, excellence models, and quality awards have highlighted the importance of performance measurement in achieving business excellence.

Performance measurement systems

Juran and Godfrey [15] argue that “the choice of what to measure and the analysis, synthesis, and presentation of the information are just as important as the act of measurement itself” and emphasise the system to which the measurement process belongs (Figure 1). The measurement process consists of steps needed to collect data and present results. The larger measurement systems also embrace the decisions that are made and the framework in which the process operates.

Fig. 1. The act of measurement is but one step in a large system. Source: adapted from Juran and Godfrey [15].

The first step in defining a PMS is to understand who will make the decisions (and how) and who will take actions (Figure 1) [15], i.e. the purpose of each PM must be clear [16], and must promote a company’s strategy [17]. It can be concluded that there are no bad PMs, only the bad use of them [18]. Before determining what to measure and how to measure it, the overall framework in which the PMS operates (see Figure 1) should be understood [15]. This involves the analysis of stakeholders’ goals [12] and the range of possible decisions and actions. Assuming that what is measured gets managed and improved,
organisations must measure only those areas that will help them better manage and make accurate decisions [19]. According to Macpherson [18] there are two approaches to identifying PMs: top-down and bottom-up. Using the first approach, the search for PMs is based on the mission and vision of the organisation. The latter, on the other hand, is determined by what data is currently available [18] and has the advantage of being cost effective by only focusing on visible data [18]. The bottom-up has the advantage of being cost effective by only focusing on visible data [18]. A third approach is [20] outside (or customer) - inside (or internal processes), endorsing the argument about the importance of looking at the organisation from the customer's viewpoint. The focus of managers will be to improve services as seen by the customer instead of increasing conformance to a model, because employees will perform exactly as the measures tell them to, regardless of their original intent [21].

According to literature, PMs should be clear, credible, balanced, tied to desired results, precise, quantifiable, clearly specified, reliable, valid, sensitive to important changes, relevant to each managerial level, flexible, able to be changed as the need arises [22] and support day-to-day operations with information that is both timely and relevant [22], [23]. Effective performance management requires reliable data [18], [23]. Potential data quality elements are discussed in [24] and [25]. To contribute to the planning phase of the PMS, Appendix 1 presents Critical success factors to improve PMSs [17].

Overall, PMs should be based upon data that can be collected and analysed at a reasonable cost and with minimal effort. The focus of measurement should be in situations where improvement can be achieved by those directly involved, through defined approaches. Several frameworks have been proposed to develop and use PMSs in organisations, a sample of which will be presented in the next section.

Performance Measurement Frameworks

In recognition of the need for more relevant, better structured and integrated PMSs, a number of frameworks and models have been developed [26]. These will be called performance measurement frameworks (PMFs) as they provide specific guidelines to contribute to the definition of such PMSs.

Given the extensive number of frameworks found in the literature, the author will review only a sample based on their impact on the academic community, the introduction of new concepts or the simplicity of implementation.

There are two basic types of PM in any organisation – those related to results (competitiveness, financial performance), and those that focus on the determinants of the results (quality, flexibility, resource utilisation and innovation) [27]. This suggests that it should be possible to build a PMF around the concepts of results and determinants. The EFQM also supports this concept.

The “strategic measurement analysis and reporting technique” (SMART) as cited by [22], consists of a four level pyramid of objectives and measures, which attempts to integrate corporate objectives with operational PMs. However, it does not provide any mechanism for identifying key PMs, nor does it explicitly integrate the concept of continuous improvement. The performance measurement matrix presented by Keegan et al. and reported by [27] seeks to integrate different dimensions of performance, and employs the generic terms “internal”, “external”, “cost” and “non-cost” to enhance its flexibility.

Perhaps the best known PMF is Kaplan and Norton’s BSC [4] [27]; it seems to be the most influential and dominant concept in the field. The authors of the BSC suggested [28] the definition of strategy maps to describe the cause-and-effect relationships between the identified measures, but according to Wilcox and Bourne [29] these relationships are outdated. According to Brown [19], though the principles behind the BSC are simple, applying them is exceedingly difficult. The collaborative culture of the integrated supply chain has triggered the emergence of new measures, especially in five areas [16]: external focus, power to consumer, value-based competition, network performance, and intellectual capital.

Bititci et al. [26] developed a model for an integrated and dynamic PMS. They investigated the use of IT tools as a self-auditing dynamic PMS, which would ensure that an organisation’s PMS remained integrated, efficient and effective at all times. A dynamic PMS should have: an external and internal monitoring system, a review system, and an internal deployment system. The model [26] also extends the notion of performance measurement into a control loop to include corrective action.

Basu [16] argued that the PMs should be more externally focused for the total network, there should be a shift from “measurement” to “management”, and a formal senior management review process with two-way communication to all partners was essential to success.

Karapetrovic and Willborn [11] maintained that integrative approaches to performance evaluation, including auditing, self-assessments, benchmarking, and performance measurements
are still required. Performance measurement is a methodology that complements the self-audit, since it focusses on identifying metrics related to business results, and on evaluating the actual performance with reference to developed metrics. Self-assessment against quality award models has gained prominence in exactly areas where quality audits were lacking, most importantly in performance improvement [11]. The EFQM believes that the process of self-assessment is a catalyst for driving business improvement, and so could act as an initiative to start a business excellence initiative [16].

Kanji and Sá [30] started with the BSC and improved it by integrating TQM principles and CSFs resulting in a model which focussed on measuring how an organisation is performing from an outside perspective. According to its authors, achievements in each of the four areas of Kanji’s business scorecard need to feed into each other to form a cycle of continuous improvement so that:

- delighting the stakeholders helps to generate revenues and satisfactory returns to the investor;
- increased revenues help to fund investments in processes and learning; and
- better processes and learning help people to delight the stakeholders and create business excellence.

The above concepts start with organisational values to derive a business scorecard index (see Part B in Figure 2). This extension to the BSC taken from an external perspective complements Kanji’s Business Excellence Model [13], which is mainly an internal assessment framework (see Part A in Figure 2), and together they form a single and complementary view of organisational performance. Each concept represents a latent variable that is measured through a set of variables that represent that concept, and altogether constitute a structural equation model. Kanji and Sá [30] argue that it is a means of overcoming one of the problems of the BSC associated with the causal relationships assumed.

The assessment against this measurement model results in a number and makes comparisons between different organisations possible. Lower scores in different criteria indicate areas in which the organisation should put more emphasis on improvement. This model was named Global Excellence Measurement System (GEMS) [31].

The Performance Prism [12] focusses on stakeholder satisfaction to integrate and align strategies, processes and capabilities. In addition, it refers to the importance of identifying stakeholders’ contributions, as they are part of a reciprocal relationship with the organisation. All these suggest that organisational values, process excellence, organisational learning and delighting the stakeholders are the fundamental dimensions to be managed and monitored. The Performance Prism’s authors argue that it is necessary to move away from thinking about measurement in the traditional sense – the process of quantification – and start to think about measurement as the process of gathering management intelligence.

![Fig. 2. Kanji’s Business Excellence Measurement System (source: [173]).](image)

Having reviewed performance measurement and its systems, the next section will address the characteristics of turbulent environments that may limit or facilitate their introduction.

**Turbulent environments**

To cope with turbulent environments organisations change to become flexible and the PMS must include information about the wider environment. As a result the PMS interacts with the organisation and with the external environment which is unique in each case, but some generalities may be described.

Factors affecting the development and use of the PMS can be grouped as (Figure 3):

- **Inputs** - The knowledge, identification of requirements and resources that will be required to develop a PMS. As organisations depend on many stakeholders, the PMS should include information related to them.

- **External environment** - It is dynamic and may enhance or limit the adoption of the PMS by changing its priority. Each organisation exists within an environment. The first difficulty associated with performance measurement is its
justification. One source of variation of the external environment arises from the variety of customers, and products that may dictate rearrangements within the organizations for example: changes in layout, in people’s responsibilities and tasks, but also may require rearrangements with partners and suppliers. External environment consists of market (including competitors), legal, technological, socio-cultural, and international factors [32]. The competitor performance can be monitored through benchmarking. Instead of considering strategy as the basis of a PMS, one must start by looking at stakeholders, which are not all within the organisation. It is commonly recognised that the external and internal environment of an organisation is not static but is constantly changing.

Fig. 3. Factors affecting the development of a PMS

Reference / Standard / Model - The reference or standard or model is either externally imposed or is related to what the organisation expects from the PMS. It may contribute to the definition of the level or target for the identified measures. The nature of the industry, the company culture, and its immediate, medium, and long-term goals; the adoption of quality tools and techniques; and the views of senior management toward award models and TQM philosophy are unique in each case.

The design of the PMS is also affected by the internal environment. Internal environment factors considered are: corporate planning, role of top management leadership, customer focus, human resource focus, process focus, quality focus, and information and analysis [32]. Neegaard [33] formulated five different contextual definitions and identified some factors that seem to explain the choice of each organisation’s configuration. The choice of configuration is contingent on a number of contextual factors, such as the organisation’s size, technology, strategy, organisational structure, culture, management style and uncertainty in the external environment.

Finally, the PMS will provide information about the system, but unless some action is taken, no improvement will be expected. It will produce results if integrated into a process-based change.

METHODOLOGY

Performance measurement in turbulent environments is at the centre of this on-going research. The research methodology to design a PMS in a turbulent environment will comprise both deductive and inductive stages. It starts with a literature review on the field of performance measurement to develop through deductive logic a conceptual and theoretical structure. This part of the research presents the findings of this deductive research which will later be tested through case studies, to allow another step of inductive research to support, change or refute the proposed elements of the PMS.

CRITICAL SUCCESS FACTORS ON THE DESIGN OF PMSs IN A TURBULENT ENVIRONMENT

Two key critical factors will be discussed Customer Performance Measures (CPMs) and organisation flexibility, as flexibility is a means to adapt to turbulent environment and customer focus is still one the principles that managers can not neglect. The following analysis reveals the importance of these two critical elements in a PMS that are implicit or explicit the renowned PMSs: Balanced Scorecard, Global Excellence Measurement System and Performance Prism, as they represent the current best practices on the design of PMSs and are accepted by practitioners and academics.

Customers

Assumptions - each organization has internal and external customers and the PMS must include customers’ information. This is a vital component of any balanced scorecard and can serve different objectives:

- if customers are “unhappy”, means that competitors are doing relatively better or that their expectations are not being met.
- if customer satisfaction is associated with customer retention that indicator can be used as a predictor of future sales and thus can be considered as an indicator of future performance or sustainability of sales.
- customers’ requirements are always changing and organisations may have products/services for different customer segments, and sell to different regions and cultures.
- most methods to assess customer satisfaction find hard to quantify lost sales or the cost of opportunity.
• information about the experience of each customer of the organization must be used and be available in future contacts with the same customer.

Potential Problems - according to the Kano Model customer needs are continuously evolving. How to know exactly what each customer wants and what he does not want and why?

The needs, opinions and expectations of the customers are usually expressed through natural language, using linguistics terms.

There are studies that argue that only a small fraction of (un)satisfied customers will actually express formally such situation to the organization, for example, through customer feedback boxes or by email. How to design reliable and flexible (CPMs) at low cost?

In the traditional formulation of a PMS, most systems variables are affected by imprecision and vagueness but they are represented using numerical crisp values. A good decision-making model needs to tolerate vagueness and imprecision because these types of the non-probabilistic uncertainty are common in decision-making problems [34].

Measuring customer performance will not improve business unless action is taken over the system. How can CPMs contribute to identify problems and aid decision making? If the uncertainty (fuzziness) of human decision-making is not taken into account, the results can be misleading [35].

Proposed Solutions - There is not one method alone to study customers exempt from limitations and thus more than one method must be used.

The organisation must provide, by all means of contact with the customer the ability for him to make a complaint/suggestion and must record that information in a simple, economic and reliable way. Additionally, it must ask simple questions such as: are you satisfied with our organization? What would you like us to do for you?

The responses to these and other questions are given normally in natural language, using linguistic terms such as: “very good”, “probably so”, “not very clear” or “acceptable”. These terms have associated vagueness and fuzziness, being much natural to refer to their values using a linguistic label instead a crisp numerical value as frequently is done [36].

Fuzzy Set Theory and Fuzzy Logic have proved to be a successful in handling imprecise and vague knowledge that characterise this kind of problems, and it has been applied in a variety of fields in the last decades.

The understanding of customers’ (present and future) needs and the evolution of society is a means of predicting future trends in the near future. So the task of studying Customers and transforming their needs into organizational requirements and contracts must be one vital process of any organization that adds value to the next product/service offered (at least in the design phase).

Flexibility

Assumptions: flexibility is the “firm’s capacity to adjust to change and/or exploit opportunities resulting from environmental changes” [37]. A flexible organization may have frequently new processes, new process owners, new suppliers, new partnerships, new subcontractors, new collaborators, etc. In this context is not valid the assumption underlying in most performance measurement studies that it is known the structure of the system and the dependence relations between parts.

All the workers and more in general customers and some stakeholders are potential owners of PMs or contribute with data to some PMs that are used in the PMS.

Potential Problems: all the above actors may have a different culture, knowledge or experience resulting data from a multitude of sources that is non-reliable and/or non-valid. Data quality [25] is the first metric that is fundamental to successful performance management deployments. The problem is how to overcome this situation or how to deal with this uncertainty of data.

Proposed solutions:
1. A colour scheme to represent the quality of each PM.
2. To use Fuzzy Set Theory for capturing vagueness and fuzziness of the input variables, the explicit representation of data semantics, the subjectivity of human perception and assessment, and the non-deterministic behaviour of the users.
3. To develop adequate methods to propagate the uncertainty of the parameters or input variables throughout the PMS.
4. To allow stakeholders of the organization to provide their opinion (greater than or smaller than) about existing PMs. Afterwards, each one that was correct about the evolution of a PM will increase the credit of their prediction while others will decrease or maintain that credit. This would be a basis to provide a level of “believability” to each PM.
References


### APPENDIX 1 – CRITICAL SUCCESS FACTORS OF PERFORMANCE MEASUREMENT

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Critical success factors of performance measurement</th>
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<td><strong>Top management support</strong></td>
<td>Management consensus concerning an organisation’s objectives and the means at its disposal for attaining them [27]. &lt;br&gt; PMs must be chosen from the company’s objectives and strategy (Maskell, 1989) (cited by [27]).  &lt;br&gt; PMSs need to achieve alignment with strategic priorities [26], [27].  &lt;br&gt; The PMS must place significant emphasis on the quality strategies of the company [17].  &lt;br&gt; The departments and functions responsible for introducing performance information must be totally committed to their service responsibilities in the organisation [17].  &lt;br&gt; The PMS must show a healthy apprehension for financial indicators and actively promote the use of non-financial indicators [17].  &lt;br&gt; Achievement of an overall feeling of urgency and perpetual improvement [21].</td>
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<td><strong>Customer relationship</strong></td>
<td>Performance criteria should be selected through discussions with customers [38].  &lt;br&gt; The PMS must place a strong focus on performance information that directly measures customer satisfaction and responsiveness to customer requirements [17].  &lt;br&gt; Visibility [21].</td>
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<tr>
<td><strong>Workforce management</strong></td>
<td>Performance criteria should be selected through discussions with employees [38].  &lt;br&gt; PM must not be used as a weapon nor used to punish or blame [17].  &lt;br&gt; Departmental goal-setting without creating inconsistencies in policy or excessive interdepartmental conflict [27].  &lt;br&gt; There are measures to indicate performance of teams [27].  &lt;br&gt; Long-, short- and medium-term goals [27].  &lt;br&gt; Part-ownership of problems – so that a solution has to be found across functional boundaries and the escape route, “it’s somebody else’s fault”, no longer has any meaning or validation [27].</td>
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<td><strong>Employee attitudes and behaviour</strong></td>
<td>The measures should be designed so that they stimulate continuous improvement rather than simply monitor (Maskell, 1989) (cited by [27]).  &lt;br&gt; Involvement of all concerned [21].  &lt;br&gt; Total commitment from all involved [27].</td>
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<td><strong>Process flow management</strong></td>
<td>PMs should provide fast feedback (Maskell, 1989) (cited by [27]).  &lt;br&gt; PMs should encourage and enable employees to control and improve processes. They must not stimulate nor promote short-term manipulation of processes [17].  &lt;br&gt; Straightforward measurement of what is important [21].</td>
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<td><strong>Quality data and reporting</strong></td>
<td>Data collection and methods for calculating the PMs must be clearly defined [38].  &lt;br&gt; Ratio-based performance criteria are preferred to absolute numbers [38].  &lt;br&gt; Performance measurement information must be freely available at all levels in the organisation to encourage employee empowerment [17].  &lt;br&gt; A thorough understanding of the existing measurement systems, both formal and informal, spoken and unspoken, as they are perceived [27].  &lt;br&gt; Performance information must be relevant, user-friendly, reliable and frequent [17].  &lt;br&gt; More extensive use should be made of subjective data [17].  &lt;br&gt; Simplicity of presentation (few and understandable variables) [21].</td>
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<tr>
<td><strong>Role of the quality dep.</strong></td>
<td>It should be acknowledged that measures change as circumstances do (Maskell, 1989) (cited by [27]).  &lt;br&gt; Undistorted collection of primary information throughout the operations area [21].</td>
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<tr>
<td><strong>Culture</strong></td>
<td>It should be recognised that measures vary between locations (Maskell, 1989) (cited by [27]).  &lt;br&gt; The corporate culture [27].</td>
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<td><strong>Structure</strong></td>
<td>Performance criteria should be under the control of the evaluated organisational unit [38].  &lt;br&gt; The measures should be simple and easy to use (Maskell, 1989) (cited by [27]).  &lt;br&gt; An appropriate mix of integration and differentiation (i.e. goals set both horizontally and vertically within the framework of the organisational chart) [27].</td>
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<tr>
<td><strong>Benchmarking</strong></td>
<td>Benchmarking must be used consistently to ensure the appropriateness of internal standards and to vitalise the continuous improvement process [17].  &lt;br&gt; Performance criteria must make possible the comparison of organisations which are in the same business [38].</td>
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