A PERFORMANCE MEASUREMENT SYSTEMS DESIGN FRAMEWORK

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Abstract
Performance Measurement Systems (PMS) are becoming ubiquitous in institutions for several reasons. PMS are being used to support actions in some day-to-day situations such as decision-making, communicating expectations, taking preventive measures and learning and understanding the processes, business environment and markets in which a company operates. There are a few reasons that lead to systems remain unchanged for an extended period, and often it requires the work of experts to design, analyze and implement a PMS. This paper presents a framework that, through a structured set of processes, guides the development of a PMS. This framework does not target companies of specific industries or sizes and is intended to be used to assess, design and implement a PMS for organizational units, such as departments, or even stand-alone initiatives, like projects.

Keywords:
Performance management system; design framework; PMSDF.

1 INTRODUCTION
The interest on Performance Measurement Systems (PMS) is not new. However, it's application is still increasing by companies of the most diverse areas and sizes, and for different reasons. PMS may have a great impact on operations, being applied to measure performance, manage the strategy, communication, influence behavior, learning, and improvement [1].

To have positive impacts, these applications must be aligned to the company strategy, offering the needed data to pursue this strategy to the managers [2].

Several process models for the development of PMS are presented in the literature. Kaplan and Norton's balanced scorecard (BSC) [3] suggests that the company measures must answer to 4 perspectives: customer, internal, innovation and learning and financial. Bourne et al. [4] propose a model where the development is divided in design, implementation, and use of the performance measures. Neely et al. [5] developed a process in which the framework presented in the current paper is mainly based in which the measures and system are results of the business strategy.

Enterprises are complex systems, and to properly develop the PMS it is necessary to have a broader view of its internal and external relations. These systems integrate business process and technologies and must make accessible to the users the information in a clear and easy way. This way, the project, deployment, and review of these systems usually involve skilled professionals working with complex factors and technologies, which increases the required resources.

In some cases, the cost of conducting a PMS implementation project is high. Operations of medium sized companies, not-for-profit institutions, autonomous operations, standalone projects, to list a few examples, are cases where the corporation operates on a tight budget, and to have a consulting company set up or update a PMS is an unrealistic excessive cost. On the other hand, these are cases where a simpler option could fit their needs.

In this paper, it will be discussed a framework that simplifies the process of development of a PMS – PMSDF (Performance Management System Design Framework). It will also be presented two application cases where the framework was used in the form of a form-based process that guides the professional through the stages of the PMSDF.

2 PERFORMANCE MEASUREMENT SYSTEMS DESIGN FRAMEWORK
This research builds on previous PMS design frameworks [6], [5] and research [1]. The main reference model was the process described by Neely et al. [5], presented in Figure 1. On this process, the development of a PMS is guided by a detailed set of tasks, to assess the company's strategy and market position, and the production processes.

Based on this process, the objective was to create a more simplified process, presenting lower complexity procedures, followed by easy to follow instructions for the practitioner in charge of the PMS project. Although simplified, the framework is in line with contemporary performance measurement (CPM), linking the measures to the organization's business strategy [7].

The Performance Measurement Systems Design Framework (PMSDF) (Figure 2) is composed of 5 main stages:
1. Company Identification
2. Competitive Diagnosis
3. Operations Strategy
4. Business Process Modeling
5. PMS Processes and Performance Measures

This framework was first used in a systematic literature review (SLR) article about urban mobility indicators [8]. Aiming to identify if the selected set of papers presented sufficient elements to understand the PMS in the studied context, it was identified elements related to all the steps of the PMSDF, indicating that the article's sample fitted to the research objective.

The following subsections will discuss the stages and activities of the framework and its forms.

2.1 Company Identification (A1)
Description: In this session, the company and the team involved in the processes of analysis, design, and implementation of the PMS are identified.
Objective: Initial identification of the business and the individuals with roles in the project and definition of a schedule of activities.
Company
Basic information, the area of activity, size, and annual revenues.

Contacts
Contact options (telephone and e-mail) and the role of the people who support the project.

Interview Schedule
Initial task definition for upcoming meetings.

2.2 Competitive Diagnosis (A2)
Description: In this stage, it is identified how the objectives of the company are currently defined, and if they are coherent with the business identity.

Objective: To verify how the company is performing in the market in which it is inserted, compared to the main competitors and the interests of its customers. Another goal here is to identify the culture and strategy of the institution and the market to identify what is considered performance in this context. During this stage, it is identified the depth of the analysis, indicating if the PMS will assess a project, a department, an operation or an organizational unit, per example.

Method: Company's representatives must provide the business information, through, for example, interviews, questionnaires or workshops. Market information may also be obtained from this internal source, but when available can be obtained from external data, such as market research.

Organizational Mission
Assessment of the company's mission statement and its effectiveness.

Organizational View
Assessment of the company's vision statement and its effectiveness.

Company Values
Assessment of the company's values statement and its effectiveness.

Target Audience
Assessment of the target audience defined and served by the company.

Target Audience Segmentation
Assessment of the target audience segmentation identified and serviced by the company.

Business success critical factors
Evaluation of adopted strategy characteristics: product characteristics, production, quality, flexibility, and pricing policies.

Positioning related to competitors
Identification of the main direct competitors of the company, the market leader and the indicators used for comparison.

Strategic objectives
Evaluation of the company's defined strategic objectives.

SWOT
SWOT analysis, displaying Strengths, Weaknesses, Opportunities, and Threats of the assessed business or Operation.

2.3 Operations Strategy (A3)
Description: The objective of this stage, is to identify the characteristics of the company's operations strategy, categorizing the performance dimensions by performance orientations, and comparing these orientations to what the competitors practice and what the market expects.

Objective: To verify, among the presented performance orientations, which need to be redefined by management, due to lack or excess of efforts.

Method: Data can be obtained from the company representatives or through customer's opinion surveys and market research.

Performance Dimensions
List the performance orientations [9], critical to the business, and the corresponding performance dimensions, also describing these dimensions. In this session, evaluate the dimensions according to the values in the manufacture or service tables.

Importance-Performance
Categorize the performance dimensions listed in the previous session (Performance Dimensions) regarding their (A) importance to customers, and (B) performance
Figure 2. Performance Measurement Systems Design Framework (PMSDF).
compared to the competition. Distribute the tabulated values in the Importance-Performance Matrix (Figure 3) [10].

**Decision Areas**
Identify current practices among the decision areas of the company and what performance dimensions these practices address [9].

**Performance Objectives**
Identify, in the Importance-Performance matrix, the performance orientations positioned the most distant from the appropriate performance zone, for lack or exceeding performance, and create a table by orientation. Check with which decision areas each performance dimension relates. Identify weaknesses in decision areas or what forces needed to improve performance within the decision area, and what possible strategic actions or choices should be made to address those weaknesses or develop strengths.

**2.4 Business Process Modeling (A4)**
Description: Identification of key customer value development processes related to identified performance objectives.

Objectives: To know the production processes to deliver products or services to customers, and the respective measurements and measures.

Method: Process information can be obtained from interviews with people involved, with managers, by process documentation or by researcher immersion.

It is advised to create models of the processes using graphical notations, like BPMN (Figure 4) or Flowchart, and identify the indicators from the tasks, when possible.

**2.5 Performance Measures (A5)**
Description: Indicators identification and implementation design.

Objectives: Select, model, test and define the process of implementation, evaluation, and review of the indicators. Distribute the activities by the team responsible for the process.

Method: The selection of the indicators is based on the information gathered in the previous stage. It is recommended that company stakeholders participate during the choice of indicators and measures, as well as in the evaluation and review of the process.

**Order winners and qualifiers**
Based on the identified request-winning criteria (from the Importance-Performance Matrix), and after verifying the current or necessary indicators in the analyzed processes, relate indicators and processes, criticality classifying them.

**Project team**
Define who is responsible for the tasks of the subsequent phases of the implementation/review process of the performance measurement system. Some responsible listed in the contacts list may appear at this stage. Modeling the indicators

Create the indicator sheet [6], for the selected indicators presented in *Order Winners and Qualifiers*, list if the implementation will not work on all indicators or if it was decided a scaled deployment, it is recommended to use the “criticality” scale to prioritize which ones to model first.

**Implementation schedule**
Create a list of activities to be developed for the definition, testing, review, and implementation of the performance measurement system. It is suggested to use Gantt Chart.

**Budget**
Identify the direct and indirect costs related to the project, the payment deadlines, and the creditors.

Possible costs relate to the acquisition of technology for the measurement, storage, and processing of data, hiring project or team consulting to deal with the increased workload for collection and management of information.

**Quality Control**
Actions to control the performance measurement process activities. It is related to the methods and instruments used in the collection and analysis of data. Control methods may be applied in the context of team training, evaluation of the measurements responding to the questioning about the analyzed process, whether the frequency or size of the sample is adequate, if the accuracy adopted is appropriate to the needs, to mention a few.
**Risks of Implementation**

The risks are related to the uncertainty of variables and the possibility of project failure. Examples of risk are that the indicator is not relevant to the problem to be corrected, or where the deviation expected to be eliminated is identified as inherent to the process studied or the cost to reduce it does not reward. Identifying the probability of risk varies according to the process analyzed, but can be estimated from company or market history, or with the help of experts, workshops, panel data, among others.

**Testing the implementation of indicators**

It is recommended that the test be done with a reduced sample, reducing the risk of impact on the production. When possible, it should be performed using low-cost instruments such as leased tools, external servers, cheaper equipment with limited accuracy, to assess whether the solution designed answers the questions that the measurement proposes. Evaluate if the proposed solution is adequate and, if not, why not and what measures must be taken for correction.

**Indicators Implementation**

After the tests, this section will manage the actual deployment in the production environment. Present which indicators are being modeled and the progress.

**Indicators Measurement**

For each measured indicator, display its target and the lower and upper limits. Targets can be objective (weight, temperature, quantity, frequency) or relative (standard deviation, maximum, minimum, percentage, quartile).

**Action plan**

Check the unwanted results in the **Indicators Measurement** section and propose action plans for adequacy. The plan can be related to the production process or the measurement process. The action plan may include changes in the production process or the performance measurement process, such as changes in criticality or characteristics of indicators.

**Performance Measurement System Review**

This phase presents which changes (triggers) occurred in the company impact the defined indicators. An increase in the quality requirement may reduce the range of measures defined (5.10), requiring a new action plan (5.11). The review can be initiated by some event or occurs periodically.

**3 APPLICATION CASES**

Based on the framework, it was created a Microsoft Word Macro-Enable Template Document (.DOTM file), with resources like forms fields, macros, and Microsoft Visio diagrams, with the intention of facilitating the execution of the process, not depending on expensive and specialized ICT platforms.

The PMSDF was applied in two cases. The first case was on sales and production operations of a medium sized upholstery factory. In this company, data was obtained from the company’s representatives on structured interviews and confirmed during scheduled visits, twice a month, through four months. It was verified that there was no clear market segmentation nor a steady production strategy. By the customer perspective, no major problems identified in the market positioning, since the company was the reference in its market. The collected data was not supporting the decision making, and in many opportunities, the printed production orders and the digital ones were not with the same information, due to the inconsistent update process. It was identified productivity losses due to internal processes. No reports were taken, and no strategic planning existed. By following the framework steps, the company defined a better a set of mission, vision, and values, sharing it with the production team. The process was modified, and the service orders were then updated in the system daily. Based on the information obtained by the collected data, changes were made in the quality control, the truck loading, and the product delivery processes. Such changes reduced the losses by logistics, rework and unnecessary material purchase.
<table>
<thead>
<tr>
<th>Company identification</th>
<th>Company’s representative</th>
<th>Operation Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive Diagnosis</td>
<td>No definition of market segmentation; No definition of mission/vision/value statements</td>
<td>No definition of the operation’s objective; Proposed a performance objective based on companies’ statements</td>
</tr>
<tr>
<td>Operation Strategy</td>
<td>Most performance objectives on appropriate area</td>
<td>No target audience defined</td>
</tr>
<tr>
<td>Business Process Modeling</td>
<td>Identified high quantity of quality issues Delivery delay by supplier</td>
<td>Operation not aligned to a strategic objective</td>
</tr>
<tr>
<td>PMS Processes and Performance Measures</td>
<td>Started updating orders’ information in the system</td>
<td>Several indicators with little or no utility; Suggested a set of urban mobility performance indicators and related objectives</td>
</tr>
</tbody>
</table>

In the second case, the objective was to evaluate a joint operation in the electric car sector, involving five large companies. It was verified that the companies did not have a common aim with this project. Although the system provided several indicators, as used energy, CO2 saved, with real-time data collecting and dashboards, it was not possible to measure the performance, as there was no performance target. In this case, following the framework, the first step was to set an objective, which was made based on the companies’ mission/vision/values statements, and performing documentary research and interviews to discover what each company aimed individually with this project. It was developed a specific framework to assist with the selection of a set of urban mobility indicators (Business Process Modeling (A4)) and measures (Performance Measures (A5)). It could be used with no harm, due to the flexibility of the PMSDF. The changes have not yet been implemented, but the use of the PMSDF was helpful in the assessment and design phases of the project.

4 CONCLUSIONS
The PMSDF was conceived to be a flexible and elegant solution, assisting not only in the design of PMS but also during the assessment and implementation stages. Because of its flexibility, it can receive inputs from different analytic methods or data sources.

In the application cases, the framework turned out to be a good option to work with small sized firms operations and standalone projects. Major operations of large companies may benefit from tailored solutions that fit better their needs, but even in these cases, the framework may have results on preliminary stages or department specific operations and projects. The framework is ready to be used in manufacture and service and has already been tested in both types of operations, with no harm.

Since the approach adopted by the framework highlights mainly the strategy of the company and not the ICT platform, it may be better accepted by businesses in less technological markets. This hypothesis must be confirmed by further tests.

Currently, PMSDF is being tested in a project to guide in the assessment, design, and implementation of PMS for multiple not-for-profit institutions. Because the framework does not distinguish between financial and non-financial indicators, the preliminary tests indicate that no major changes are going to be needed.

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6 REFERENCES

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