

ANALYSIS OF THE BALANCED SCORECARD FORMULATION PROCESS FOR SETTING UP ENGINEERING DESIGN PERFORMANCE METRICS.

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Abstract

The selection of effective metrics for monitoring business processes, specially the ones related to the Engineering Design Process, can be not only very time consuming, considering the number of activities that are usually found in this process, but also can lead to the selection of metrics that measure a non-representative aspect of the process, or will not be considered by the decision makers in the course of action.

To prevent this situation and save company's resources, it is necessary to identify the right set of metrics, that is, the ones that will influence the enterprise's strategy. One way to achieve this is to deploy a given strategy into aspects that can be easily understood by tactical and operational staffs (where the major part of the Engineering Design activities happens).

This paper presents the general view of a method for choosing appropriate metrics for the engineering design process and is focused on demonstrating the usefulness of the Balanced Scorecard formulation approach to accomplish both, the deployment and the election of the key processes where the metrics selection will be performed. Two industrial case studies are presented where the proposed approach has been tested, with good results.

Keywords: Performance metrics, strategy, design in industry, design management, balanced scorecard.

1 Introduction

The practice of Engineering Design (ED) calls for a deep insight and understanding of the product requirements, their deployment into product specifications, and the further determination of definitions and technical specifications that are the basis for the design of the various systems and composes the whole product. These are, among others: features, structures, parts, manuals, catalogues and tooling.

A key subject related to successful ED is the evaluation of the design process performance that, ultimately, reflects the enterprise's competence for translating its strategy into champion products. The existence of ED metrics that can be used to measure this performance is thus a topic of great relevance [1] and has been one important topic of investigation in this research arena in the last few years, as shown by [4].

One key question typically bounding these investigations is the identification a small number of metrics that are the most relevant, that is, metrics that are (1) simple to gather, (2) linked to the company's strategy, and (3) useful for the actors involved in the decision making at all key levels.

Most of the available literature is based on the hypothesis that there exists a number of typical, universal relevant metrics (including both proactive and reactive metrics). Examples of metrics included in this set are: time to market (TTM), product quality, return on investment (ROI), and so on [2].

A whole new approach proposed in this paper is based on the hypothesis that the relevance, and therefore the usefulness of a set of metrics rely upon the degree of relevance and linkage to the company's strategic objectives.

Indeed, the idea is that any design performance follow-up process should not exist solely for grading the status and performance of the organization's design process, but rather, it should be applied and understood as a tool to support the overall business strategy of a company.

On the other hand in complex ED situations hundreds of multi-functional, interdependent processes can be identified. To formulate specific metrics for measuring the performance of each of these processes can be an excessively time and cost consuming task within any company, and helps to partially explain the current lack of utilization of proactive design metrics by most of the companies.

The approach proposed and discussed in this article deals also with this problem. This came through after comparing the findings from literature review on metrics of engineering design [2], and the lessons learned stated by the people involved with the practice of Balanced Score Card (BSC).

The approach for establishing ED metrics comprises two major steps:

- (1). The selection the ED process(es) (in its various levels, according to a particular situation) that are most influential on the enterprise strategy for an specific product under development (application of the BSC principles).
- (2). The performance of a "metrics engineering" on the selected processes, which will result in the identification of a few relevant ED metrics.

The method has been applied to two real industrial cases, as a means of validating/refining the proposed approach, and further understanding the key aspects related to the establishment of metrics in the ED practice. The results of these two cases, with the focus on the first step, are discussed later in the paper. The details of the "metrics engineering" step needs refinement, and will be addressed in a future publication.

2 Applying the BSC principles as a Means to Selecting Relevant Processes for an Strategy

The origins of the Balanced Scorecard can be tracked to the early nineties, when its authors have joined into an endeavour to develop a new performance-measurement model. The effort

has lead to several articles, , where many aspects of the model were described. An extended description of the whole Balanced Scorecard model is provided in [1].

The Balanced Scorecard (BSC) has been designed to counterbalance the financial exclusive focus in vogue at a large scale in the companies, by including three additional perspectives related to long term business results: Costumers, Business Internal Processes and Learning & Growth. Although the most common idea of the Balanced Scorecard lead to a measurement system, as it was originally conceived, the model has evolved to a strategy management system.

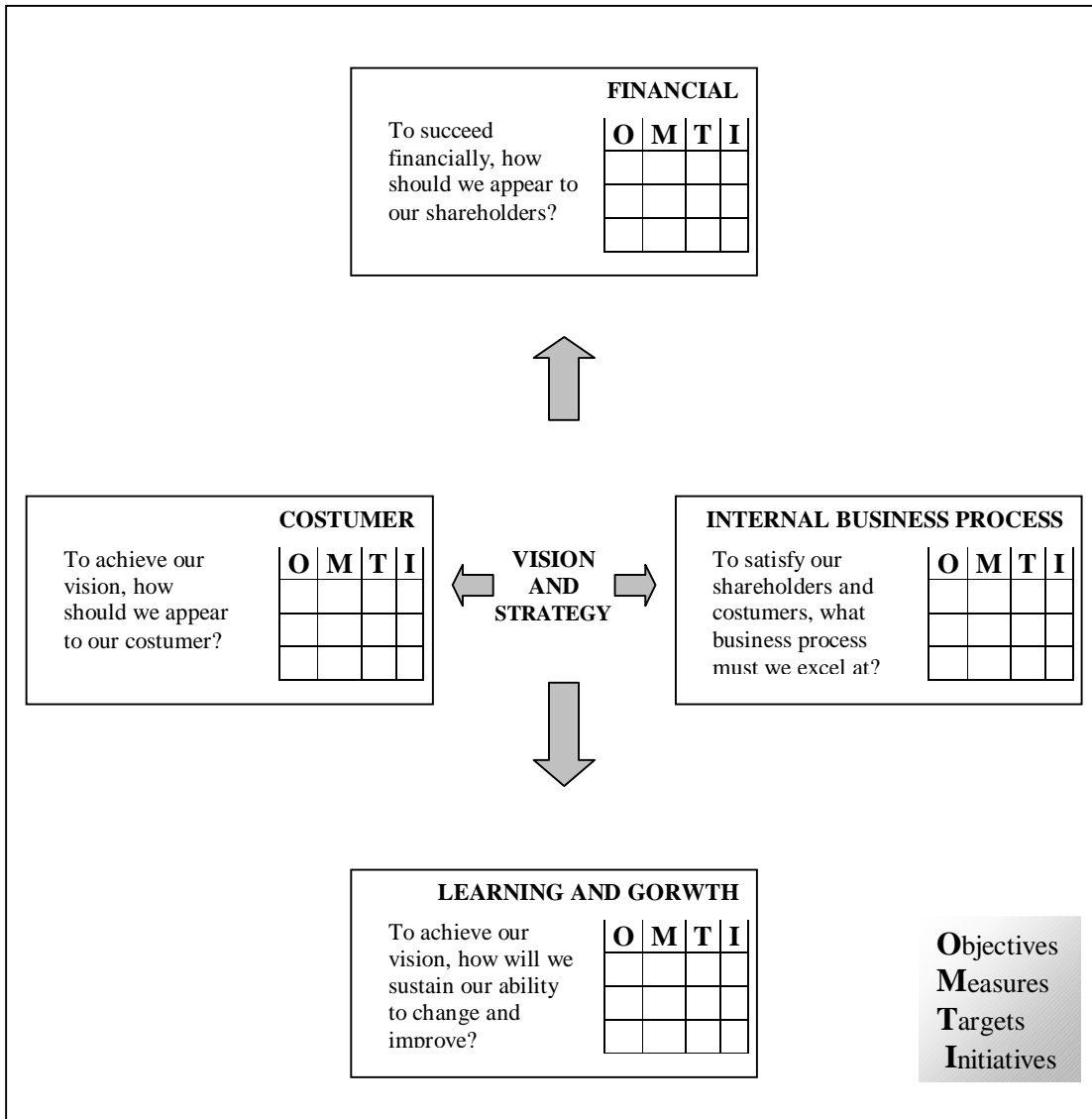


Figure 1: BSC dynamics (adapted from [1])

As a means to communicate the enterprise vision and strategy by deploying them to all the organization levels, the way of building the scorecard results is a very instructive and insightful process that conducts the users to think and focus on the most relevant issues of the business. The figure 1 depicts the BSC dynamics.

By using the four business perspectives, the Balanced Scorecard formulation is capable of connecting actions on the operational level to the highest topics of the enterprise strategy and vice-versa. A structured way of answering the questions in the boxes of Figure 1, might lead to a cause and effect diagram, as shown in the Figure 2

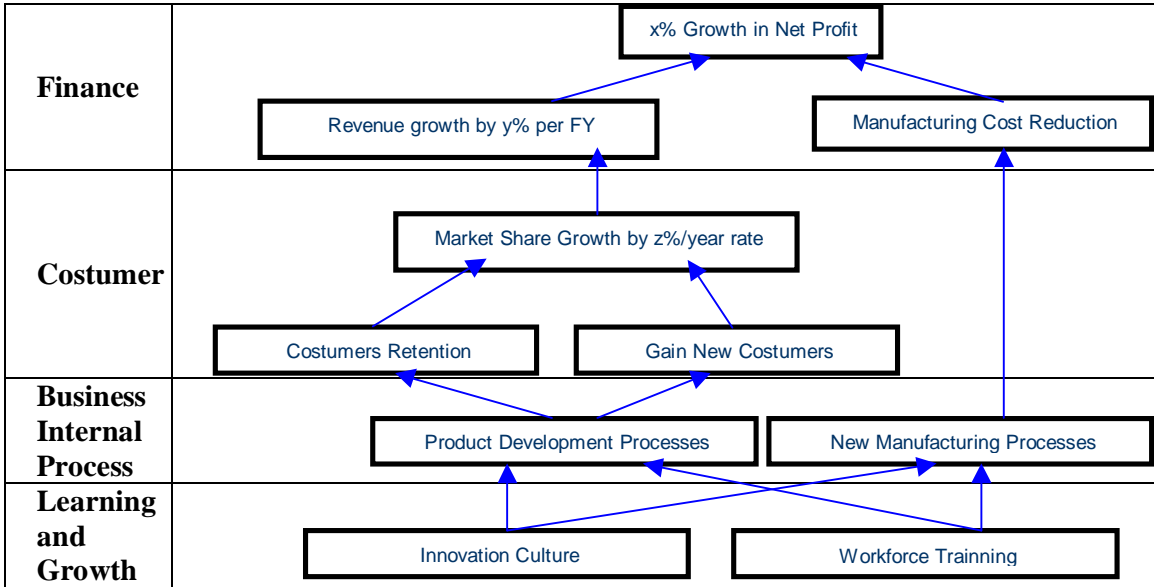


Figure 2: BSC cause and effect diagram

Consider that the strategy for this manufacturer is “To be the strongest player in the market by having financial and market share sustainability”. How could it be achieved? A possible answer could be “By maintaining an x% net profit growth per year, that, fundamentally, comes from y% revenue increasing and k% reduction in manufacturing costs”. But, y% growth in revenues per Fiscal Year imply in extend the market share by a z% rate per year. This extension means “costumer retention and gain new costumers” that is possible, according to the company vision, through excellent products in the market that meet costumers requirements.

The remaining question is “what business processes should the company excel at in order to achieve such performance?” and the answer might be “the Engineering Design Process”, supported by an innovation culture and workforce training. From this point, one could drill down to the next level, and find the key process(es) within the general ED process. By doing so, the discussion of metrics would be approximated to the reality of the actors involved in the daily decisions (design managers, engineers, etc) of the company, whereas retaining a strong bound to what matters to the company as a whole.

As it will be shown below, these fundamental questions, part of the BSC formulation process, are used to select the business processes that most influence the enterprise strategy success. The method for metrics selection has been applied in a Brazilian mobility segment manufacturer and uses the BSC experience. This corresponds to the first part of the proposed method. Once the appropriate process is selected, the second part of the method consists in performing an “metrics engineering” on the select process(es), i.e., to select the set of metrics to fulfil the strategic requirements As stated before, the details of this “metrics engineering” needs further refinement, and will be presented in future publication. For the present

publication, only the resultant metrics derived from the approach are presented in the two cases discussed below.

3 Case Studies – Practical application of the proposed method

The case studies have been carried out in a global manufacturer of the mobility sector, sited in Brazil,.. The goals of the case studies were to test the basic hypothesis the approach is based on and, at the same time, to gather further insights for the refinement of the approach, particularly the details of the “metrics engineering” phase of the approach.

4 Case 1: Metrics for the Phase Review Process

One case study has been carried out as part of the Phase Review Process (PRP) that the company uses in its Product Development Process (PDP). The objective was to select metrics that would help the program managers to monitor whether the Phase Review meetings (PRM) were accomplishing the program needs. This check is one of the responsibilities attributed to the team in charge of the Phase Review Process. This is graphically represented in Figure 3.

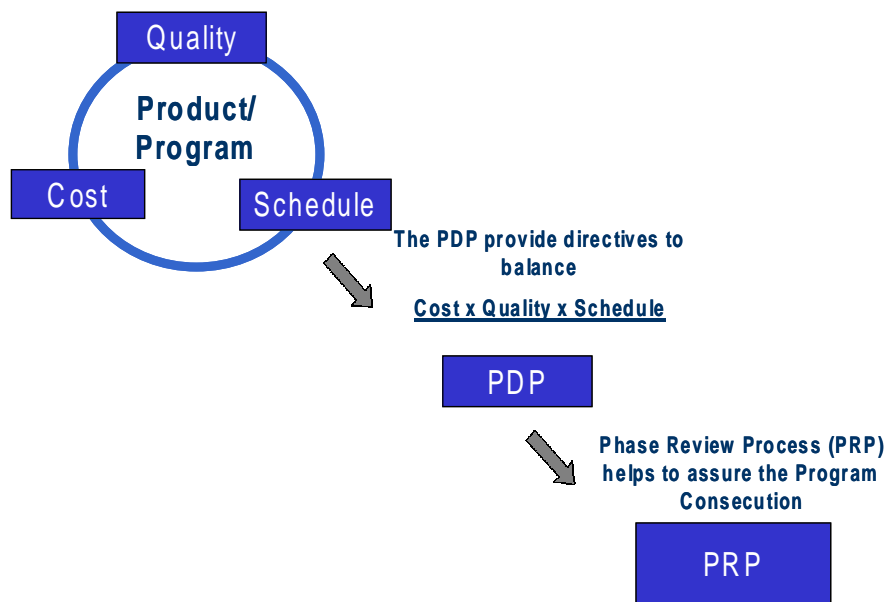
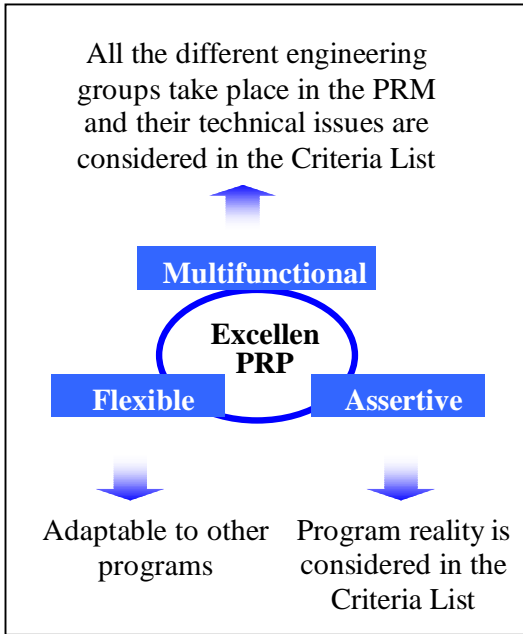


Figure 3: PRP customer identification

The financial perspective of the BSC approach is not applicable in this case. The customer perspective should be addressed is the following focus of analysis. Once it is determined who are the PRP costumers (Figure 3 helps to identify them)), the next question that arises is: To achieve our vision, how should we appear to our customer? A possible answer might be “We want to be perceived as to have an excellent PRP”. This statement claims for a better understanding of the PRP and leads to other question: Which PRP values are the most significant to our customer? In other words, what makes the PRP excellence?

Figure 4 shows the three most important aspects considered by the customer: Multifunctionality, flexibility and assertiveness (as found by the company’s marketing

department). Thus, in order to satisfy the costumers in terms of these three attributes, what sub-process must we excel at the PRP? The answer for this question is supposed to be the “key” sub-process for the given strategy. It is possible now to apply the “metrics engineering” on the selected sub-process, i.e., to select context specific metrics that are useful for the specific situation. The approach assures that the metrics designed are linked with the overall strategy. For this case study, the results are shown in Figure 5.



PRP METRICS	
Value	Metric
Multifunctionality	% of Product Development Processes considered in the Phase Review Meetings
Flexibility	Number of Programs using the PRP
Assertiveness	% of Proposed Criteria / Checked Criteria

Figure 4: Costumer Values for the PRP

Figure 5: PRP metrics selected

The Figure 6 shows the statements, questions (Q) and answers (A) utilized as a guide for applying the approach. Although the objective of the approach is not to build the Balanced Scorecard, the thought behind the BSC formulation process was found to be valid for matters of electing the process for further metrics selection.

Write the Vision for your business here	V → <input type="text"/>
Q – Who is the costumer?	A → <input type="text"/>
Q – How should we appear to our costumer?	A → <input type="text"/>
Q – Which are our costumer values?	A → <input type="text"/>
	A → <input type="text"/>
	⋮
	A → <input type="text"/>
Q – To satisfy our costumer according to its values, what process must we excel at?	A → <input type="text"/>

Figure 6: Questionnaire for the method first part

5 Case 2: Metrics for Customer Satisfaction

The second case where the method has been applied concerns the deployment of a customer retention strategy for a market segment. The question to be answered in the case was: “Which set of metrics and in what process should they be gathered and monitored to guarantee that the strategy has been accomplished?” Applying the proposed method, initially is found the relevant process(es) followed by the search for the relevant metrics within these processes

For reasons of simplicity, the financial perspective is skipped from the analysis. By doing so, it is possible to link the strategy directly to the customer perspective and, hence, to the Business Internal Process. Starting with the questions shown in Figure 6, the strategy was written and then the customer values related to the strategy accomplishment were identified. The company must respond to the customer through actions, activities, operations, and so on, that generate products or/and services with a high degree of added value, likewise the market expects. This *company's homework* is done by its internal process. Once the process (or processes) is (are) identified, the next step is to apply the metrics selection by “metrics engineering”.

Using the structure provided in the Figure 6, after writing the strategy it was asked: How should we appear to our customer? In other words, which are the customer values in that market segment? In that case it has been found that customer wants:

1. Adequate technical support
2. Products that fits the contracted requirements.
3. Low Life-Cycle Cost products.
4. Rapid time-response for products deliveries.

To achieve our customer values, what processes should we excel at?

All the items above may be addressed to the Product Development Process as a whole, but we may choose the most representative topics by ranking them. Once it was done, the items 2 and 4 had been found the most important aspects. The next step was to identify the Product Development sub-processes that are related to the items 2 and 4 above, i.e., that fit the customer requirements. These sub-processes were identified and allow designing context specific metrics: Number of engineering modifications on in-service products, customer ordered modification time-response and product technical fitness for customer requirements. This set fits the metrics requirements [2] and are derived from a process strongly related to a strategic goal.

6 Analysis of the results

An innovative approach to select metrics down to the process level that are connected to the company's strategy has been devised. It comprises two steps: (1) selection of the relevant process(es) of the business strategy and (2) establishing relevant metrics for this process. The paper was focused primarily on the first step.

The approach has been applied in two real industrial situations. By applying the approach, a very concise set of metrics has been found. In both cases, the metrics were gathered on the operational level and are strongly related to the enterprise strategy. Although details of the metrics design process were not provided, the selected set of metrics for the case studies fulfil the requirements for “good metrics” presented in [2].

As the proposed approach, based on an extended interpretation of the Balanced Scorecard formulation process, just selects metrics for key processes (those analytically linked to the company business strategy), it is supposed to yield reduction in terms of:

- Time and cost for electing effective design performance metrics;
- Cost for gathering data for design management;
- Time for analysing design PD performance information.

No data is however available to prove these gains. Finally the authors ascertain that the Balanced Scorecard building process can indeed be applied into the Engineering Design scenario as a means to identify the most important processes related to the enterprise strategy and hence, to *engineer* performance metrics for managerial decisions. The continuation of the project is necessary to validate the convenience of the identified design metrics into the decision making process, and to refine the “metrics engineering” step of the approach

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