

Success Factors and Performance Measurements

A Missing Link in Product Development?

Stefan Cedergren

School of Innovation, Design and Engineering
Malardalen University
Vasteras, Sweden
Stefan.cedergren@mdh.se

Vinit Parida

Entrepreneurship and Innovation
Lulea Technical University
Lulea, Sweden
Vinit.parida@ltu.se

Abstract—Performance measurements are important for managing operation and supply chain activities. The literature within performance measurement and success factors in innovation and product development is vast, but with little cross-fertilization. In industry there is a clear consensus among manager’s that their measurements are not covering what is important to be successful. One explanation for this, as argued for in this paper, might be that there is a weak connection between what is considered to be important (a success factor) and what is actually measured by the performance measurement system in product development. In this paper the findings from a survey among large manufacturing companies in Sweden is presented. The paper is concluded with an analysis and discussion regarding why success factors are not represented in the performance measurement system and recommendations for future research.

Keywords; *Indicators, product development, innovation, performance, management*

I. INTRODUCTION

The importance of performance measurements in managing operations and supply chain activities is well established both in practice and in the literature. Similarly, for innovation and product development in particular, the ability to measure performance has intrigued researchers and practitioners alike. The ability to measure performance is important for many different reasons. Performance measurements are of great importance in this context, since without them we cannot answer the most basic questions such as “*how well are we doing*”, “*what have we learned*” and “*what should we do in the future*” [1]. It is therefore important to have a learning perspective on performance measurements and thereby be able to identify and perform improvement activities based on the knowledge gained from the performance measurement system.

Moreover, today the markets are becoming increasingly competitive and making the demand for the product-development process to continuously deliver new products has become even greater. Hence, the findings in a survey by the Boston Consultancy Group that 65 per cent of senior managers were reported to be dissatisfied with their ability to measure performance in product development [2] is illustrative. Rubinstein [3] further concludes, after examining the trends in the field of engineering and technology management, that the methods used for evaluating projects have not been improved

much during the last 50 years. The consequences of this are companies struggling in how performance should be measured in practice and that they are constantly looking for ways of improving their way of measuring performance with limited success [4].

One explanation for this may be that the performance measurements used within product development projects often are inherited from the manufacturing process. The problem is that the number of products produced far outnumbers the number of development projects. As a result the feedback loops that work well in a manufacturing process may not be suitable for product development. Popular measurements for product development projects are result oriented measurements related to time adherence, project cost, product cost, and quality. It may be argued that this is a side affect of focusing too much on result-oriented measurements as may be sufficient in a manufacturing context. Thus, there is a need for measurements that can serve as indicators of performance that can be used in the management of product development projects.

It is generally agreed that when designing performance measurements they should be related to the important criteria for performance [5]. For product development the criteria for performance may translate into success factors for product development. We argue that success factors for product development ideally would be covered by the performance measurement system since they represents the foundations for successful product development and thus important criteria for performance. However, in the literature on performance measurements, as concluded in the literature review in this paper, seldom leverage the literature focusing of success factors and vice versa. Therefore, in this study we aim to examine the relation between success factors and the performance measurements used by large product-delivering organizations.

II. RELATED WORK

A. Performance measurements in product development

In a review of the innovation and product-development literature by Adams et al. [6] they conclude that the literature is characterized by a diversity of approaches, prescriptions, and practices that can be confusing and sometimes even contradictory when it comes to performance measurements. Still, one of the most cited frameworks in the literature is the

performance measurement categorization by Griffin and Page [7] consisting of customer acceptance, financial success, product and project success, and firm level success. In a survey of commonly used performance measurements related to the development of new products in the US [8], the following five metrics were those most commonly used:

1. R&D spending as a percentage of sales
2. Total patents filed/pending/awarded/rejected
3. Total R&D headcount
4. Current-year percentage sales due to new products released in past X years
5. Number of new products released

The categorization of performance measurements by Griffin and Page [7] and the commonly used performance measurements [8] illustrates that measurements are heavily lagging or result oriented and the perspectives of process or leading indicators are missing. These commonly used metrics are either input or outcome oriented measurements, e.g. the current-year percentage sales due to new products released in the past X years is a measure of the result developed for up to X years ago, and says little about the current development activities.

Sink and Tuttle [9] argue that the main focus of the performance measurement system is to provide managers with the information needed to be able to make decisions about the actions to be taken in order to improve the performance of the organization. It is important to also adopt performance measurements that encourages behavior that will achieve the goals of the organization [10]. Learning and improvements are thus an important part of the performance measurement system, in line with the arguments by Chiesa et al. [11]. However, there seems to be a missing link between what the aim of the performance measurements are and what is actually measured.

Performance measurements can be separated into those who are lagging or result oriented measurements and those who are leading or process-oriented measurements. Lagging or result oriented measurements tell an organization where it stands in its efforts to achieve goals but not how it got there, or even more important, what it should do differently [12]. Leading or process measurements monitor the tasks and activities throughout an organization that produce a given result [12]. Such measurements are essential for cross-functional teams that are responsible for processes that deliver an entire service or product to a customer, such as the product-development process [12]. Leading indicators include measurements affecting the process, while lagging indicators measure the result of already performed actions.

Leading indicators of performance that can be used during the development of a new product in order to improve the performance of the development activities is missing when the most commonly used measurements are discussed. We argue that these measurements may not be standardized in the same way as result orient measurements can be. Due to the fact that the processes used for developing new products differs between companies and even functions in an organization. Software development typically uses different development

processes compared to e.g. mechanical development. We argue that performance indicators thus may be difficult to standardize.

In an extensive review of measurements within innovation and product development by Adams et al. [6] it was concluded that there exists a plethora of extant measures, obviating the need for the development of new measures. However, there are few performance measurement design processes that specifically focus on developing performance criteria, before the performance measurements are decided on. Hence, there is a risk that the role of measurement makes the measurements important themselves; rather than focusing on what is important to measure, focus is on what is measurable.

B. Success Factors in Product Development

The idea of having a limited set of factors that contribute to successful product development is intriguing. Similar to performance measurements there is a considerable amount of empirical research on the determinants of new product-development performance reported in the literature [13, 14].

For example Tang [15] identified a distinct set of success factors for product development: Leadership, Organizational culture, Human resources, Information, Product strategy, Project execution, Product delivery, and Results. In a thorough review of critical success factors by Ernst [13], the following categorization, as previously developed by Cooper and Kleinschmidt [16], was adopted: Customer integration, Organization, Culture, Role and commitment of senior management and Strategy.

In a recent meta-review of the success factor literature, by Chen et al. [17], especially focusing on decreasing the development cycle time, the success factors were grouped into process, project, team, and strategy. The findings presented by Chen et al. [17] are important since it is one of the most recent studies and it is published in a very distinguished journal. Table 1 presents an overview and definition of the success factors identified as important for product-development speed.

Table 1. Important success factors identified by Chen et al. [17]

Success factor	Definition
Top management support	Senior management's favorable attitude and commitment to product-development initiatives.
Goal clarity	The extent to which a product-development project's vision, mission, goals, and definition are clearly identified and communicated.
Process formalization	The use of explicit rules and standard procedures in the product-development process.
Process concurrency	The extent to which stages of the product-development process overlap or are conducted concurrently.
Iterations	The process of building and testing a prototype in a product-development initiative.
Learning	The process through which a project team gains or creates knowledge in performing product-development activities.
Team leadership	The degree to which a project's leader possesses skills, knowledge, and experience relevant to both management and technical

	aspects of the project.
Team experience	The degree to which team members possess experiences, knowledge, and skills.
Team dedication	The degree to which team members dedicate themselves to a product-development initiative.
Internal integration	The degree of cooperation among multiple functions and interaction among team members in a product development initiative.
External integration	The involvement of external partners like suppliers and customers in a new product initiative.
Team empowerment	The decision-making autonomy of the project team

C. Linking Performance Measurements and Success Factors

Performance measurements and success factors in product development are both areas where there has been a lot of research published in the recent years. Still, there seems to be little cross-reference between success factors and performance measurement researcher so far. There is no obvious link between what is perceived as success factors and what is measured by the performance measurement system.

Also, a lot of the literature is normative in character building on the best practice. The problem is that it may be difficult to identify leading indicators of performance in product development that are applicable for all or most organizations developing new products. This is particularly true when you include the traditional result oriented measurements that may be commonly used by a larger amount of companies. What is an important performance indicator may not be as important for another organization, since they are very context dependent.

III. RESEARCH METHOD

A quantitative research method was used to examine the link between success factors and what is measured in large product development organizations. Based on our understanding of the performance measurement and innovation management literatures, we wanted to test and validate that there is a weak link between what is perceived as success factors and what is measured by the performance-measurement system within the development of products.

To test the hypothesis a survey was developed. The survey was designed in order to validate the hypothesis based on inputs from a large population, so that we could partially generalize our finding. Moreover, to ensure that the success factors were based on prior literature, we based our survey on a recent meta-review from Journal of Operation Management by Chen et al. [17] with the addition of architecture as an important success factor within complex product development. A complete list of the success factors can be found in Table 1. For each of the 13 success factors every respondent was asked if the success factor was perceived as a success factor. The follow-up question was if the success factor is evaluated by the performance measurement system.

1. How important is Success Factor X for successful product development in your organization according to your opinion?

[1= Not at all - 7 = Most important]

2. To what extent does your organization systematically evaluate Success Factor X through a measurement system?

[1 = Not at all - 7 = To a large extent]

This set of questions was repeated for each of the 13 success factors. The respondents selected for the survey were all managers and decision makers working in the development of complex products. As they had long experience of working with development projects, they were suitable for providing a holistic organizational view on the success factors and performance measurements. Theoretical sampling was used to identify and select the respondents. Once the survey instrument was tested with other research and few industrial participates for any irregularly, we distributed the survey to the network of managers and decision-makers involved in this research. They were requested to complete the survey and further distribute it to five additional persons. This resulted in complete 36 responses from a diverse set of industries.

IV. EMPRICAL FINDINGS

A. Findings from the survey

The initial questions of the survey captured the respondents satisfaction of there organizations way of measuring performance and two thirds of the respondents where satisfied with the current performance measurement system. More specifically, the data points collected through the survey are illustrated on radar chart (see fig. 1). The chart shows two different views, first related to the respondents view on the importance of a specific success factor (i.e. your opinion) and second related to the respondents view on how well these success factors are measured (i.e. internal evaluation). Through this graphical representation, it becomes generally viable that the two views were significantly different, as what is measured by the organization, and what is regarded as important by the organization at two totally different levels. Furthermore, team leadership, goal clarity, top management, and team experience were the highest ranked success factors, whereas iterations and process formalization were the highest measured success factors.

Taken together, we can conclude the following findings; first the success factors proposed by Chen et al. [17] hold value to our sample companies as most respondents regard them to be critical measurement parameters for development projects dealing with complex products; second there is a strong difference between what is important to measure as compared to the extent they are measured; and finally the background of respondents might influence the variation in the outcome as for the project level innovation measurement the proposed critical factors can be much more valid than the strategic level measurements of the organization. In the next section, we will build on these findings and link them to the literature.

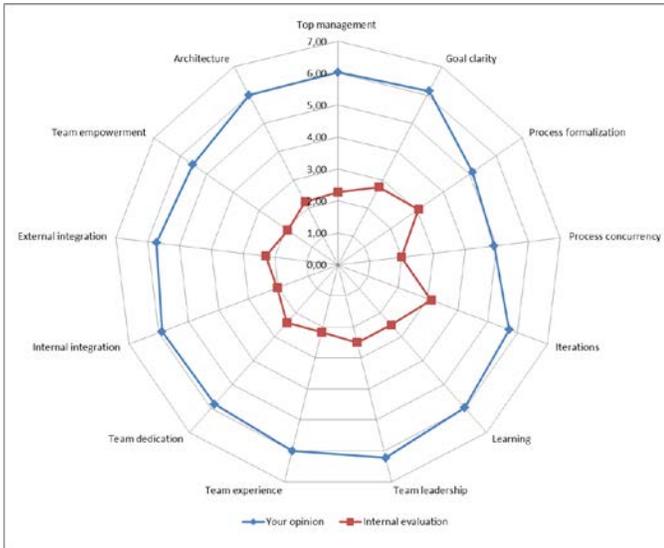


Figure 1. View on success factors and performance measurement in large Swedish companies

V. ANALYSIS OF THE FINDINGS

It is evident from the empirical findings that there is weak or no relation between what is measured by the performance measurement system and what is considered to be a success factor for product development. In short, it can be argued that the performance measurements are not necessarily evaluating what is important. It could also be that the current measurement system is designed around another set of success factors than the ones presented in Table 1. This possibility is however unlikely since the success factors are selected from a set of success factors identified from a meta-review of success factor studies [17]. Thus, our findings confirm that there is little cross-fertilization between success factors and performance measurements in practice, which is in line with the prior literature.

There are a number of arguments that might explain why the link between success factors and performance measurements in product development is weak and largely absent. One explanation can be that the customer or user of the measurements is different regarding their requirements. As one might favor process-oriented measurements compared to result-oriented measurements. The users of the result-oriented measurements are typically top senior managers, who are not directly involved in the product development projects. Hence, they might be more interested in the results and in a common way of evaluating the portfolio of development projects. These measurements are important for comparing and identifying development projects deviating from the budget and plan. In contrast the customer or user of the process-oriented measurements are project managers and other stakeholders directly involved in the management of product development projects. It can be argued that they can do their job without formal measurements e.g. by talking to people, compiling reports, analyze various information sources etc. However, having a structured approach with objective measurements may be useful to complement and make sure that you do not miss important aspects and factors that are important. Moreover, performance measurements are important for

example to encourage behavior that will achieve the goals of the organization [10] and provide managers with necessary information to make decisions about performance improvement actions to be taken in order to improve the performance of the organization [9].

Another argument that could explain why success factors are not integrated in the way performance is measured is that we organize all our product development efforts as projects. Projects are then managed according to the best practice, often resulting in a focus on project performance i.e. time, cost and quality. Project performance in terms of time, cost and quality easily end up as result-oriented measurements independent of what is to be developed. Sometimes the link between project success and product success is mutually elusive [18]. However, the traditional result-oriented performance measurements related to project performance are important but we argue that it is important to complement with process-oriented measurements related to what is important in order to be successful for the specific project.

VI. CONCLUSIONS AND FUTURE RESEARCH

This research study set out to investigate the relation between success factors and performance measurements in product development. In order to do that a literature review and a survey of performance measurements in large manufacturing companies in Sweden was set out. The results, clearly indicates that there is a gap between what is considered to be a success factor and what is measured in product development. It can be argued that the performance measurements are not measuring what is important to be successful. This might explain why managers are not satisfied with the current way of measuring performance in product development.

The research presented in this paper only studies large manufacturing organizations in Sweden and is based on a limited set of respondents. Thus, there are several important future research study topics

- Replicate this survey in other populations, as well as collecting larger sets in order to validate the findings presented in this paper.
- A qualitative study that would provide reasoning behind why the identified success factors are regarded to be important.
- Adams et al. [6] conclude in their review of the literature in performance measurements related to innovation and product development that there exists a plethora of extant measures, obviating the need for the development of new measures. Research is needed to investigate if this holds true when it comes to measurements of success factors in product development.
- Researchers need to further examine how the identified success factors can be integrated in the current performance measurement system. Will it only require extension of the performance measurement system, or does it need to be introduced through a significant change within the organization.
- To what extent can we generalize the success factor by Chen et al. [17], given that the success factors can

vary due of size of company (small vs. large) or product focus (complex vs. generic), it maybe worth the research effort to focus on developing a method for identification and implementation of customized success factors rather than focusing on a development of a “one shoe fit all” approach.

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