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A life cycle approach to business performance measurement systems

Anna Landström[a]*, Peter Almström[a], Mats Winroth[a], Carin Andersson[b], Anna Ericson Öberg[c], Martin Kurdve[ad], Sasha Shahbazi[e], Magnus Wiktorsson[e], Christina Windmark[b], Mats Zackrisson[d]

[a]*Department of Technology Management and Economics, Chalmers University of Technology, Vera Sandbergs alle 8 ,412 96 Gothenburg, Sweden*

[b]*Department of Production and Materials Engineering, Lund University, Ole Römers väg 1, 223 63 Lund, Sweden*

[c]*Volvo Construction Equipment AB, Styckåsvägen 1, 67132 Arvika, Sweden*

[d]*Swerea IVF AB, Argongatan 30, 431 53 Mölndal, Sweden*

[e]*School of Innovation, Design and Engineering, Mälardalen University, Smedjegatan 37, 632 20 Eskilstuna, Sweden*

Abstract

Virtually every company has implemented a Business Performance Measurement System (BPMS) with the purpose of monitoring production and business performance and to execute the corporate strategy at all levels in a company. The purpose of this article is to shed light on common pitfalls related to the practical use of BPMS and further to present a life cycle model with the purpose of introducing structured approach to avoiding the pitfalls. The article contributes to further development of the BPMS life cycle concept and practical examples of how it can be used.

Peer-review under responsibility of the scientific committee of the 8th Swedish Production Symposium.

Keywords: Business performance measurement systems; Performance indicators; KPI-life cycle

* Corresponding author. Tel.: +46 72-986 26 86
E-mail address: anna.landstrom@chalmers.se

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1. Introduction

Business performance measurement systems (BPMS) are widely used within Swedish manufacturing companies today. The use of BPMS is vital, especially for large companies, for disseminating strategies as well as controlling the operation. Using BPMS provides a better basis for decision making and improves the financial results of the organisation [1]. There is a lot of research within this area and several multidimensional frameworks for performance measurement systems have been presented [2]. However, there is limited research related to the actual application of BPMS and only a few studies discuss failures related to BPMS [3].

To increase the knowledge on the actual application of BPMS in industry today, and to develop a handbook to support companies in their daily work with the BPMS, a project called "Sustainable and resource efficient business performance measurement systems" (SuRE BPMS) was carried out within the Swedish Strategic Innovation program Produktion2030.

This paper, which is a part of the research project, has the purpose to shed light on common pitfalls related to the practical use of BPMS and furthermore to present a life-cycle model with the purpose of introducing a structured approach to avoiding the pitfalls. The following research questions will be answered in this paper:

1. Which pitfalls, related to BPMS, are present at Swedish manufacturing companies today?
2. How can these pitfalls be avoided?

To identify the pitfalls related to the BPMS today, qualitative data from 6 companies was collected. Each company was represented by one or several experts in BPMS that had been involved in the research project. The experts were asked to describe common pitfalls related to BPMS in their organizations in text and send them to the researchers. The pitfalls were later presented and discussed in a workshop with both the experts and the researchers.

2. Pitfalls identified in practice

Each company submitted a list of pitfalls related to the BPMS of their organization. In total 42 pitfalls were collected from the companies. Some were the same or similar between the companies and other were not formulated as pitfalls, but rather as lack of best practice. The researchers have therefore chosen to summarize the pitfalls into the 8 topics below with some explanations and motivations for them.

2.1. Connection to strategy

One identified pitfall is KPIs that are not clearly connected to the strategic objectives and goals of the organization which makes it harder to understand the purpose of the specific KPI and why it is important for the organization.

2.2. Design of BPMS

When it comes to the design of the BPMS some pitfalls were identified. The relation between different KPIs needs to be known in order to achieve an efficient BPMS. There are often negative relations, so-called trade-offs, meaning that when one KPI improves, the other one gets worse. The lack of understanding of these relations often leads to sub-optimizations within the company since the whole picture of the organization and a systems view is missing. Another effect is problems within target setting since without knowledge about the trade-offs the organization can set contradictory targets that are impossible to achieve without negatively affect the result of another KPI. Another common pitfall is having too many KPIs. The main problem of having too many KPIs is that the decision makers get too much information and it becomes harder to focus on what is most important for the organization. Some KPIs are used mainly because of the available data and not based on what input that managers need to make well-informed decisions. A similar pitfall is to use too many aggregated and lagging KPIs, e.g. economic result parameters, and very few leading KPIs, e.g. internal efficiency measures, which makes it hard to identify the problems before they affect the results of the organization.

2.3. Design of KPIs

Unclear definitions or lack of definitions of KPIs are common pitfalls within the studied group of companies. One effect of unclear definitions is that it leads to individual interpretations and misinterpretations, both in terms of what to measure and how to interpret the results. The misinterpretations result in misguided decisions or lack of information for decision making. Another effect of unclear definitions is that the KPIs are not intuitive, it can, for example, be hard to know if the results should be above or below the target. This also affects how the employees can see how they can affect the result of the KPI. KPIs that are cascaded down from top management to lower levels might not always be suitable for managing the operations at lower levels and in some cases the employees at the lower levels might not even be able to affect the results of the KPI. This leads to decrease in engagement from the employees and can create anxiety within the workforce. Another pitfall is using relative KPIs when the connection between the different parameters are not known. For example, energy consumption and produced quantity. Does the energy consumption actually increase with the number of products produced? Comparing different parameters without knowing the relation between them might lead to misguiding information and in worst case making the wrong decision.

2.4. Target setting

There are some pitfalls related to setting targets for KPIs. The targets should not only be set based on historical data but also be based on planned improvement initiatives and their expected outcome. It is also important to avoid targets that tolerates deviations outside the accepted tolerance limits without creating an alarm signal to the management and operators. There can also be a lack of long term perspective in target setting. Every year the starting point for the target is set to a lower level in order to show an improvement during the year. This causes a saw tooth-pattern in the results over long term and can be used to hide lack of improvements in the process.

2.5. Support system

Support systems for the BPMS are important. However, there is a risk that complex computer systems, implemented to reduce the amount of time that is spent on administrating the KPIs and their results, can make it harder to change and manage the KPIs. There is also an identified pitfall related to the introduction of new KPIs. A new KPI is designed and introduced to the organization but there is no follow-up on if the definition and analysis is followed as intended or that the data collected for the KPI is correct.

2.6. Visualization

How to compile and visualize the data is also an important area in which the companies identified some pitfalls. The more aggregated KPIs the harder it becomes to identify the cause of the problem leading up to deviations. It is also easier to miss or misinterpret deviations if the data is consolidated over different production lines or sites, or if it is visualized by mean values. Another pitfall related to visualization is the 2-point comparison in which you only compare two data points at the time. This can lead to that you miss the natural variation within the process, which in turn might lead to wrong decisions.

2.7. Using the KPIs

One common pitfall is that there is no action plan clearly connected to the KPIs to help the managers and operators to determine which actions to be taken when the results deviates from the target levels. It is also important to visualize the action plan closely to the KPIs to help the employees to see the connection between the targets and the actions. Another aspect related to the actions taken based on the KPIs is that it often becomes hard to relate actions to results if the time between them is too long. KPIs should not only be used for monitoring and control but also to affect the behaviour of the employees. It is also important for managers to remember that some qualitative information might be missed if they only look at the numbers presented by the KPIs. It is always important to go and look at the process

in order to analyse the results from the KPIs in a good way. KPIs can also be used for comparison between different units and sites. The comparison can cause fear for the employees of losing their job if the results are too low and the company decide to move the production to a more profitable and efficient site. KPIs connected to an incentive system might result in that deviations are not reported in order to achieve the target or choose to set targets that they know that they will reach without making any improvement to the processes.

2.8. Revision

One frequent pitfall is that KPIs are not changed when they become irrelevant causing a static BPMS. A static BPMS often results in large number of indicators since new KPIs are included but the old irrelevant KPIs are not removed. Which in turn leads to information overload for the managers trying to make the right decisions.

2.9. Summary

To summarize the pitfalls identified by the studied companies, the original 44 pitfalls are reduced to 19 and structured into eight groups (Table 1).

Table 1. Pitfalls related to the BPMS.

Strategic connection	P1. KPIs are not connected to the strategic objectives and goals
Design of BPMS	P2. Unknown relations between KPIs
	P3. Too many KPIs
	P4. KPIs based only on available data
	P5. Imbalance between leading and lagging KPIs
Design of KPIs	P6. Unclear definition of KPIs
	P7. KPIs that cannot be affected by the organizational unit
	P8. Relative KPIs without known connections
Target setting	P9. Target adjusted to show improvements
	P10. Lack of long term thinking
	P11. Targets based only on historical data
Support systems and verification	P12. Complex computer systems
	P13. Lack of verification
Visualization of KPIs	P14. Too aggregated KPIs
	P15. No visualization of variation or trends
Use of KPIs	P16. Measuring without actions
	P17. Taking control actions without understanding the KPI
	P18. KPIs for benchmarking can create fear
Revision of KPIs	P19. Static BPMS without plan for revision

3. BPMS life cycle

As indicated by the headlines in Table 1, several of the pitfalls can be associated to stages in a life cycle (i.e. design, use and revise). The idea of putting BPMS in a life cycle perspective is not new. Bourne and Bourne [4] have proposed a life cycle of the performance measurement and management process consisting of four phases; design, implement, use and review.

However, there is no clear connection to the strategic objectives and goals of the company in the life cycle by Bourne and Bourne [4]. Therefore, the concept of the double loop learning [5] was added to the life cycle. Double loop learning consists of two loops, one for comparing the performance to the strategic objectives and one loop for questioning the relevance of the strategic objectives based on the information about the performance of the company. This means that the results from the use phase should also be used as input to identify new challenges in the strategy formulation process.

Another part of the life cycle by Bourne and Bourne [4] that needs to be clarified is the use phase which is the phase where the companies spend most time. This phase has been extended into a performance review process cycle which consists of measuring and collecting data, compile and analyse the data, reporting and communicating the information to the right stakeholder, and make the right decision based on the data.

Based on these changes the model in figure 1 was developed and the different phases in the model is described in the following sub-sections. The proposed ways of carrying out the life cycle phases are based on a combination of theory from the literature, and empirical results of best practice in the studied companies.

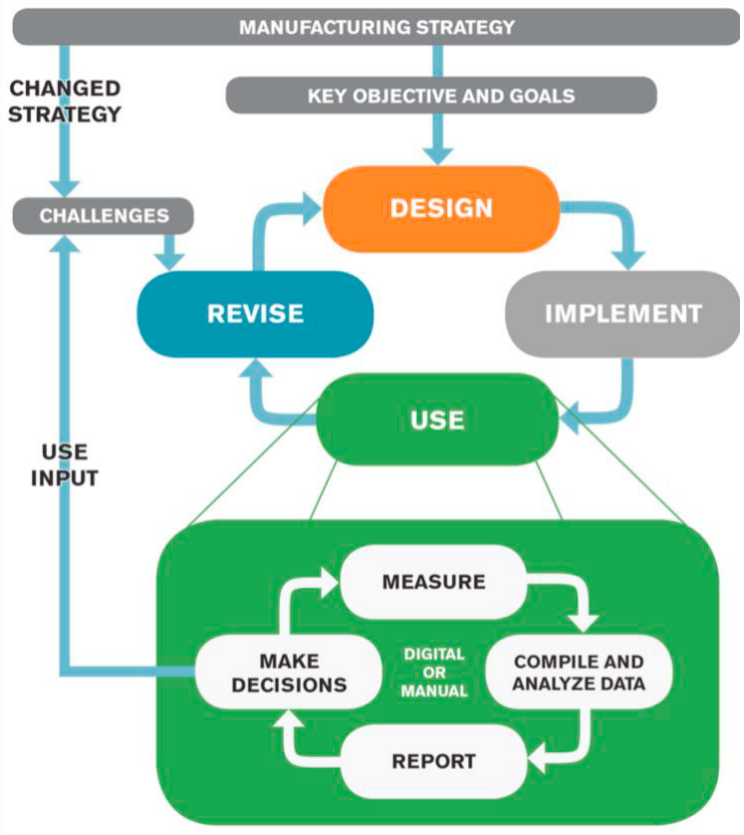

Fig. 1. The BPMS life cycle. [6]

3.1. The strategic connection

To make sure that a company works towards its long-term goals it is important to have a well formulated manufacturing strategy [7]. The strategy provides the manufacturing managers with the long-term objectives that needs to be fulfilled in order to achieve the corporate goals. These objectives are then translated into KPIs and cascaded down through the organisation in a process called strategy deployment [8]. This process serves as input to the design phase of the BPMS to make sure that the KPIs support the managers to make decisions and actions in line with the strategy, avoiding *P1*. It is also important to make sure that the information from the BPMS is fed back into the strategy formulation process to make sure that the strategy is suitable for the processes within the organisation.

3.2. Design

The design can be performed at different levels, indicating both a hierarchical relationship and the logical order to carry out the design. The first level concerns the BPMS architecture and the design of the system itself. There are several existing frameworks such as the Balanced Scorecard [9], the performance prism [10] and the performance pyramid [11]. They all structure the BPMS based on different perspectives that is important to measure, for example the balanced scorecard has four perspectives (Finance, customer, internal business processes, and learning and growth) [9]. The most commonly used perspectives in Swedish industry today is safety, quality, delivery, cost and people [12].

These perspectives will be the base for the next level of design; determining which KPIs to measure in each perspective. On this level, it is beneficial to use a pull-approach [13], i.e. you start by thinking about who needs to make a decision in this perspective, what information that is needed, and finally what KPI that may provide that information. This approach reduces the risk of having to aggregated KPIs (P14) since the information need determines what level of aggregation that is suitable. To avoid *P5*, it is also important to make sure that there is a balance between proactive leading KPIs and reactive lagging KPIs [14].

The last two steps in the pull-approach is related to the third level of the design phase; individual KPI definition. In this step, it is important to define what to measure and how to measure it. One established framework for designing and documenting individual KPIs is the performance measurement record sheet [15]. The Performance measurement record sheet consists of 10 different elements that need to be defined for each individual KPI, e.g. purpose, target, formula, frequency, and who acts on the data [15]. The framework helps to design well-defined KPIs, avoiding *P6*, with a documented focus which reduces the number of KPIs (*P3*) since KPIs are based on the need for information and not on the availability of data (*P4)*. By following this framework KPIs that are hard to affect (*P7*) or not connected to actions (*P16*) can be identified and redesigned before they are implemented since an action plan should be defined during the design phase.

The last level in the design phase is the target setting. There is a lot of issues related to the target-setting process, for example, if the targets are set too high, they can create stress and lower the motivation of the employees (P18), and if the targets are set too low, they can encourage complacency [16]. To avoid these problems, it is important to base the target setting on a rigorous data analysis, which not only consider the past performance but also a forecast of future performance and reassessing the capabilities of the organisation [17] (P11). It is also important to consider the stakeholders' expectations on the performance [17] to avoid P9 and P10.

3.3. Implement

The first step in the implementation phase is to set up procedures to support the BPMS. The organisation needs procedures to secure that the data is collected correctly and in an efficient way, to report the data to the right stakeholder, and establish procedures to take actions based on the measurements. To support these procedures there is often a need for IT-systems which should be developed and introduced during the implementation phase. The data collection process is preferably done automatic and sensors and data collection software needs to be bought or developed to fit the organisation's needs. In case the data collection is done manually it is important to create standardised templates for the employees to fill in, in order to secure the quality of the input data.

When the support systems are in place the next step is to educate the employees about the BPMS. The link to the corporate and manufacturing strategy of the organisation should be explained in order to motivate why it is important to follow up the KPIs and how it will help the company as well as the employees forward. After the link to strategy is explained, each KPI should be discussed. The definition of the KPI and the different elements it consists of should be explained as well as an instruction about how to measure and interpret the results. The last step in the education process is to make sure that all employees get information about the different roles related to the BPMS and who is responsible for what. It is also important to set up routines to verify the data collection methods during the use phase to make sure that the correct data is collected (*P13)*.

3.4. Use

The use phase consists of its own cycle with four steps; measure, compile and analyse data, report, and make decision. In the measure step, all the data needed for the elements in the KPIs are collected. It is important to make sure that the collected data is reliable. If the data collection is done manually it is important to ensure that the standard procedures for measurement are followed. Data collection should not only include value of a KPI but also additional information for guiding the manager to identify further improvement actions (*P17)*.

The compile and analyse data step focuses on transforming the data to information through different analysis and visualisation tools. The challenge of visualising the data is to make it easy to interpret and at the same time make sure that it contains as much information as possible. The simplest way of visualising a KPI is with a red or green dot. Red means that the result is off target while the green indicates that the results is within the target limits. This however

does not contain much information. Instead it is often preferable to also visualise the trend and variation of the results. The graphical representation can for example be a control chart (*P15)*.

In the report step, information from the analysis is communicated to the right stakeholders. This step does not only address the creation of different kinds of reports and scorecards, but also how the information is communicated to the employees through white boards and computer screens. Therefore, the first step is to determine which stakeholder that needs what information and how it should be communicated. For example, the communication with the shareholders is often done through different reports providing mostly financial indicators, while the communication to the shop floor workers often is done through white boards showing information about how the production processes are doing. The type of information in the different reports also decide how often it is appropriate to report new results. To shareholders it might be once every quarter of a year, while for the workers, updated information might be needed every other hour, in order to make the right decision in time.

The last step in the use life cycle is to make decisions based on the information from the KPIs. In this step, the information is analysed to determine if there is a need for creating an action to solve a problem or improve a process. When making this decision it is important to not only look at the results of individual KPIs, but also to adopt a system's view to avoid making decisions that lead to sub-optimization (*P17)*. If there is a need for taking actions, it is also important to prioritize between different actions and to discuss the risks and benefits of different suggested actions.

3.5. Revise

There is a lot of different frameworks to revise the BPMS [12,18,19], in order to avoid static and irrelevant KPIs (*P19)*. These frameworks aim at comparing the strategic objectives of the company with the set of KPIs used at the company with the purpose to identify gaps or false alarms. Medori and Steeple [19] define "gaps" as the KPIs that should be measured according to the strategic objectives of the company but are not present in the existing BPMS. "False alarms" are KPIs in the existing BPMS that are not related to the strategic objectives of the company and therefore are no longer relevant or useful to the company [19]. According to Bourne [2], there are four levels of revision of BPMS:

1. Revision of the strategy, the BPMS architecture and cascading structure
2. Revision by omitting or adding KPIs
3. Revising an individual KPI definition
4. Revising the KPI target value

The frequency of revision depends on the level of revision. Revising individual KPIs and targets, should be periodic and the time between revisions depends on the organisation and the individual measures [20].

4. Discussion and conclusion

This paper presents several pitfalls related to BPMS identified by practitioners in their own organisations. Several of the pitfalls identified are also accounted for in the literature. For example, Bourne and Bourne [4] refer to empirical studies where organisation in the United Kingdom have experienced similar pitfalls regarding e.g., target setting. Van Camp and Braet [3] also identify pitfalls or failures within BPMs. They divide the failures into three levels: metrics, frameworks and models, and management. These levels are related to the pitfalls found in our study.

Since the pitfalls still exist, it is obvious that the practitioners in the studied multinational companies have not learnt to any large extent from the theories and the available literature. This motivates the need for a more accessible handbook.

To avoid these pitfalls a new model based on the BPMS life cycle was developed. Most of the identified pitfalls are directly addressed by the model. However, to avoid P8, an understanding of how the different parameters in the production system is related to each other is needed which is not included in the life cycle model. Another pitfall not addressed by the model is P12, complex computer systems that hinders changes in the BPMS, which should be addressed in the design of the architecture of the IT-system supporting the BPMS.

Only six companies contributed to the study, which limits the generalizability of the results. All the participating experts represented production sites in Sweden. However, all the sites are parts of large multinational manufacturing companies. All companies use their BPMS and their sets of KPIs in a similar way [12], highly influenced by visual management and lean production. The performance of their KPIs are displayed on whiteboards on the shop floor and they all have daily meetings discussing deviations from targets and actions to be taken to achieve the goals. They also share the structure of the BPMS with several categories where safety, quality, delivery, cost, and people are the most used. These categories are used both for their monthly scorecards as well to structure their whiteboards for the daily production meetings. These similarities together with the coherence of their identified pitfalls makes the results general for companies with similar approach to BPMS.

The conclusion is that the companies need a more structured way to manage their BPMS and a life cycle model is proposed to provide that structure.

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