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CONCURRENT SESSIONS **Tuesday 13:30 – 17:30**
KEMPINSKI HOTEL CORVINUS **Erzsébet tér 7-8, Budapest V.**

REGINA BALLROOM III. **Tuesday 13:30 – 15:00**

12.1. MANAGEMENT OF QUALITY OR QUALITY OF MANAGEMENT I.

Session Chair: ***Lars Sörqvist****, Sandholm Associates and Royal Institute of Technology, Sweden*

14.10 Performance Measurement Systems in Engineering – Their Influence and Challenge
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“Performance measurement systems in engineering, - their influence and challenge”

The literature and relevant research on performance measurements state that a performance measurement system has an impact on organizations and performance. We found through a literature review, that the approach in modern performance measurement thinking is multidiscipline, multiphase and multifaceted, and can be summarized to be about trade-offs and have “no right answer”. There exist several common models and frameworks on performance measurement. Continuous improvement is closly related to performance measurement, but appears as one of many objectives in literature. In recent years the attention has been drawn towards the effect and interaction of performance measurement, organizational factors and improvement processes. Through our literature review, we found little research on common performance measurements systems suited for engineering activities.

In order to explore the effects of performance measurement on organizational factors and improvement processes in engineering, we followed the engineering phase of a multi-discipline Norwegian oil and gas project, from its early to late stage. The study was based on assessment of data from surveys, from its early to late stage.

We found through our case study, strong indications on performance measurements influence on the project organizations internal factors, like behavior and collaboration; which in turn leads to goal achievement. Our case study confirmed the effects of performance measurement as multifaceted, but we observed a change of influence on several factors over time. Behavior is less influenced at the late stages of a project. The purpose and influence of performance measurement is then replaced with more common monitoring activities and stronger focus on efficiency and productivity, than, for example improvement processes. Nevertheless, a performance measurements system may be a good tool to promote and protect achievements on goals and quality metrics in engineering.

Performance measurements are necessary for improvement activities, but since engineering and design processes in itself are fragmented, existing engineering performance measurements systems appears as fragmented. They appear also less suitable as basis for improvement. This was confirmed through our case study, where we did not find any strong correlation between performance measurement and improvement activities in engineering.

Our study has identified important factors influenced by performance measurement in engineering, and pointed out new direction on awareness and how the focus and affect may change during a project. Frameworks and models for the future must take these factors into consideration, and special attention should be paid to how to focus on more people-oriented performance measurement systems, how performance measurement can facilitate improvement in engineering and how to bring common understanding to engineering’s value and contribution to large projects with many phases.

1 Introduction

An important part of building- or modification projects to the oil and gas industry includes large and important quantities of engineering efforts. Often the foundations of projects successes or failure depend on how efficient and effective the engineering phase of a project is performed. Effective development, design and engineering processes have evolved to become a competitive advantage (Salter 2003). The "triple constraint" of any projects, comprising time, cost, and scope, together with quality, are emerging as equally important. The challenge is to balance these, so that one of them does not go the expense of one of the other (Rose 2005). Performance measurement is often referred to as a solution to company's management problems (Salter 2003), and the interest in performance measurement as a tool for management have increased significantly over the last few years (Bourne 2005).

Performance measurements are closely connected to continuous improvement. The use of performance measurements systems have slowly merges with quality improvements techniques and processes, but the focus on performance measurement has demonstrated a shift toward preconditions and critical success factors (Bourne 2005). Generally, there is a growing interest and focus on other measures than time and cost, away from the traditional financial measurements.

The challenges and the relationship between measurements and improvement in engineering have received less focus and attention in literature and research. This makes it interesting to explore and discuss frameworks, tools and factors influenced by performance measurement systems in an engineering phase.

In order to explore the aspects and relationship between engineering, improvement and performance measurement, a review of relevant and established research on methods and models have been conducted. To verify review findings, the literature review have been supplemented by a case study in a Norwegian oil and gas project, in order to find if practices and research in general are applicable for engineering phases.

2 Research and theory on Performance Measurement

2.1 Introduction

Performance measurement is often referred to as the process of quantifying action, but also to establish quality-related dimensions of performance (Neely 2005). Effectiveness and efficiency is central in the performance measurement context, distinguishing between the ability to meet customer satisfaction (effectiveness) and the economically of internal processes providing a given level of customer satisfaction. These two dimensions demonstrate that any action on performance could be either internal or external motivated, and that a business's performance level is a function of the effectiveness and efficiency of the actions it undertakes; where some claims that effectiveness must be the primary focus (Spitzer 2007).

Performance measures could be either quantitative or qualitative. They should be verifiable, and expressed in a sense making and understandable numerical variety, be comparable to a given fixed reference, and should be an expression of something that provides value to the stakeholders (Kald 2000; Chang 2002; Melnyk, Stewart et al. 2004; Spitzer 2007).

According to Franco – Santos (Franco-Santos 2007) there are no common definition on a business performance measurement system. The reason of a lack of a common definition, are probably the wide range of disciplines having their professional approach and contribution to the subject (Franco-Santos 2007).

There are a number of definitions on performance measurement, but the most common, accepted and most cited are the definition by Neely (Neely 2005):

- «set of metrics used to quantify both the efficiency and effectiveness of action»
- «the reporting process that gives feedback to employees on the outcome of actions»

The concept of performance measurement is basically a feedback mechanism and this could be illustrated by Fig.1, showing a single feedback and control loop of a business process.

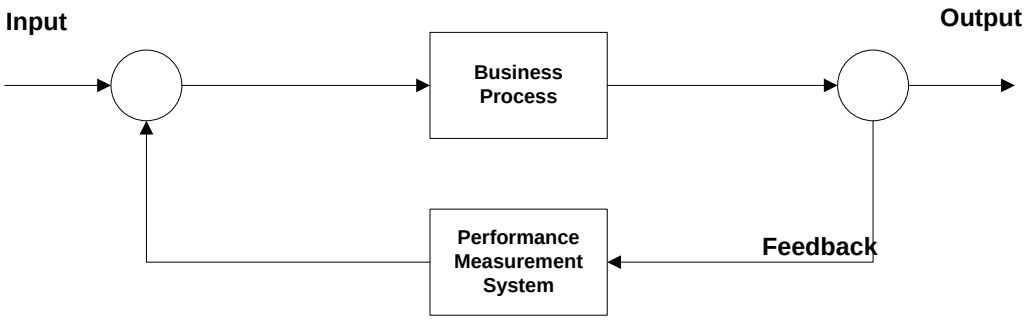

Figure 1 Feedback loop of a business process

2.2 Historical development

The performance measurement interest has a long history, starting with financial measures and often referred to be introduced as early as 1903 by Du Pont (Neely 1999). A major change of focus in the performance measurement field away from the financial focus increased in the mid 1980 (Franco-Santos 2007), with Kaplan and Norton's Balance Scorecards (Kaplan 1996) as the most prominent. This was followed by a subsequent development of a wide range of performance measurement systems (Lin 2007).

In the 1980's the need to develop a more balanced tool and appropriate frameworks must be seen in the context of business development at the time:

- The introduction and need of new management principles and improvement initiatives in manufacturing (i.e. TQM, JIT)
- New technology
- Increased and tougher worldwide competition
- Quality as competitive factor (as cost no longer regarded as the most important competitive advantage)

It is important to bear in mind that the historical development of performance measurement in the 1980s and early 1990s had its origin in the businesses basic need to survive, and not primarily to operate and facilitate continuous improvement. Historically, this is the basis for performance measurement as we know it today.

The practices of merely using financial accounting as a tool to determine performance, and as a basis for decisions, have become a well accepted shortcoming (Lin 2007). There is no shortage of reviews on the main purposes and reasons why organizations choose to implement performance measurement systems:

- Strategy management (Neely 2005)

- Measure performance, check position (Neely 2005)
- Monitor productivity (Veronica Martinez 2008)
- Reduce cost (Veronica Martinez 2008)
- Control operation (Melnyk, Stewart et al. 2004)
- Communication (Neely 2005; Johnsson 2008)
- Learning and Improvement(Neely 2005; Johnsson 2008)
- Confirm priorities (Johnsson 2008)
- Influence behavior (Neely 2005)
- Support their compensation system (Veronica Martinez 2008)

Some research have through their studies identified and grouped five typical characteristic processes for a performance measurement system (Franco-Santos 2007):

- Selection and design
- Collection and manipulation of data
- Information management
- Performance evaluation and reward
- System review

These steps are often presented in more detail by others, and some include the necessity of linking performance measurement to strategy processes (Bourne 2005). However, all stress that the processes are equally important in order to ensure positive impact of performance measurement.

Today's performance measurement system research and increase interest, is mostly driven by the shifting business environment, varied international competition, more demanding customers, the need for a holistic approach and better decision basis (Neely 1999; Melnyk, Stewart et al. 2004). It is important to remember that performance measurement is not seen as an activity adding value in itself. The added value is generated by the decisions and actions based upon the measurements in order to manage and prioritize (Melnyk, Stewart et al. 2004; Spitzer 2007; Johnsson 2008).

2.3 Research areas

There seems to be an ongoing debate in literature if the performance measurement affects business performance in a positive way. A recent literature study comprising 99 published papers, concludes that the «research findings is contradictory» (Bourne 2005). Others claim that research show that companies using performance measurement systems can achieve additional benefits, and organizations that have a balanced and integrated performance management system, perform better than others (Veronica Martinez 2008).

The research on performance measurement has so far been mainly on the design (Neely 1996) and implementation of performance measurement systems (Mike Bourne 2003; Johnsson 2008), dominated by management literature (Melnyk, Stewart et al. 2004).

For example we found little research covering the entire product development process with performance measurement in a holistic way ("The Performance Prism" developed by Neely may represent an exception in this connection).

Franceschini (Franceschini 2006) claims that performance measurements will have an effect on organizations action and decisions one way or another in any case. The basis for better insight to the diversity of performance measurement may then be concentrated both on the affect and premises of performance measurements.

2.4 The challenges and influences

Performance measurement includes many aspects of organizational behavior, i.e. the aspects and relationship between measurements and action, motivation and the need of collaboration in an organization (Melnyk, Stewart et al. 2004). Bourne lists preconditions and some critical success factors, comprising both technical and organizational factors (Bourne 2005):

- Company values
- System maturity
- Organisational structure, climate, culture and size
- Management style, commitment
- Competitive strategy
- Performance reviews
- Focus and accuracy of measures (what is important to measure?)
- Resources and capability
- Information system infrastructure
    - Integration (systems being holistic)
    - Interactivity (ongoing interactively)
- Human factors, employee involvement
- Other management practices and systems

One of Bourne's main conclusions are that managers engagement and interaction with the process have greater influence on business performance than how well the process are performed (Bourne 2005). This is in a way supported by Spitzer (Spitzer 2007) claiming the performance measurement system is only 10% technology, and the rest is use and an organizations approach on performance measurements. Spitzer (Spitzer 2007) stress the importance of looking at performance measurements as a "social process", where dialogue is the core.

Although the increased focus on organizational success-factors, some research has focused on the shortcomings and challenges on existing and common frameworks (Neely 2005, Ghalayini 1996):

- Suited for monitoring and control (minimize variation) rather than continuous improvement
- Lack "tools to "model, control, monitor activities", related to process improvement
- Static and not dynamic updating
- Do not look ahead, not prognostic or preventive measures
- Short-termism
- Lack of strategic focus

- Encourage local optimization
- Deficient information on customer needs and what competitors are doing.

Some research on performance measurement reveal and highlights positive effects on organizations introducing performance measurement systems (Kald 2000; Veronica Martinez 2008).

The effect of business performance and results appears debatable, but some of the typical positive effects are listed (Veronica Martinez 2008):

- Increase people focus.
- Feedback; facilitate motivation and cooperation, both vertical and horizontal.
- Increase communication skills.Feedback in general.
- External effects; sales growth and overall performance.
- Change of employee's behavior and approach to improvement, but also a change to drive new routines, practices and new competencies.

Some claim that the overall influence of performance measurement is stronger on internal factors than external factors, so organizations should increase their interest on internal effects, since they in the end affect the final business results (Veronica Martinez 2008).

On the other hand, some research does not find any connection between performance measurement and business results (Ittner 2003; Veronica Martinez 2008), particularly because the performance measurements systems are time and resource-intensive. This is supported by Johnston (Johnston, Brignall et al. 2002) claiming that performance measurement systems may lead to monstrous and costly systems which do not contribute to any performance improvement at all.

Organizations represented with high percentage of complex task and requirements of knowledge intensive processes, i.e. engineering and design processes, performance measurement and feedback can also have negative effect on performance (Busby and Busby 1999). The risk that performance measurement can lead to counter productivity is also supported by Francis (Francis 2005), i.e. used in a way that threatens employees job security (Spitzer 2007).

Neely presents examples of common problems in companies using performance measurement systems (Neely 1999; Neely 2005):

- Increased bureaucracy.
- There are too much data (too many measures) and to little analysis.
- Different departments have conflicting and competing performance measurements and incentives.
- Diverted attention ("misleading prioritization").
- Information given by performance measurement do not enable companies to achieve objectives and strategy, nor in the strategic decision process.
- Targets and indicators used are based on financial standards.
- Achievement of leadership, earnings and marked share mainly measured by financial criteria, dominated by a cost focus.

As for positive effects , negative effects can be experiences differently depending on business

sectors (Veronica Martinez 2008).

Although the processes associated with performance measurements appears critical, it is clear that performance measurement is more than a system processing data and information. Part of the critical success factors for performance measurements, lays in the organizational factors and premises an organization already has. The main conclusion is that continuous improvement is only part of many objectives, and that performance measurement systems seldom stand out as any miracle medicine on their own (Salter 2003).

3 Performance measurement in Engineering

3.1 Research areas within Engineering

There are virtually no relevant articles on performance measurement systems related to engineering in the oil and gas industry specifically. In general terms, there are some articles on engineering in connection to manufacturing, construction and research and development environment (R&D) (Colt 1997; Pillai 2002; Pillai 2002; Chen 2006).

Engineering is usually discussed in most research in the context of a project's overall performance and/or mentioned along with common project and productivity measurements as time and costs (Busby and Busby 1999; Kueng 2000; Salter 2003; Lin 2007). Few articles focus on quality, improvement or other approaches in measuring engineering performance than cost and time.

Engineering performance have traditionally been associated to time and cost, and the production of design documents (Georgy 2005). Performance measurements in engineering and design are very traditional and no global frameworks seems to be tailored for this purpose. Georgy (Georgy 2005) claims that current and common performance measurements in engineering are unable to assess the design and engineering process' effect on a projects as a whole. This in turn, can affect engineering activities negatively (Armentrout 1986).

To the extent that performance measurement is a theme, literature focus mostly on the process «how to» establish systems for the engineering discipline (Johnsson 2008). The amount of hours per document is still one of the most common methods to monitor performance in engineering, regardless of industry. This despite the fact that the method have several identified weaknesses (difficult to compare between projects and documents, the capture of correctly data etc.) (Georgy 2005).

One of the main reasons for this focus may be because the monitoring of product development performance is characterized and dominated by its complexity and natural inbuilt unpredictability (Johnsson 2008). Some claim that the importance of performance measurement is overestimated in connection with innovative management in complex organizations, being able only to reveal "light" problems if they not are supported by feedback, discussion and debate (Salter 2003). This debate may have contributed to the deficiency on research on performance measurement in the context of design and engineering of complex products and systems (Johnsson 2008).

The research focus is not much different from the general approach, but the focus on continuous improvement and organizational success factors seems less prominent.

3.2 Challenges and influences within Engineering

Today's performance measurement in engineering is mostly subjective and characterized by the underlying processes built on knowledge and experience in the organization. They are not

suitable as basis for improvement, mainly because the design processes in itself are fragmented (Salter 2003).

Because engineering and design are largely based on hidden knowledge-based processes that's makes them difficult to plan, manage and improve, performance measurement in engineering is dominated by measurements that are easy to measure, and not what management considered critical for the design and engineering process (Johnsson 2008).

The focus and use of feedback appears quite different in engineering. Feedback appears as a separate field of interest, apparently because of the perception on designers and engineers distinct position. Feedback can in engineering have both negative and positive effect. In engineering the effect of feedback is highly influenced by a number of conditions (Busby and Busby 1999) and is depended of both designers self-perception, context, goals and situation. Traditionally, we like to look at performance measurement as a single feedback mechanism with positive effects, although the risk of the opposite is larger in engineering and design environment. In some studies, the feedback mechanisms related to design and engineering are presented as unreliable.

Another aspect of feedback in engineering is customer feedback. Customer feedback can often open up for valuable adjustments during the projects and give good indication of success or not. Often the value of customer feedback is reduces because of lack of systematic feedback from customers and no systematic approach collecting and processing customer feedback. Often customer feedback is too late in the projects and the time between design and feedback from operation make it less relevant and difficult to associate with improvement activities in engineering (Salter 2003).

Today's one-sided financial monitoring is inadequate for design and engineering activities, but beyond the field of interest on feedback, few organizational factors different from those discussed in general, are found related to performance measurement and engineering.

Continuous improvement is actually a more prominent theme within the engineering discipline, but in return, the challenge seems larger. The considered best potential for improving the design and engineering process is to collect data from the design and engineering processes. The main challenge is to search for performance measurements to see designs and engineering's impact on a whole project. The introduction of more qualitative measures in the design and engineering process is regarded as one the most difficult part (Salter 2003).

4 Case study

Our literature review revealed that some of the biggest challenges to performance measurement are related to organizational factors, although this does not seem to be the main focus within performance measurement and engineering. The challenge to develop appropriate, relevant and useful performance measurement systems to facilitating continuous improvement can't bee overlooked or underestimated, but to be considered more as a prerequisite to achieve objectives.

The focus on organizational factors and performance measurement seems quite narrow when it comes to engineering compared to the general interest on performance measurement. Based on our findings in the literature review, a survey was designed in order to bring insight to performance measurements impact on organizational factors and improvement activities. The survey was performed during a multidiscipline engineering phase in a Norwegian oil and gas project.

To explore the correlation between the effect and significance of performance measurements a

framework was established. Prominent and widely discussed themes regarding effect, purpose and roles in performance measurement generally were included in this framework. An overview of the factors are sorted and classified as leading or lagging indicators in Table 1.

The survey was distributed to all employees in the engineering discipline in a specific project; including project management and all disciplines. The survey comprised registration of demographic data and they were asked to rate the organizational factors, continuous improvement activities, goals and results in connection with the use and focus on performance measurements systems in the project. The survey was performed at two different stages in the project. Since our study was limited to one project only, our data was limited to the amount of project member working in the project at the given time. Both the surveys had a response rate in the range of 60-70 %.

The project had existing traditional time and progress reporting with earned value and cost reporting, integrated in monthly reports with supplementary data on quality performance and HSE indicators. Engineering performance was also reflected in the follow up of design reviews and quality assurance activities. To reduce complexity, the data from this survey represents only the process of using performance measurement as the subsequent processes to design and implementation of performance measurement systems.

In organizations several factors will interact and influence each other, so for insight we performed both a single and on multiple factors analysis on the influence of performance measurement systems in engineering (Figure 2).

	Area affected	**Area, detailed**
Leading indicators	Organizational factors (influencing factors)	Learning, knowledge management Attitude/influence behavior Control (Strategy)* Communication/collaboration Improvement Information flow Feedback/monitoring
Lagging indicators	Project objectives (goals)	Quality Time Costs Flexibility Dependability Values HSE
	Profit /efficiency (profitability)	

Table 1. Overview over single factors influenced by performance measurement systems

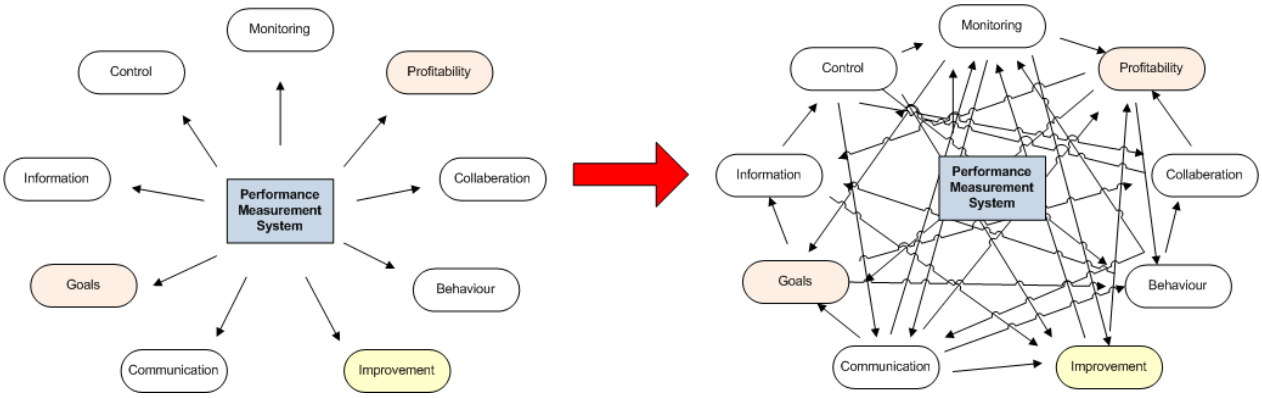

Figure 2 Performance Measurement Systems analysis, illustrating both the single- and multiple factors influence

4.1 Singe factor analysis

For insight, we explored the influence and relationship between performance measurement and single factors at a time, using scatter-diagrams and correlations factors. In our study we were able to identify factors that have positively affected by the use of performance measurement systems, and we observed how these factors changed during the project. Table 2 gives a short overview.

	Areas affected most	Affect	Ind	Areas little affected	Affect	Ind
Early stage of project	Profitability Project objectives (goals) Attitude/influence behaviour Teamwork (within the discipline)	(+) (+) (+) (+)	LA LA LE LE	Control Improvement	(+) (+)	LE LE
Late stage of project	Project objectives (goals) Profitability Improvement Teamwork (within the discipline)	(+) (-) (+) (+)	LA LA LE LE	Attitude/influence behaviour Feedback/monitoring Control	(-) (+) (-)	LE LE LE
Change of affect during project	Attitude/influence behaviour Control	(-) (-)	LE LE	Project objectives (goals) Improvement	(-) (-)	LA LE

Table 2. Overview over single factors influencing by performance measurement systems

Using single factor analysis and correlation gives a good indication of which factors that is influenced by performance measurement systems, and which factors most affected over time in a project. Even this is a single factor analysis; it is interesting to observe that project objectives are one of the factors positively influenced by performance measurement. This is no surprise, but what's interesting is that performance measurement does not necessary have positive impact on profitability (in fact it was negatives, but this may be influenced by other factors not under the control of the project). At the tail of the project, it is interesting to observe that performance measurement has little influence on behaviour. Performance measurements have also small affect on control activities at this stage, and seem to be replaced by monitoring activities instead. The affect on control activities and behaviour are

the two factors that change the most over time. It does however appears that performance measurement have most affect on collaboration, within each discipline; in the project independently of the project stages. As a single factor correlation, performance measurement show little influence on improvement activities.

4.2 Multiple factor analysis

For better insight we explored the influence and relationship between performance measurement systems and multiple factors. To support our exploration of correlations between the performance measurement system and multiple factors we used the same model and stepwise linear regression analysis. We explored and analyzed the relationship and influence of the 10 (8 influencing factors, project goals and project profitability listed in Table 1) identified factors listed, where we have illustrated the expected relation by equation:

$$Y = \beta 0 + \beta 1\ X1 + \beta 2\ X2 + \beta 3\ X3 + \beta 4\ X4 \ldots\ldots\ldots\ldots + \beta 10 X10 \quad (1)$$

From our exploration and assessment, it was hard to find any significant relation between the all listed factors and performance measurements systems. By using the stepwise linear regression analysis we did find significant relation between a set of factors only. Table 3 gives a short overview of the affected factors.

Areas correlating with use of a performance measurement system		
Early stage of project	Project objectives (goals) Attitude/influence behaviour Teamwork, with other disciplines	Linear regression R Square=0.41 P-value (respectively): 0,002, 0,007, 0,037
Late stage of project	Profit /efficiency (profitability) Project objectives (goals) Teamwork, with other disciplines	Linear regression R Square=0.47 P-value (respectively): 0,002, 0,0006, 0,030

Table 3. Overview over multiple factors correlating with a performance measurement system

Using the stepwise linear regression, this gave many of the same factors that emerged and stood out in the single factor analysis. There are also strong indications that the influence of performance measurement vary over time in a project, and that improvement activities in fact, are little influenced by performance measurement.

One of the differences found in the factors is well to note. We found through the single factor analysis, that collaboration within each disciplines were affected, but looking at multiple factors, the collaboration between disciplines are connected and influenced by performance measurement. Also here, the projects goals stand out with positive correlation, and the influenced on these factors does not change during the project.

The effect of performance measurements changes during the project on some factors, especially on its ability increase profitability of the entire project at late stages, and the effects on behaviour are stronger at the beginning than at the end of the project.

Our exploration and assessment of the data, did help us to find set of significant factors that is influenced by performance measurements in engineering

There are strong indications on performance measurements influence and some internal factors in engineering like behaviour and collaboration, which in turn influence and lead to goal achievement.

There is reason to believe that behavior is less influenced at the late stages of the project and replaced with monitoring activities and stronger focus on efficiency and productivity. Performance measurements have possibly influence on project collaboration climate, both within disciplines and between disciplines, but the indication is stronger on multidiscipline cooperation in order to achieve goals. We have observed through our exploration, that performance measurements influence on internal and external factors changes over time in a project.

Most surprisingly we did not find any correlation between performance measurement and improvement activities or processes in engineering.

The focus and importance on feedback mechanisms may be somewhat overrated in literature. We did not find feedback to be so prominent or critical in engineering, but the importance of organizational factors and work facilitation to be more important.

Even if not all of our findings was in line with literature, this gives a foundation for further work and understanding to explore other models and approaches to influence continuous improvement in engineering. Our data may be insufficient to make a conclusion based on data only (based on the few data points and limited to one project only), but have given better insight on important factors influencing by performance measurement in engineering especially.

5 Findings and conclusions

Through our case study we found that the relationship and impact of performance measurements and organizational factors, goals and improvement are not unique, but the effects of performance measurement are multifaceted and changes over time. Many performance measurement systems are still most suited for “monitoring and control”.

Performance measurements can also act «as means of surveillance, motivation, monitoring performance, stimulate learning, sanding signals or introducing constraints». Our case study did not find any strong correlation between all of these elements in an engineering environment.

While some have found that the overall influence from performance measurement systems is stronger on internal factors (people focus, feedback, cooperation and communication) than on external factors, we found support on this for behaviour and collaboration only.

Our review does not give any set answers, but we can summarize some common ground on models and frameworks. These points are also relevant for performance measurement in engineering, and include some of the challenges for engineering too:

- Performance measurement affect on business performance is contradictory, and there are no unambiguous connections between performance measurement and business results.
- Performance measurements are covered by many disciplines, and are a «multi faceted concept».
- The performance measurement issue is a difficult one, with no «right answer».
- Design of models and frameworks have a growing interest on intangible assets to ensure the interest of multiple stakeholders.

- Since engineering and design processes are fragmented, performance measurements systems are less suitable as basis for improvement, which may explain why we found no significance between performance measurements and improvement activities.
- Feedback in engineering may not be prominent, but can turn out negative, due to organizational factors.
- Performance measurements are necessary for improvement activities, but not enough to make improvement and are no universal remedy to continuous improvement.
- Engineering and design performance data are rarely associated and connected with management tools and principles, so engineering needs metrics not only what's easy to measure, but critical or important.
- Performance measurement systems and broader understanding of the overall affected of engineering and design phase, its contribution and value to projects as a whole.

Frameworks and models which meet these challenges may affect and influence several factors than we found, and may give other contexts and conditions to ensure.

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