

THE APPLICABILITY AND COHERENCE OF KEY PERFORMANCE INDICATORS IN GLOBAL PRODUCT DEVELOPMENT

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1. Introduction

Selecting and applying Key Performance Indicators (KPIs) in conventional Product Development (PD) is challenging and is compound by Global Product Development (GPD) [Taylor and Ahmed-Kristensen 2013]. The added challenges of globally re-locating parts of PD such as communication difficulties, IP rights and aligning goals and expectations [Hansen and Ahmed-Kristensen 2012], together with motivations to reduce costs, increase customer base and gain access to new competencies [Christodoulou 2007], make it difficult to know which KPIs should be selected and applied when measuring the success of a GPD project [Canez et al. 2000], [Dabhilkar et al. 2008]. A recent trend, given the sacrifices and risks associated with GPD, has seen the practice of outsourcing and offshoring parts of PD reversed and many companies decide to localise rather than globalise PD [Eppinger 2009]. Previous studies have shown that the decision to globalise PD is often made on an ad-hoc basis [Hansen and Ahmed-Kristensen 2011] without clear understandings of the potential benefits or risks from such decisions [Dabhilkar et al. 2008], [Kitcher et al. 2013]. Performance measurement and monitoring, which provides accurate feedback on the efficiency and effectiveness of a process, is an established practical method to support decision making and achieve sustainable business success [Neely et al. 2000], [O'Donnell and Duffy 2002], [Nenadal 2008]. Furthermore, the inclusion and application of a Performance Measurement Framework (PMF) during the process of GPD has been highlighted as a key element to ensure learning's are identified and incorporated in the decision making process [Canez 2000], [Tripathy et al. 2011], [Hansen and Ahmed-Kristensen 2012]. The Balanced Scorecard (BSC) by Kaplan and Norton [1992] and the more recent Performance Prism [Neely et al. 2002] present two of the most applied PMFs to date. However, it is difficult to assess if these are reliable for GPD. A study by Jiang and Qureshi [2006], which included a review of 168 articles from the outsourcing literature, concluded that there were no studies with fully reliable quantitative indicators of performance. In contrast, similar reviews [Griffin and Page 1996], [Cooper 1998] identified large numbers of reliable KPIs used by companies within the field of conventional PD. Given the opportunities and challenges that arise from GPD, the authors argue that it is not always adequate to simply use existing PMFs and KPIs that are applied in conventional PD for GPD [Taylor and Ahmed-Kristensen 2013]. This paper investigates the coherence between strategic level goals and challenges and the operational level KPIs in GPD. Furthermore the applicability of the KPIs in the context of GPD is investigated. In doing so, the paper draws conclusions from a systematic review of literature consisting of 59 articles, presents the results from a survey with 28 respondents from industry and reports on an exercise carried out by 16 companies at a recent workshop, where strategic level goals and challenges for GPD were validated.

2. Literature review

2.1 Global Product Development

GPD is the globalisation of tasks and activities throughout PD, from the start of the process of the fuzzy front-end and research and development to manufacturing and maintenance activities [Hansen and Ahmed-Kristensen 2012]. The globalisation of tasks may involve outsourced engineering work along with captive offshore engineering facilities [Eppinger and Chitkara 2009]. Outsourcing is defined as: a different company owns the foreign organisational unit where the relocated work is completed. Offshoring is defined as: the company in question owns the foreign organisational unit where the relocated work is completed. A survey that PD specialists PTC recently conducted in BusinessWeek Research Services [2006] of over 1000 engineering managers at manufacturing organisations found that 70% of the companies were either in the process of executing or were already executing GPD. Table 1 illustrates the classified strategic goals and motivations behind GPD from four independent studies in literature, which are the results from case studies and surveys that focused on the PD and manufacturing industry. The results have strong similarities and the research in this area is maturing. The authors categorised the goals within three dimensions, namely; financial benefits, operational benefits and market benefits (shown in the right column in table 1). Three of the goals from three of the independent studies could not be categorized and are within the ‘Other’ category; Risk mitigation, Fewer regulations and Competitive advantage. The importance and relevance of each of the goals vary depending on the context.

Table 1. Classified and categorised goals for GPD from four independent studies

Source:	[Hansen and Ahmed-Kristensen 2012]	[Christodoulou et al. 2007]	[Denmarks Statistics 2011]	[Taylor and Ahmed-Kristensen 2013]	Categorised
Goals for GPD	Lower costs (salaries) Lower project costs Lower logistic costs	Cost	Reduction of labour costs Reduction of costs other than labour costs	Cost reductions	Financial benefits
	New competencies Resources with knowledge of local market Increasing innovation heights Better resources Scalability and flexibility of resources	Access to resources Innovation and learning Agility	Lack of qualified labour Access to specialised knowledge/technologies Improved quality or introduction of new products	Access to new competencies and resources Increase customer base Flexibility and scalability	Operational benefits
	Close to local market knowledge Close to local suppliers, customers and competitors	Customer service	Access to new markets Reduced delivery times	Reduce time to market	Market benefits
		Risk mitigation	Less regulations	Competitive advantage	Others

Companies face difficulties when globalising parts of PD. Previous studies highlight seven key challenges: 1) Cultural differences 2) Knowledge sharing 3) Communication 4) Documentation 5) Lack of a common vision 6) IP rights and security 7) Standardising tools and processes [Hansen and Ahmed-Kristensen 2012]. Similar to the goals, the challenges vary in importance depending on the context, and the risks they pose can directly impact the decision rationale and the eventual success of GPD. The majority of the research on outsourcing has focused on success stories and best practice, with companies reluctant to publicise when decisions made during the process failed to work out as

planned. Studies by Hansen and Ahmed Kristensen [2012] found that the case companies investigated had only considered the positive impacts of moving abroad, leaving few processes in place to handle the difficulties. The solutions to these difficulties were implemented on an 'as needed' basis and the consequences had not been evaluated. In addition, the companies were observed to switch strategies of offshoring and outsourcing. A number of case studies by Baithelémy [2003] highlight the need to understand the hidden costs involved with outsourcing. The hidden costs impact the success of GPD and challenge the decision rationale. While successful outsourcing requires spending on vendor searching, management costs or training to name a few, these costs can potentially turn successful outsourcing efforts into a failure. From the case studies, Baithelémy concludes that while carefully selecting the vendor and aligning expectations and clearly defining a set of performance measures may be costly, such expenses are necessary to reduce the impact of the hidden costs. The cases illustrate the importance for management to receive accurate feedback on the performance of GPD projects and a need for additional quality procedures. Accurate feedback provides the grounds for decisions to be made as illustrated in the Global Decision Making framework [Hansen and Ahmed-Kristensen 2012]. In practice a company is likely to start slow, outsource a part of a process, assess the performance, and then decide on how to proceed [Neely et al. 1997], [Jagdev et al. 2005].

2.2 Performance measurement

There are many descriptions and definitions of what constitutes performance and the measurement of performance in literature. A commonality among researchers, which is how performance is defined in this paper, is to define performance as the effectiveness and efficiency of a process with the purpose of achieving a fixed objective or set of goals [Kaplan and Norton 1992], [Neely et al. 2002], [O'Donnell and Duffy 2005]. Efficiency is defined as the amount of resources used in relation to those available for the process, while effectiveness is defined as the attainment of objectives or goals relative to the process. Measuring performance is often carried out with KPIs, which in engineering design are defined as quantifiable measurements that help an organisation measure the success of critical factors [Gries and Restrepo 2011]. The KPIs vary in nature and are categorised by the designers of the Balanced Scorecard as: Leading indicators – that identify factors affecting a process and; Lagging indicators – that identify events that have taken place. The complexity and coherence between the KPIs, goals and risks are crucial to ensure successful measurement and feedback on the process [O'Donnell and Duffy 2005].

2.3 KPI applicability

Studies in literature, which explore the use of KPIs in conventional PD, have reported large amounts of measures used in industry such as *Development cost*, *Project lead time*, *Customer satisfaction*, etc. [Kitcher et al. 2012], [Palm and Whitney 2013]. However, there is a lack of research reported on KPIs for GPD and those reported are often not defined to a level of granularity that can be applied at an operational level and it is challenging to understand how the KPIs are actually measured [Jiang and Qureshi 2006]. Taisch et al. [2011] propose a framework, with the example KPI: *Number of identified customer needs*. The framework provides a systematic approach towards describing how the given KPI should be measured in practice, which enhance KPI applicability. They propose that each KPI used for a given project should follow the framework; however, the decision maker may focus their attention on feedback from the most relevant KPIs for their context. When considering successful performance measurement, it is important to distinguish between the process of creating a PMF, i.e. selecting the right measures, and the actual output of the process of performance measurement, i.e. the measurement. This paper focuses on the process of creating a PMF. Neely et al. [2000] propose six criteria for successful performance measurement system design: 1) Should be derived from companies strategy; 2) The purpose of the measure must be made explicit; 3) Data collection and methods of calculating performance must be clear; 4) All stakeholders must be involved in the selection of the measures; 5) Take account of the organisation and; 6) the measures should change as circumstances change. The first criterion is arguably most important and is mentioned throughout literature. The remaining criteria link strongly towards the use and validity of the PMF. There are many examples in literature where PMFs have had a negative impact on organisational behaviour [Neely et al. 2000].

The underlying issue with the cases is the lack of coherence between the strategic level goals and the operational level KPIs. For a successful PMF for GPD, it is important that this coherence is present to avoid the negative impact on organisational behaviour.

2.4 Current frameworks

Two of the most well documented PMFs are the Balanced Scorecard (BSC) [Kaplan and Norton 1992] and The Performance Prism [Neely et al. 2002]. Kaplan and Norton [1992] state the BSC framework represents a balanced approach to measurement as it considers financial and non-financial factors from four perspectives: Customer, Internal, Financial, Learning and growth. The framework is widely used in industry ranging from the financial to the healthcare sector. However, the framework has been analysed and evaluated and when considering PD, authors argue that the framework is difficult to implement in an organisation that has a diverse and dynamic environment [Molleman 2007]. O'Donnell and Duffy [2005] raise concerns regarding the practicality of the framework for the PD process. The framework does not fully support coherence between the business level goals and the operational level KPIs. Furthermore, previous studies by the authors of this paper highlighted a need for the inclusion of further perspectives than the four recommended when considering performance measurement in GPD [Taylor and Ahmed-Kristensen 2013]. The Performance Prism is a more recent framework with a strong focus on identifying and mapping stakeholder's needs. In addition to the BSC, The Performance Prism ensures the goals and measures selected are prioritised and weighted accordingly. However, the framework offers little about how the KPIs should be realised [Tangen 2004]. The Performance Prism is a framework that focuses on the process of creating a PMF. The two frameworks are excellent examples of strategic level tools for the design of a PMF. However, they rarely help with the practical realisation and applicability of KPIs at an operational level.

2.5 Summary of literature

Table 2 presents a summary of the literature on performance measurement in GPD. The summary consists of 59 articles, which are analysed in four independent categories, namely: Field of research, Method, Proposed model and the Industry sector to which they apply. The summary not only illustrates the gap in literature in performance measurement in GPD, but also the gap in performance measurement at an operational level in GPD. The findings support those of Tangen [2004], where the study highlighted the need for performance measurement to be operationalised. As illustrated in Table 1, the strategic level goals and objectives for GPD are maturing. However, the current frameworks and summary of literature focusing on performance measurement in GPD highlight the lack of research on operational level performance measurement in GPD. Furthermore, there is a need for a challenge based approach, when considering the selection and the applicability of the KPIs. The following section presents how the authors intend to build on these findings.

Table 2. Summary of literature (GPD = Global Product Development, PM = Performance Measurement, OD = Other Discipline)

Field of research	GPD (GPD+PM)	PD + PM	OD + PM
No. of articles	19 (9)	30	10
Method (primary)	Survey	Case studies	Analysis of literature
No. of articles	13	27	19
Proposed model	Descriptive	Prescriptive	n/a
No. of articles	37	14	8
Industry	PD	Manufacturing	Other
No. of articles	18	23	18
Total number of articles	59		

3. Methodology

3.1 Research aim

The aim of the research was to investigate the coherence between the strategic level goals and challenges and the operational level KPIs in GPD. Furthermore, the applicability of the KPIs was investigated. This was two-fold: first the literature review categorised the strategic level goals in GPD and highlighted the gap in operational level performance measurement, presented in Table 1 and Table 2. Second, the empirical studies in the following sections investigate the KPIs used in GPD, relative to the strategic goals and challenges.

3.2 Research approach

An independent survey and an exercise at a workshop on GPD formed the empirical investigations. The survey was collected for a previous study [Taylor and Ahmed-Kristensen 2013] where results were analysed and compared with the four perspectives of the BSC. This paper builds on the initial survey results by analysing the coherence between the KPIs and the strategic goals, and the applicability of the KPIs at an operational level. The exercise further contributes towards how managers measure performance relative to a set of defined strategic goals and challenges. The knowledge gained from the survey was used as a basis to design the data collection exercise for the workshop.

3.3 Participants

The survey was distributed to 100 companies and 28 completed responses were received. 27 of the companies were Danish and 1 from the UK. The respondents consisted of 19 large, 2 medium and 7 small companies from the manufacturing or PD sector [Taylor and Ahmed-Kristensen 2013]. The participants of the exercise were attendees of an industrial workshop with a focus on GPD. The participants at the workshop were professionals with previous experience in GPD. Information on the size, industry sector and position in the company of the respondents are presented in Table 3.

Table 3. Size of participating companies for the exercise

		Size:		Small	Medium	Large	
No. of participants:				6	5	6	
Industry:	Product dev.	Energy	Engineering	Innovation	Business dev.	Electronics	
No. of participants:	8	5	1	1	1	1	
Position:	Founder	Top Mgt.	Engineer	Consultant	Project Mgt.	Offshoring Mgt.	Designer
No. of participants:	3	3	3	1	5	1	1

3.4 Data collection

3.4.1 The survey

The survey was kept short (between 7 to 10 minutes) to maximize the response potential. Multiple choice questions were designed where possible to help with the analysis of data, these included the option *other* to allow for the collection of responses outside of the choice. The respondents were asked to list their goals and motivations for GPD. Following this, they were asked to select the KPIs used for measuring the performance of GPD. The results from the questions were categorised by the authors. The categorised KPIs were aligned under the relevant goals for GPD. In some cases there was not a clear link between the goal selected and the KPI proposed for measuring the goal by the respondents. In this case, the authors realigned the KPI under the goal it was linked with. The realignment was then validated with a colleague (who had experience with the topic) using a kappa analysis, which indicated a strong validation scoring: 0.78.

3.4.2 The exercise at the workshop

The methodology was kept as close to the survey as possible to allow for the comparison of data sets.

The participants were provided with brief instructions of how to complete the exercise beforehand, and no KPIs were presented to avoid influencing their response. Each participant was asked to think of a past or present GPD project that they were involved with. For the project they were asked to follow the steps presented in Figure 1. First, the participants were asked to select and prioritise the goals and challenges for GPD (Step one). In addition to the survey, the participants were asked to state their strategies towards achieving the goals and avoid the challenges (Step two) in an attempt by the authors to strengthen the applicability of the KPIs stated in the following step. The final step (Step three), the participants were asked to state the relevant KPIs used to measure the goals and challenges.

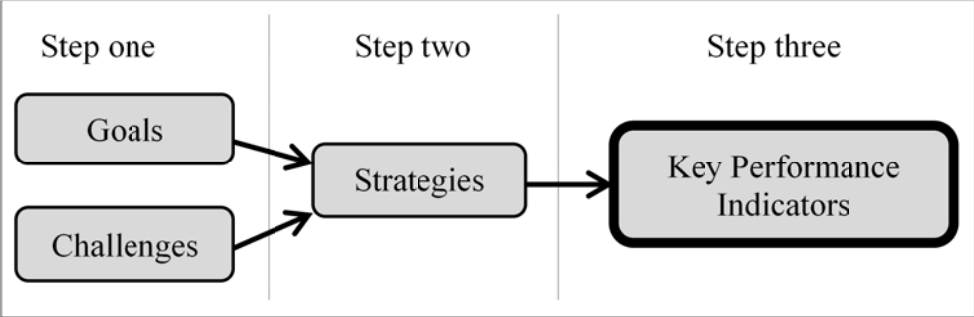


Figure 1. Three step approach to completion of the exercise

The exercise produced two sets of data: KPIs used for measuring the goals for GPD and KPIs used for monitoring the challenges and minimizing risk for GPD. The KPIs were put into two categories: *measurable* and *immeasurable*. The *immeasurable* KPIs were not analysed in this paper. In some cases, there was not a clear link between the goals or challenges selected and the KPI proposed. In these cases, the authors realigned the KPI under the goal or challenge it was linked with.

4. Key findings

The results from the survey and exercise form the analysis of the coherence between the strategic level goals and the operational level KPIs applied in GPD. From the survey, each of the responses for the goals, and KPIs for measuring the goals of GPD, were analysed for frequency of response. From the exercise, each of the responses for the goals and challenges, the strategies towards achieving the goals and challenges, and the KPIs used for measuring the goals and challenges, were analysed for frequency of response.

4.1 The survey: KPIs relative to the goals for GPD

From the survey, the following key observations were made, which are illustrated in Table 4:

- *Cost reduction* was the most frequent goal for GPD, as selected by the respondents (16 response), and *Reduce time to market* the least selected (2 responses).

A total of 18 KPIs were stated relative to the five goals for GPD. From the KPIs, *Customer satisfaction* was the most stated KPI (10 responses), with *Development cost* and *Project Vs. Timeplan* the second and third most selected KPIs respectively. There were a total of 7 KPIs for measuring the most selected goal of *Cost reductions*.

Table 4. KPIs relative to strategic level goals for GPD with frequency mentioned: Survey

Goals	Freq.	Coded KPIs	Freq.
Access to new resources	8	<i>Leads to Future Opps</i>	3
		<i>% New product sales</i>	2
		<i>Share knowledge and expertise</i>	5
Cost reductions	16	<i>Break-Even Time</i>	3
		<i>ROI</i>	5
		<i>Margin goals</i>	2

		<i>Development cost</i>	9
		<i>Profit goals</i>	3
		<i>Cost pr. hour</i>	1
		<i>cost of ext. vs. internal dev. cost</i>	2
Reduce time to market	2	<i>Speed to market</i>	6
		<i>Ease of manufacture</i>	4
		<i>Project vs. timeplan</i>	8
Flexibility and scalability	8	<i>Market position</i>	5
		<i>Flexibility</i>	4
		<i>Met unit vol. goals</i>	2
Increase customer base	3	<i>Customer satisfaction</i>	10
		<i>Market share</i>	4

4.2 The exercise: KPIs stated relative to the goals for GPD

From the exercise, the following key observations were made in relation to the selected goals for GPD and the KPIs for measuring them (Table 5):

- *Access to new resources* and *Reduce time to market* were the goals with the highest priority. The goal with the lowest priority was *Increase customer base*.
- An additional category was created: *Risk mitigation*, as this was a goal mentioned twice by two separate participants.

The frequency of the strategies mentioned was not included in Table 5 as all strategies were only mentioned once, with the exception of *Use of external expertise* and *Outsource tasks*, which were mentioned 4 and 3 times respectively. In total there were 44 KPIs collected that the participants stated as measures for the goals for GPD. 28 of the KPIs were considered to be *measurable* by the authors. These KPIs were then categorised and those that did not cohere with the selected goals were realigned, which resulted in a total of 15 KPIs relative to the goals (Table 5). *Project lead time* was the most frequently mentioned KPI with 8, which was a KPI for measuring the goal *Reduce time to market*. The frequency of KPIs mentioned for each goal was relatively balanced, with the exception of *Reduce time to market*. Examples of *immeasurable* KPIs were: 3rd party review, milestones, management and coordination. These were considered to be strategies to achieve the goal rather than measure performance towards the goal and were not included in the analysis.

Table 5. KPIs and strategies relative to strategic level goals for GPD with frequency mentioned: Exercise

Goals	Freq.	Coded strategies	Coded KPIs	Freq.
Access to new resources	9	Development of competencies	<i>No. of new projects</i>	2
		Quality service		
		Process indicators	<i>No. of new alliances</i>	2
		Partner screening		
Cost reductions	8	Use external expertise	<i>Output Vs. resource allocation</i>	1
			<i>Development cost</i>	2
			<i>Labour cost</i>	1
Reduce time to market	9	Increase resources	<i>Project lead time</i>	8
		Process control		
		Increase no. of designers		
		Platform strategies		
		Outsource tasks		

		Use external expertise		
		Process control	<i>Project plan status</i>	2
		Outsource tasks		
		Partner screening	<i>Clarity of requirements</i>	1
Flexibility & Scalability	8	Variation of product family	<i>Capability of supplier delivery</i>	2
		Identify correct partner		
		Use external expertise	<i>Capability to take similar work</i>	1
Risk mitigation	3	Reduce iterations	<i>No. of delays in project plan</i>	1
		Process control	<i>No. of solved work packages</i>	1
Increase customer base	2	Close to customers	<i>No. of new customers</i>	1
		Variation of customers	<i>No. of sales from new location</i>	1
		Use external expertise	<i>Quality</i>	2
		Outsource tasks		

4.3 The exercise: KPIs stated relative to the challenges of GPD

From the exercise, the following key observations were made in relation to the selected challenges for GPD and the KPIs stated for measuring them (Table 6):

- *Communication* and *Cultural differences* were the challenges with the highest priority, mentioned 16 and 10 times respectively.

The frequency of the strategies and KPIs mentioned was not included in Table 6, as all were only mentioned once, with the exception of the KPI *Frequency of process problems*, which was mentioned twice. Furthermore, there were no strategies or KPIs mentioned by the participants for monitoring the challenges and minimising the risks of *Documentation* and *Lack of common vision*. There were almost 50% fewer KPIs in Table 6 than in Table 5. 41 KPIs were considered to be *immeasurable* by the authors compared to 8 that were *measurable*.

Table 6. KPIs and strategies relative to strategic level challenges for GPD with frequency mentioned: Exercise

Challenges	Freq.	Coded strategies	Coded KPIs
Communication	16	Face-to-face meetings	<i>No. of goals met on time</i>
		Clear goals	<i>No. of agreements kept</i>
		Status reports	<i>No. of problems during project</i>
		Multimedia based communication	<i>Frequency of communication problems</i>
Cultural differences	10	Cultural exchange awareness program	<i>Employee feedback on job stability</i>
IP rights	5	Patent application	<i>No. of patents</i>
Knowledge sharing	7	Common document base	<i>Availability of documentation</i>
Standardising tools and processes	5	Mutually clear process	<i>Frequency of process problems</i>
Documentation	<i>No strategies or KPIs mentioned</i>		
Lack of common vision	<i>No strategies or KPIs mentioned</i>		

4.4 The implications

The results in Table 4 and 5 propose a balanced set of KPIs for each of the goals. However in comparison, when considering monitoring and measuring the challenges in GPD, Table 6 contains fewer KPIs despite the clear importance of the challenges *Communication* and *Cultural differences* in GPD. This is confirmed by literature where focus on KPIs is on the goals of GPD with little

consideration of the additional challenges as a result of GPD. Although participants of the survey and exercise stated KPIs for measuring the goals, the applicability at an operational level was weak and there were many KPIs that the authors deemed to be *immeasurable* when considering the KPI description framework [Taisch et al. 2011]. Furthermore, the coherence between the KPIs stated and the goals and challenges selected was absent in a number of cases. For example, *Market position* was a KPI stated for measuring the goal *Flexibility and scalability* in the survey and *Quality* as a KPI stated for measuring the selected goal *Increase customer base* in the exercise. When considering criteria 1 in the success criteria for performance measurement [Neely et al. 2000], which is arguably the most important, the criteria states: The measures should be derived from companies strategy. However, given the categorisation and realignment process by the authors of the KPIs, the coherence between the strategic level goals and challenges and the operational level KPIs is lacking.

4.5 Limitations

Although all participants of the workshop had experience in GPD; their level of experience, in terms of number of years or the complexity of tasks that they outsourced or offshored, was unclear.

5. Conclusion

With the systematic review of literature and two independent empirical studies, this paper has investigated the coherence between strategic level goals and challenges and the operational level KPIs in GPD. Furthermore, the applicability of these KPIs in the context of GPD was investigated. From the analysis of literature (59 articles), the gap between operational level KPIs and strategic level goals and objectives was made explicit and a lack of research on KPIs for GPD was apparent. As a result of the analysis of literature, there were three key implications:

- Only 9 articles were found out of 59 that focused on performance measurement in GPD.
- Only 1 of these articles focused on performance measurement in GPD at an operational level [McKay et al. 2013] and the remaining at a strategic level.
- Only 14 articles proposed prescriptive models, which address the practicalities of measurement and offer guidance for the actual selection and implementation of measures.

From these results, we conducted a survey with 28 respondents and an exercise with 16 companies. KPIs from a goal oriented approach were presented that are used in industry for measuring the performance of GPD. Furthermore, building on previous studies [Taylor and Ahmed-Kristensen 2013] a challenge oriented approach to performance measurement was presented. The goals and challenges for GPD were validated through the exercise with the creation of one additional goal: risk mitigation. The results from the two studies imply that companies feel the goals and challenges are relevant and important for GPD, however when considering the applicability and coherence of the KPIs with these goals and challenges at an operational level, there is a lack of understanding of how they should be measured and monitored. By building on previous research in the area and adapting key aspects of methodologies from performance measurement, this paper has: highlighted a lack of research on KPIs for GPD at an operational level; presented KPIs used in industry for measuring performance of GPD at an operational level; and highlighted a lack of applicability and coherence with these KPIs, especially when considering a challenge based approach to measurement. Further work should focus on linking KPIs in GPD to current processes and procedures in a company at an operational level.

References

- Barthelemy, J., "Seven deadly sins of outsourcing", *Academy of Management Executive*, Vol. 17., No. 2., 2003.
- Caney, L. E., Platts, K., Probert, D. R., "Developing a Framework for make-Or-Buy Decisions", *International Journal of Operations & Production Management*, Vol. 20., No. 11., 2000, pp. 1313-1330.
- Christodoulou, P. et al., "Making the Right Things in the Right Places", IFM, Cambridge, 2007.
- Cooper, R., "Benchmarking new product performance", *European Management Journal*, Vol. 16., 1998, pp. 1-17.
- Dabhilkar, M., Bengtsson, L., "Invest Or Divest? Relative Improvement Potential in Outsourcing Manufacturing", *Production Planning & Control: Management of Operations*, Vol. 19., No. 3., 2008, pp. 212-228.

Eppinger, S. D., Chitkara, A. R., "The Practice of Global Product Development", MIT Management Review

Gries, B., Restrepo, J., "KPI Measurement in Engineering Design - A Case Study", *Proceedings of the 18th International Conference on Engineering Design - ICED 11*, Culley., et al, Denmark, 2011.

Griffin, A., Page, A. L., "PDMA success measurement project: Recommended measures for product development success & failure", *Journal of Product Innovation Management*, Vol. 13., No. 6, 1996, pp. 478-496.

Hansen, Z. N. L., Ahmed-Kristensen, S., "Successful Global Product Development: Guide for Industry", 2012.

Hansen, Z. N. L., Ahmed-Kristensen, S., "Connecting Global Product Development with Corporate Strategy", *Proceedings of the International Design Conference - DESIGN 2012*, Croatia, 2012.

Hansen, Z. N. L., Ahmed-Kristensen, S., "Global Product Development: The Impact on the Product Development Process and how Companies Deal with It", *International Journal of Product Development*, Vol.15., No 4., 2011, 2012, pp. 205-226.

Jagdev, H., Irennan, S. A., Browne, J., "Strategic Decision Making in Modern Manufacturing", Springer, 2004.

Jiang, B., Qureshi, A., "Research on Outsourcing Results: Current Literature and Future Opportunities", *Journal of Management History*, Vol. 44., No. 01., 2006, pp. 44-55.

Kaplan, S. K., Norton, D. P., "The Balanced Scorecard - Measures that Drive Performance", *Harvard Business Review*, Reprint number 92105, 1992.

Kitcher, B. et al., "Understanding the Effects of Outsourcing: Unpacking the Total Factor Productivity Variable.", *Production Planning & Control: The Management of Operations*, Vol. 24., No. 05., 2013.

McKay, A. et al., "Realising Design Engineering Capability Across Distributed Enterprise Networks", *The ninth international symposium on global manufacturing and China*. China, 2013.

Molleman, B., "The Challenge of Implementing the Balanced Scorecard", *6th Twente Student Conference IT*, 2007.

Neely, A. et al., "Designing Performance Measures: A Structured Approach", *International Journal of Operations and Production Management*, Vol., 17., No. 11., 1997.

Neely, A. et al., "Getting the Measure of Your Business", Cambridge University Press, 2002.

Neely, A. et al., "Performance Measurement System Design: Developing and Testing a Process-Based Approach", *International Journal of Operations and Production Management*, Vol. 20., No. 10., 2000.

Neely, A., Adams, C., Kennerley, M., "The Performance Prism: The Scorecard for Measuring and Managing Business Success", Cranfield School of management, 2002.

Nenadal, J., "Process Performance Measurement in Manufacturing Organisations", *International Journal of Productivity and Performance Management*, Vol., 57 No. 6., 2008.

O'Donnell, F. J., Duffy, A. H. B., "Design Performance", Springer, 2005.

O'Donnell, F. J., Duffy, A. H. B., "Modeling Design Development Performance", *International Journal of Operations and Production Management*, Vol. 22., No. 11., 2002, pp. 1198-1221.

Palm, W. J., Whitney, D. E., "Prioritizing the Many Measures of Success in Outsourced Design", *Proceedings of ASME*, Portland, 2013.

PTC, "Global Product Development –From strategy to execution", *BusinessWeek research Services*, 2006.

Taisch, M. D., Corti, Terzi, S., "Towards a Performance Measurement System for Lean-Oriented NPD Processes", *Global Product Design: Proceedings of the 20th CIRP design conference*, 2011.

Tangen, S., "Performance Measurement: From Philosophy to Practice", *International Journal of Productivity and Performance Management*, Vol. 53., No. 8, 2004, pp. 726-737.

Taylor, T. P., Ahmed-Kristensen, S., "Performance Measurement in Global Product Development", *Proceedings of the 19th International Conference on Engineering Design - ICED 13*. Seoul, 2013.

Tripathy, A., Eppinger, S. D., "Organising Global Product Development for Complex Engineered Systems", *Engineering Management IEEE*, Vol. 58., No. 03., 2011, pp. 510-529.

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