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Decision making in global product development

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Abstract

Many engineering companies experience new challenges when globalising product development. Global product development (GPD) is a relatively nascent research area, and previous research reveals the need for decision support frameworks. This research investigates how decisions are made when companies outsource or offshore product development tasks, and how these decisions can be improved. A brief literature review on existing research on GPD and decision making is given, followed by two case studies, where implications of decisions are investigated. The findings point towards further studies required for creating a decision support framework for managers to make better decisions in the future.

Keywords: Decision making, global product development

Introduction

Over the last couple of decades, globalisation has reshaped the way engineering companies are structured and operate, and as a result, global product development (GPD) has emerged as an essential area in engineering disciplines. In today's global economy, most engineering companies are to some degree global. Either they are global in their market, in their production or global throughout many different phases of their value chains (Eppinger & Chitkara 2006; Kedia & Mukherjee 2009). Outsourcing of production to low cost countries is not a new phenomenon, and (Hansen & Ahmed-Kristensen 2011b), and consequently extensive research in this area already exists. However, since the late 1990's, an increasing number of engineering firms have also gradually globalised more complex development tasks, including R&D, concept development, detailed design, testing, and marketing (Eppinger & Chitkara, 2006; Lewin *et al.*, 2009). This leads to new managerial challenges, as traditional co-located product development processes and organisations are no longer viable (Andersson & Pedersen 2010). Product development processes need to be decomposed into manageable parts which might be geographically dispersed, and managing these require further research attention (Hansen & Ahmed-Kristensen, 2011).

Many engineering companies have explored the new challenges and new structures, processes etc. that the new global agenda sets (i.e. (Bardhan 2006; Zedtwitz *et al.*

2004)). However, the understanding of the implications GPD has on these companies organisation and strategies is still a relative nascent research field (Makumbe et al. 2009) and will be a growing field in the coming years (Lewin et al. 2009). Engaging in GPD requires new competencies and capabilities from engineering manufacturing firms (Eppinger & Chitkara 2006; Harvey & Griffith 2007), as it is quite different from traditional, collocated product development. Some of the key differences between traditional product development (PD) and GPD are: 1) R&D teams become increasingly virtual, and therefore they rely heavily on effective virtual collaboration (Eppinger & Chitkara 2006). 2) GPD requires fully digital product development systems (Eppinger & Chitkara 2006) and 3) GPD results in challenging cultural differences between geographically diverse development teams (Lewin & Peeters 2006). In addition, GPD requires a clear definition of the interfaces of the: 1) organisational processes; 2) product development processes and; 3) modules of the product itself (Hansen & Ahmed-Kristensen 2012). These differences create new challenges for companies doing GPD; new decisions need to be made, and these challenges and decisions are the foundation for this research.

Definitions

Global Product Development (GPD) is here defined as a product development operation where development activities include distributed teams in multiple global locations. **Outsourcing** refers to companies sourcing a 3rd party supplier to deliver a certain task, product component or part of the PD process, while **offshoring** refers to companies expanding their own development activities in new locations, while maintaining ownership and control of the subsidiary (Hansen & Ahmed-Kristensen 2012).

Background

Previous research shows that companies engaging in GPD often apply a “learning-by-doing” approach if they have little or no experience with outsourcing or offshoring of development tasks (Eppinger & Chitkara 2006) (Hansen & Ahmed-Kristensen 2011a). Primarily driven by cost savings through low-cost labour for development, these companies experiment with new ventures into GPD, and only when they have gained experience, they retrospectively assess and evaluate the decisions made (Lewin & Peeters 2006). Often, however, the expected cost savings are not met due to unforeseen costs that are revealed once the decision is executed, leading to failure and the decision being changed (Stringfellow et al. 2008).

When looking at a traditional product development process (Figure 1), a common pattern found in previous studies is that companies often start by outsourcing late stages of the product development process (e.g. test and production), since these are considered less essential for decision making and often also as less strategic importance to the company (Hansen & Ahmed-Kristensen 2012).



Figure 1: Product Development Process, (based on Ulrich & Eppinger, 2008)

Once the companies have gained experience with this, earlier stages of the product development process gradually follow (Hansen & Ahmed-Kristensen 2011a). If the

earlier stages of product development are globalised, they are most likely to be offshored, allowing the offshoring company to retain close control over them (Hansen & Ahmed-Kristensen 2011b). Other studies complement this finding, concluding that firms might often outsource less research intensive activities first, and once their experience with international R&D grows, more complex tasks are relocated globally (Rilla & Squicciarini 2011). When taking the first steps toward a global product development organisation, many companies have no previous experience or extensive assessment to build their decisions upon. Hence decisions regarding location and layout of new global development capabilities are often made in relation to the company's existing footprint (i.e. locations with existing production facilities or other existing activities) (Christodoulou et al. 2007).

Research questions and methodology

Companies who decide to globalise their product development efforts need a better basis for making the right decisions (i.e. decisions regarding: location, which development tasks to globalise, and how to prepare the organisation for GPD) (Hansen & Ahmed-Kristensen 2011b). Hence the trigger for this research is to investigate whether the dependency on a long and costly "learning-by-doing" history and experience can be avoided by creating a general decision framework, which builds on companies' previous experiences. The research aim is to gather information for a decision support tool, which can be applied in a general way to reduce dependency on expensive and protracted learning-by-doing processes. Such a tool is expected to improve the quality of decision making in companies who currently do not have extensive experiences with GPD, and can potentially save them a lot of time and resources. The decision support tool is aimed at CEO's and top management in engineering manufacturing companies. Such a tool will especially be valuable for SME's who do not have the budget or resources to go through the long experience learning process.

The main questions this research addresses to fulfil the aim are:

- 1) How are strategic decisions whether to outsource or offshore product development tasks made?
- 2) How are strategic decisions regarding location made?
- 3) How are decisions made regarding which activities to place where in the GPD setup?
- 4) Which information is needed for top management to avoid failure in the above decisions?

Methodology

To achieve the research aim this study adopts the following methods:

- 1) A brief review of literature concerning GPD and decision making, and an outline of identified research gaps.
- 2) Preliminary results of two retrospective case studies in Danish engineering companies, where previous decision processes and decision information are assessed through qualitative studies in these companies.

The literature review informs which topics and questions must be further investigated in the case studies.

Relevant literature

To understand the decisions made in GPD it is important to understand which motivations there are for GPD, which challenges have been identified, and why decisions have failed. A brief summary of these is given in this section.

Motivations

A reasonable amount of previous research has dealt with the motivations that companies have for outsourcing or offshoring product development tasks. This earlier research is based both on theory and case studies with companies. From this body of research, it is possible to identify some general motivations for engaging in GPD. The motivations mentioned most frequently throughout the studied literature are cost related, either with regards to labour-cost savings or other development-cost savings (supply chain costs, overall project costs etc.) i.e. (Eppinger & Chitkara 2006; Makumbe et al. 2009; Hansen & Ahmed-Kristensen 2012). This supports the common understanding that outsourcing will lead to cost savings for the outsourcing company. Access to new markets and access to new competencies is also a recurring motivation in literature; companies often see an opportunity to expand into new markets (i.e. the growing markets in Asia and Africa), through outsourcing. For example a case study by Khurana (2006) revealed that 52% of 32 US based case-companies were undertaking international R&D to gain closer access to local markets. The same motivation was stated by some of the Danish case companies in earlier studies (Hansen & Ahmed-Kristensen 2011b). Gaining access to additional resources, which may not be available in the headquarter location of the company, also represents a recurring theme in the articles analysed.

Challenges

Several studies have considered the challenges companies face when they outsource or offshore product development tasks. The most frequently mentioned challenge in literature is cultural differences (i.e. (Hansen & Ahmed-Kristensen 2011b; Makumbe et al. 2009; Lewin & Peeters 2006)). At the same time, cultural challenges are also considered some of the most difficult challenges to address. As GPD has a geographically distributed nature, communication often relies heavily on digital channels rather than face-to-face communication, and this can increase the cultural difficulties experienced among distributed development teams (Lewin & Peeters 2006). Challenges regarding knowledge transfer and documentation are also found to be difficult to address (Hansen & Ahmed-Kristensen 2011b) as GPD sets new requirements for the way an organisation deals with knowledge management. This is an example of a challenge where some of the companies studied actually experienced increased development times, increased cost etc. This indicates that the capabilities of overcoming these challenges (i.e. documentation and knowledge management systems) should be included when making a decision assessment.

Why decisions fail

Some of the main reasons for decisions to fail are: 1) Expected cost savings are not met (Larsen et al. 2012); 2) loss of control over the outsourced activity (Barthelemy 2003) and 3) decrease in product quality (Hansen & Ahmed-Kristensen 2011a). As a consequence of these challenges, decisions are often changed over time, or in some cases the outsourcing or offshoring decision is even withdrawn altogether (called back-

shoring, back-sourcing or re-shoring (Fratocchi et al. 2014)). Other studies have found that the cost savings actually exceeded expectations, primarily due to labour arbitrage (Lewin & Peeters 2006). C  nez et al. (C  nez et al. 2000) concluded that make-or-buy decisions are often made purely on the basis of cost, and that this can lead to failure since other important factors are neglected in the assessment. They propose a more holistic framework, looking at a broader range of aspects such as manufacturing processes, cost, supply chain management & logistics and support systems. These contradicting cases indicate that the success of a decision related to cost (and other factors) is very case dependent; cost savings might be achieved in one case, while they fail in others.

Decision Making Methods

Studies addressing decision making in GPD have so far focused on specific topics, for example: Choosing the right location for outsourcing or offshoring (Lin et al. 2007; Badri 1999), make-or-buy decisions (C  nez et al. 2000; Cruz-C  zares et al. 2013) and using decision methods such as integrated Analytic Hierarchy Process (AHP) or Case Based Reasoning (CBR) for supplier selection (Ho et al. 2010) and using AHP for assessing core capabilities of the firm (Hafeez et al. 2007). However, all of these solely address isolated areas of decision making, and do not inform on how to plan and execute overall GPD processes (for example how to plan and segment the product development process and ensure to have the right interfaces between distributed development tasks and processes). This indicates that a more coherent, multidisciplinary decision making framework is needed to address the broad challenges experienced when making decisions in GPD.

Case studies

In order to investigate how decisions had been made, and how they were implemented, case studies have been conducted in two Danish engineering companies.

Case selection

The retrospective studies are conducted in two Danish engineering companies who have been selected for the studies based on fulfilment of *all* the following three selection criteria: 1) Company has an R&D/product development department, 2) Company has a global footprint, and 3) Company has experiences with making decisions in GPD within the past 15 years.

Data collection

The interviews were conducted in two Danish engineering manufacturing companies in March 2014. Data collection consisted of two interviews: One with a Vice President of Innovation (Case A) and one with a Global Program Manager (Case B). As the case-studies are ongoing, only preliminary data and results from the first interviews are presented in this paper.

Interview method

As the nature of the case studies is explorative, the interviews were semi-structured interviews based on an interview guide. In the interview guide, a list of questions was prepared in advance, which is used as a guideline, but allowing the interviewer to skip between questions and ask in-depth follow up questions on other questions, depending on the interview progresses.

Data analysis

Interviews were transcribed and analysed, and answers to the research questions were compared across cases as well as against literature. The results from the literature study combined with the finding from the interviews are used to identify which decision parameters a decision support tool should enclose. An overview of the main finding from the two cases is shown in **Error! Reference source not found.**

Table 1: Case overview

	Case A	Case B
Industry	Healthcare	Mechanical engineering
Size	1700 employees globally	18000 employees globally
Global setup	4 global R&D centres	5 global R&D sites
Motivation for global development	<ul style="list-style-type: none"> • Have development closer to production • Cost reduction in total R&D expenditures 	<ul style="list-style-type: none"> • Scalable global setup • Conservation of project knowledge across many projects
Key decisions	<ul style="list-style-type: none"> • Opening additional R&D centres in Asia • Moving specific development tasks to global R&D sites 	<ul style="list-style-type: none"> • Change of global organisation and governance structure • Moving an existing project into a new global set-up
Offshoring or outsourcing?	<ul style="list-style-type: none"> • Both outsourcing and offshoring 	<ul style="list-style-type: none"> • Mainly offshoring, a few tasks were outsourced
Location decision	<ul style="list-style-type: none"> • Based on existing production sites 	<ul style="list-style-type: none"> • Based on existing production sites
Implementation	<ul style="list-style-type: none"> • Ad-hoc implementation • New roles and responsibilities were developed along the way 	<ul style="list-style-type: none"> • New governance model • New decision board. • New work-package standards & documentation
Lessons learned	<ul style="list-style-type: none"> • Better definition of roles and responsibilities needed • It can be difficult to attract the right resources/skills on location 	<ul style="list-style-type: none"> • Documentation is very important for distributed work • Level of details for new roles is important • Communication across sites is a challenge
Assessments made	<ul style="list-style-type: none"> • Risk assessment • Financial assessment 	<ul style="list-style-type: none"> • Execution plan • Level 2 risk assessment

Case A:

The central decision in case A was to establish additional development centres in two locations in Asia. This was basically a decision of adding R&D capabilities to already existing production sites, because Danish staff was already present at these locations. The decision was primarily motivated by cost savings (getting more R&D out of the same money spent, due to lower wages in Asia) as well as the option to have development and production closer together at the Asian development sites. The new R&D sites were gradually included over new development projects, where it was

decided from the beginning to involve the global teams. The new GPD setup was a natural expansion of existing activities, but the new tasks in the global R&D centres were not clearly defined from the start. This led to some confusion on which responsibilities were where? The case A company also experienced some challenges in attracting the right resources in the new location. Since the R&D centres changed from being purely production sites to development sites, new skills are needed, and these can be difficult to attract in the chosen location.

Case B:

The central decision in case B was to re-structure the whole development organisation from a centrally based development function placed in the headquarters in Denmark, to a global development function divided into five global development sites. As part of the organisational change, a new governance model with new decision making logics was also implemented. Strategic decisions about global development projects are now made by a central decision board. The global R&D sites have been divided into specific capabilities, which can be utilized across projects. With the new global governance set-up, the business has gone from being a resource-based business to a delivery based business.

Key findings

Both case interviews were transcribed and answers to the research questions were extracted from the transcripts. A more comprehensive coding and analysis of case interviews is planned.

Strategic decisions regarding offshoring or outsourcing

In both cases, the decisions were made by the board of executives. In case A the decision was based on a natural expansion of the existing activities. In case B it was a strategic re-organisation to prepare for global growth. None of the interviewees mentioned specific structured methods (i.e. AHP or some of the other mentioned in the literature) being used for the decision assessment. But risk assessment was mentioned in both cases as a central decision tool. This points towards risk assessments being a commonly used method for evaluating decisions.

Strategic decisions regarding location

In both cases, the location decision was based on existing presence (existing production facilities) which were extended to include R&D functions. Both cases mentioned the importance of having R&D close to the existing production. Case B has defined very detailed requirement specifications and work-packages in order control the deliveries from each global site. Decisions on where to locate each development tasks is based on available resources and competencies in the global development sites, and tasks are specified in the work-packages.

Decisions regarding development activities

In case A, the development activities that are located in the global development centres are based on the competencies that were already present in the production sites. The R&D sites in Asia are especially involved in design for manufacturing, as they are typically the locations to produce the final product.

In case B, role descriptions were made, and skills and capabilities are mapped within the flow streams of each development site. This way the global development manager has a better way of assessing which resources and competencies are available at which development sites. In case B, the new global governance also ensured clearly defined

interfaces between organisational processes and organisational units, which is mentioned to be a key success factor in theory (Eppinger & Chitkara 2006; Hansen & Ahmed-Kristensen 2012).

Information needed for top management

In both cases, the overall decision has actually proven to be a success, and therefore no critical “decision withdrawing” has taken place. However, some experienced challenges were identified, and these correspond with the challenges from theory (i.e. longer lead times, more documentation and communication challenges to be overcome). In case B, lead time considerations have been identified as an important risk in the new global set-up. Case B also showed that much more detailed descriptions of work packages helped overcome some of the documentation challenges. This was perceived as a success. This goes in line with theory, that much more standardization and documentation is needed (Hansen & Ahmed-Kristensen 2011b).

In both cases, a series of additional interviews with the project managers responsible for the global development projects are planned, and these interviews will focus much more on the experienced challenges of implementing the GPD decisions.

Conclusion & perspectives

This paper presents background theory and the first results of two retrospective case studies on decision making processes in case companies doing GPD. The cases provide new empirical insight towards which criteria decisions in GPD are based on, why they succeed or fail and to some degree which information and methods are needed to make better decisions.

Case A showed how the overall expected cost reductions in R&D expenses were achieved through globalising development tasks, and the strategic decision is at large perceived as successful. However, some of the challenges described in this case were a need for clearer role descriptions of the new roles, and also a need for making sure that the right competencies and resources are available at the chosen location. Case B also had overall good experiences with the decision to organize development in a new global set-up. However, in this case, new challenges emerged regarding communication across development sites, as well as challenges with keeping lead times short.

The preliminary results presented here point towards additional empirical data collected in case companies, including more examples of specific decisions and their corresponding parameters to be assessed. The findings from the empirical studies (additional interviews) will function as base for developing a decision making tool that supports top management in both strategic and tactical product development decisions. As the cases presented here had an overall successful result of their decisions, it should also be considered to include additional case studies, where the decision has been less successful, to analyse for decision failure in such cases.

One key object to consider and address in the further empirical studies and development of the decision support tool is the generalizability of the studied cases to general decision making. It must be carefully considered which decision parameters are very case or industry specific, and which are generally applicable. This should ensure a better quality of the decision tool to support managers and CEO's to make better GDP decisions in the future.

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