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The sustainable utilization of human resources in global product development

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Abstract. This empirical paper investigates the challenges global product development faces in regard to a sustainable utilization of resources through case studies and interviews in six Danish multinational corporations. Findings revealed 3 key challenges, which relates to increased rework in product development and production, overlapping work and a lack of utilization of knowledge and information at the supplier or subsidiary. The authors suggest the use of strategic simulation in order to gain greater transparency in the global network and thus utilize resources better. Strategic simulation is the combination of numerical and narrative simulation and can be used as a tool to support strategic decisions regarding different scenarios. The use of this method promotes an ongoing iterative process to constantly clarify points of uncertainty and enhance adaptability in order to promote a sustainable process.

Keywords: Global product development, human resources, offshoring, outsourcing, production network, strategic simulation, sustainability, transparency

1   Introduction

Today's business environment is characterized by a short time to market, changing customer specifications, global competition, and strong demand for local price competitiveness. Many Western companies have responded by developing global development and production networks. This can be done by globalising the supplier network and moving more tasks previously conducted internally to foreign suppliers; this is also called outsourcing. Furthermore, companies can internationalize by having plants and offices around the globe and move tasks and functions previously conducted in the home country to these locations, this is called offshoring. Both offshoring and outsourcing is often motivated by cost savings, and to be close to a market, or to gain certain competences [1].

1.1   Background and motivation

Sustainability can be understood as the capacity for a company to learn about the conditions of its existence and wants in relation to a global network. Sustainability encourages attention to uncertainty, ambivalence about multiple goals and distributed power. Sustainable development can be understood as a functional condition where a process can be sustained over time with consideration for socio-ecological systems [2]. A company needs to consider these different aspects when developing global production and development networks with foreign or their own offices and factories abroad to develop a sustainable network. The focus of this paper is on resource usage as this is highly relevant from an environmental, employee and financial perspective. Resources here cover both tangible assets (e.g. employees) and intangible assets (e.g. knowledge and time). The aim of this paper is to view this aspect of sustainability within the context of offshoring and outsourcing of development and production of highly engineered products.

2   Empirical method

The findings are based on case studies of six Danish multinational corporations with production and development activities in Eastern Europe, India, or China, and target markets in Europe, North America, and the emerging economies in the Far East and Eastern Europe. Table 1 illustrates the case companies with regard to type of company, company work form, the position of the interviewees, and the number of interviewees. The cases were selected to get breadth in the dataset across sectors and sizes.

Table 1. Characteristics of the case companies

Company synonym[1]	Type of companies	Country	Interviewees' company positions and number of interviewees
X1	Business to business (B2B) and business to consumer (B2C) telecommunication manufacturer	Outsourcing of production to China Offshoring of engineering to China	Vice presidents, managers 3 interviewees
X2	B2B equipment and service to the raw materials sector	Offshoring of engineering and R&D to India and USA	Vice presidents, managers 11 interviewees

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[1] All case companies are given synonyms to respect their wish for anonymity

X3	B2B engineering consultancy within pharma and biotech	Offshoring of engineering to China and USA	Managers 12 interviewees
X4	B2B service and equipment provider to the energy sector	Offshoring of engineering to China	Managers 3 interviewees
X5	B2B electronics and mechanical manufacturer	Offshoring of production and low-level design to China	CEO and Vice presidents 5 interviewees
X6	B2B electronics and mechanical manufacturer	Outsourcing of production and low level design to China	CEO and Vice presidents 4 interviewees

38 interviews with top managers and vice presidents were conducted, audio recorded, transcribed, and analysed. Each interview was semi-structured and lasted around 1 hour. The variety of interviewee positions enabled a multifaceted view of the research focus.

3   Findings

According to this study most case companies first offshored production and only later added higher value functions. Several of the case companies later outsourced production to gain flexibility and to focus on core competences. This process of globalisation of supplier network and internationalisation presented the case companies with new and unforeseen challenges. These were related to the increasing complexity of the development and production process mainly due to culture and virtual collaboration. Culture was a source of complexity in communication due to the difference between high and low context countries [3]. The countries the Danish companies moved to were mainly high context countries where most of the meaning is implicit in the context and the person, whereas Denmark is a low context country where the meaning is explicit and most of the information resides in the explicit message. This caused misunderstandings and frustration among the employees due to different approaches to communicating knowledge and information between the Danish headquarters and the foreign office. A manager from one of the case companies illustrated this; "*The Danish way is very simplistic but the Indians they blow small things up to huge achievements and everything is fantastic.*" Complications caused by virtual collaboration included virtual coordination of knowledge and information across cultures. An interviewee put it like this;"*The biggest challenge is to keep everybody informed about everything, because all the informal communication will not happen.*" These complications were seen in lower quality of the product and in the development process, more rework, more

misunderstandings and greater time lag between product changes to implementation than before the company had offshored or outsourced the given function or task. The findings showed communication and knowledge sharing across cultures was a key contributor to complexity. Furthermore, security measures were also high in subsidiaries; in many foreign subsidiaries the local employees did not have access to all the information and documentation that their Danish colleagues had in the headquarters. Managers in subsidiaries also devoted time to check the work of the local engineers for quality and security reasons.

The headquarters of the multinationals employed two approaches to counteract the increased complexity brought on by greater reliance on a global network; 1) increased use of explicit knowledge and 2) simplification of the product and development process. The first was mainly reached by gradually introducing more procedures, using more explicit knowledge by attempting to transform or create explicit knowledge from tacit knowledge, and streamlining as much interaction as possible. An interviewee explained this approach; "*We know we have to be more detailed both out there and in the incoming area. And that is the hard lesson. [...] You have to tell them in details [what to do].... And that is not normal here [in Denmark].*" The second approach was done either by simplifying the development process or production to fit a lower educational or technical level and in this way simplify communication and knowledge sharing. In development the use of less complex methods and tools were often employed, while in production older and fewer machines would be used as this also exploited the low cost of labour. The companies often experienced complications when attempting to increase the use of explicit knowledge mainly due to three reasons; 1) no written procedures existed, 2) most knowledge needed for the task was tacit and 3) high context cultures rely less on the explicit, coded message than low context cultures do. A manager from one of the case companies illustrated this; "*... the written communication can be difficult and misunderstandings can easily occur.*" Complications with simplifications were related to product quality as the use of more manpower increased the risk for human error in production and the development of a less complex product design could lower functionality of the product in an unexpected way which could impact the product's attractiveness to certain markets and customers. This meant it took additional resources to employ this solution, increasing both overall resource usage and cost. However, simplification could also have positive impacts as it could save time and resources by reaching the same goal in a simpler way [4].

To summarize, the findings showed a waste of resources in three places within global networks:

1.   Rework in production and development due to misunderstandings and quality issues.
2.   Repeated work in the headquarters and at the supplier or subsidiary as most work had to be checked for quality and compliance to standards.
3.   Focus on one-way knowledge and information sharing which limited full advantage of the knowledge and information which resides with the subsidiary, the supplier or which could be created in the interaction between

all the nodes in the network; for example between the headquarters, the supplier, and the subsidiary.

This waste of resources is clearly unsustainable according to the definition listed earlier. The case companies' solution to the complexity might address the first issue as more standards could ease some aspects of communication and thereby avoid misunderstandings and quality issues. Furthermore, the need for the headquarters to check most of the received material may also be lessened. However, the issue of one-way knowledge and communication were not resolved by this approach. This could be due to a combination of factors like a belief that there is no knowledge and important information at the foreign office, trust and identity issues or even that it could threaten current power and organisational structures. While increasing transparency can happen through codification and increasing structures there are also inherent risks involved; for example, knowledge transformation obstacles to creative interaction, the loss of customization to certain markets or clients, and a move towards more rigid structures of communication. All of this could mean resources are wasted in the global production and development process as long term advances of globally distributed knowledge and talent can be overlooked [5]. The solution initiated by the case companies also ignores the situation where knowledge cannot be transformed from tacit to explicit knowledge, or where it is very costly to do so. Furthermore, the consequences of implementing these solutions were not considered by the case companies at the time of implementation. This ad hoc approach to problem solving increases the chance of having to revisit the same situation over and over, thus increasing the likelihood of resource waste and unsustainable development.

4 Recommendations

Strategic simulation can be a methodological way to support and assist companies engaged in global networks. Strategic simulation consists in this context of the combination of narrative and numerical simulation. The combination of narrative ad numerical simulation has been used for environmental analysis and to validate requirements from stakeholders [6].

4.1 Narrative Simulation

Narrative simulation is more specifically defined as Interactive Scenario Analysis, which is concerned with the development of pictures of what might be as well as how to get there by the means of dialogue between scenario builders and relevant stakeholders. Scenarios can help decision makers, planners and stakeholders to get an overview and deeper insight of the possible outcomes of particular decisions. The special feature of scenario analysis is the long term perspective as well as the combination of vision making, story-telling, and strategy formation [7].

4.2   Numerical Simulation

Numerical simulation is defined as "*an analytical technique in which a mathematical or logical model of a real system is built in order to draw conclusions about the behaviour of the real system by studying the behaviour of the model whose cause-and-effect relationships are the same as (or very similar to) those of the system under study. The experiments are performed in a compressed time.*"[8]. This refers to simulations, not as replicas that give exact results but instead show trends and indicate consequences of a scenario rather than showing the best solution [8].

4.3   Combination of Numerical and Narrative Simulation

The combination of the numerical and narrative simulation can be used as a tool to support strategic decisions regarding different scenarios. The idea of combining the two methods as an approach to strategy development is to enhance creativity, clarification, and communication [9; 10] in order to improve transparency. The combined simulation approach (CSA) is also a tool to aid experimental thinking when working with uncertainties rather than reflecting the current reality. *Creativity* can be improved as the numerical model offers feedback to the narrative model, which then again can be further developed and expand the numerical model and in this way creating an iterative process. It can be seen how responsive an outcome is to changes in some parameter or condition. Exploring the boundaries of the model can provide valuable insight to both the narrative and the numerical model. This means that many different situations can be researched and adapted as things evolve. *Clarification* can be enhanced for both sides as the idea of CSA is to start with a scenario and then translate this narrative into a computer model, which forces a precision and clarification. However, CSA does not stop there as the important point is the interaction between e.g. mangers in the headquarters and the subsidiaries, which again should help clarify uncertainties and ambiguities in the narrative and the scenario. CSA promotes an ongoing iterative process between the two methods constantly clarifying uncertain points and unforeseen factors. *Communication* is increased as the narrative and numerical models are an opportunity for others to share their insights and critique of the models as they are developed, and furthermore by making the models explicit it can be subjected to outside review.

The core of the strategic simulation is to make it possible for decision makers to test different outputs of possible solutions in order to prepare for future consequences, and to give the possibility of testing different inputs to a system. This approach could therefore reduce the likelihood of having to revisit the same situation, and thereby reduce resource waste. In this manner more sustainable decisions can be reached [11]. In the following the three issues will be viewed in relation to strategic simulation.

Rework in production and development due to misunderstandings and quality issues

The models can help make tacit knowledge more explicit since they give a visual image of the system, and since they will need specific information in order to function. This means that clarification can be enhanced for both sides as the idea of the combination is to start with a scenario and then transform the parts of the narrative

that can be transformed into a computer model, which forces a precision and clarification of terms and mechanisms. The CSA promotes an ongoing iterative process between the headquarters and the subsidiaries constantly clarifying uncertain points and enhancing adaptability to unforeseen factors. This means that the rework in the production and development can be reduced making the process more sustainable in the sense of using fewer resources for a more qualified result and having a more workable relationship between headquarters and subsidiaries.

Repeated work in the headquarters and at the supplier or subsidiary

Using CSA to examine different possibilities of how to perform procedures for quality and standards at the supplier or subsidiary sites could reduce the repeated work. CSA can in this way show the different advantages and disadvantages of different scenarios of how to perform quality and standard check. CSA can also help investigate different optimal and sustainable solutions depending on which parameters are valued in the outsourcing/offshoring process. These parameters can for example be costs, quality, delivery time, and delivery quality.

Focus on one-way knowledge and information sharing

In order to utilise the resources it is important that knowledge and information from the subsidiaries is used as this information could possibly help reduce other issues identified. This lack of information sharing can be decreased as the narrative and numerical models are an opportunity for others to share their insights and critique of the models as they are developed. By making the models explicit and visual they can promote a more effective communication and knowledge sharing between the headquarters and the subsidiaries and suppliers. This way it can reduce misunderstandings in language and culture as the models are represented more visually and as they can create a common framework for language for the different actors in the outsourcing/offshoring problematic. This means a more sustainable process in that resources for security measures can be reduced if the system is so transparent that it is easy to see what is going on. Furthermore, as mentioned in the case, interviewees in the subsidiaries explained how they would discover ways to increase efficiency in the company's processes and procedures not only at the subsidiary, but which could also be employed in the headquarters, but no clear procedures existed for information and knowledge sharing from the subsidiaries to the headquarters. If CSA can result in a common framework for language, and thereby in a bilateral instead of unilateral communication it will be a more sustainable process as it overall could give a qualitatively better result.

5 Conclusion

Findings revealed 3 key challenges related to sustainable human resource use in global product development. These were related to increased rework in product development and production, overlapping work and a lack of utilization of knowledge and information at the supplier or subsidiary. The authors suggest the use of strategic

simulation in order to gain greater transparency in the global network and thus utilize resources better. CSA promotes an ongoing iterative process to constantly clarify points of uncertainty and enhance adaptability in order to promote a sustainable process. CSA is believed to promote sustainability by utilizing human resources in a sustainable fashion for all the parties involved in the global network.

6   Study limitations and notes for further study

The findings could be limited by the choice of cases and the culture and background of the interviewees (Danish managers and leaders).
Further research is needed in order to determine if the findings reflect a general trend. Furthermore, a longitudinal study to view how these 3 challenges are conformed in the companies would supply valuable information. Finally, it could be of great interest to follow the development within a global network which implements strategic simulation in the manner described here.

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