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Søndergaard, Erik Stefan; Oehmen, Josef; Ahmed-Kristensen, Saeema

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Extension of Internationalisation Models: Drivers and processes for the Globalisation of Product Development – A comparison of Danish and Chinese Engineering firms

Erik Søndergaard

Department of Management Engineering

Technical University of Denmark

Diplomvej, Building 372, room 229

2800 Kgs. Lyngby, Denmark

Phone: +45 45 25 60 75

E-mail: esso@dtu.dk

Josef Oehmen

Department of Management Engineering

Technical University of Denmark

Produktionstorvet, Building 424, room 126

2800 Kgs. Lyngby, Denmark

Phone: +45 45 25 60 39

E-mail: jooehm@dtu.dk

Saeema Ahmed-Kristensen

Dyson School of Design Engineering

Imperial College London

10-12 Prince's Gardens, South Kensington Campus

London SW7 2AZ

Phone: +44 (0)20 7594 8843

E-mail: s.ahmed-kristensen@imperial.ac.uk

Abstract

This paper develops an extension to established production- and supply chain management focused internationalisation models. It applies explorative case studies in Danish and Chinese engineering firms to discover how the globalisation process of product development differs from Danish and Chinese perspectives. The paper uses internationalisation and global product development theory to explain similarities and differences in the approaches. Grounded in case-study results, a new model for internationalisation is proposed. The new model expands the internationalisation process model to include steps of product development and collaborative distributed development beyond sourcing, sales and production elements. The paper then provides propositions for how to further develop the suggested model, and how western companies can learn from the Chinese approaches, and globalise their product development activities from the front end of the value chain rather than from the back-end.

Keywords: Global product development, internationalisation, outsourcing, offshoring, China

1. Introduction & research aim

Whereas outsourcing and offshoring of manufacturing is a fairly well established and researched field, with its practice gaining increasing importance among engineering companies over the last three decades, the outsourcing and offshoring of R&D has become increasingly important. During the last decades, research and development (R&D) internationalisation by establishing captive R&D offshore units has emerged as an important practice for large manufacturing companies (Parida et al. 2013).

Engineering manufacturing companies rely more and more on Global Product Development (GPD) in order to stay competitive and innovative in today's global

market (Tripathy & Eppinger 2011), and therefore globalisation is not only desirable, but essential (Santos et al. 2004). Consequently, many companies have set up engineering centres globally to gain proximity to markets, knowledge and resources (Zhang & Gregory 2011). Therefore, many organisations at some point will have to decide how they want to organise product development globally, and which development activities they want to carry where, resulting in outsourcing and offshoring decisions. The drive towards GPD has been influenced by price pressures, growing external markets, availability of competencies and talent in overseas locations and advances in communication that facilitate information flow across locations (Eppinger & Chitkara 2006).

The study of GPD lies at the junction of many fields, including business, engineering design and operations management (Bardhan 2006). In this paper, business and engineering design theories are combined and used for exploring and explaining the different strategies for internationalisation of product development in Danish and Chinese firms, building on an exploratory case study. A review of existing literature shows that some of the main reasons for firms to outsource R&D are cost reductions (Kumar & Snavely 2004), reduce time to market (Huang et al. 2009) focus on core activities, getting scalable and flexible resources and getting new knowledge and expertise in technology and organisational processes (Kumar & Snavely 2004; Zhao & Calantone 2003). In addition to these contributions, the drivers related to outsourcing and offshoring of product development from a Danish perspective were previously examined (Søndergaard & Ahmed-Kristensen 2014), with the main drivers being price pressure (cost reduction of development tasks) as well as growing external markets and access to resources. Previous work also identified the most common barriers to GPD from a Danish perspective, with the main ones including loss of product quality,

increased lead-times, lack of common vision, collaboration issues along with cultural differences and language barriers (Søndergaard & Ahmed-Kristensen 2014; Hansen & Ahmed-Kristensen 2012). However, the corresponding drivers for Chinese companies to internationalise their R&D are not studied to the same extent, and therefore this paper investigates the Chinese perspective by examining drivers and globalisation processes in Chinese firms, and comparing these with the ones observed in Danish companies. A comparison of Chinese and Danish companies is chosen to represent highly industrialised vs. emerging countries. Consequently, the research questions this paper addresses are:

- RQ1: What are the main drivers for PD outsourcing and offshoring decisions in Danish and Chinese engineering companies?
- RQ2: Can the existing process model of internationalisation be adequately describe internationalisation of product development from the Danish and Chinese perspective?
- RQ3: If not, how can the model be adjusted to accommodate both internationalisation and global product development processes, and how can such a model describe different strategies towards global product development?

Pursuing answers to these questions, the paper presents a short summary of internationalisation and GPD models and theory, and applies these theories to a study of Danish and Chinese engineering firms. The paper is structured as follows: First, a background of relevant literature and theories is outlined. Subsequently, the research methodology is summarised, followed by a section presenting the main results of the study. A discussion section provides discussion of the observed results, and introduces

propositions for new theory and models, and the paper rounds off with a concluding section, containing implications and future research.

2. Theoretical background – Models for Internationalisation and GPD

2.1 Definitions

Internationalisation is a term widely used for describing the outward movement of firm's international operations, or increasing involvement in international operations. In a more broad term, internationalisation is described as 'the process of adapting firms operations (strategy, structure and resources) to international environments' (Calof & Beamish 1995). Global Product Development (GPD) is when a company has their product development activities globally distributed (Hansen & Ahmed-Kristensen 2011). This practice may involve outsourced engineering work along with captive offshore engineering facilities.

Similarities and overlaps in the definitions of these terms indicate that they are different sides of the same coin, and the terms simply indicate the perspective taken. Internationalisation and globalisation are general terms, often used in business and management literature, whereas GPD refers to a more practical, engineering view and describes how to implement internationalisation and globalisation in engineering operations. For clarity, this section presents a brief background on internationalisation, globalisation and GPD, setting the context for the following case study and data analysis.

2.2 The internationalisation model (Uppsala model)

One of the earlier theories for describing and understanding the internationalisation

process of the firms, which has received wide recognition and is often used in different contexts, is the Uppsala model of internationalisation – a process model describing the steps a firm goes through in internationalisation of the business – first proposed by (Johanson & Vahlne 1977). Internationalisation of the firm is here defined as a result of a series of incremental decisions (Johanson & Vahlne 1977) leading to a gradual internationalisation. Internationalisation is a process of experiential knowledge accumulation, and the speed of internationalisation is dependent on the acquisition of knowledge in and about the foreign market(s). There are two aspects in the internationalisation process: State and change (see Figure 1). Typically, companies make commitments in the foreign markets (i.e. by starting regular export activities or opening a sales subsidiary) based on market knowledge, and these commitments lead to change on the current activities, and consequently new market commitments. The alterations between the two states increase the market knowledge and commitment, and every cycle of state and change thus leads to a higher degree of internationalisation.

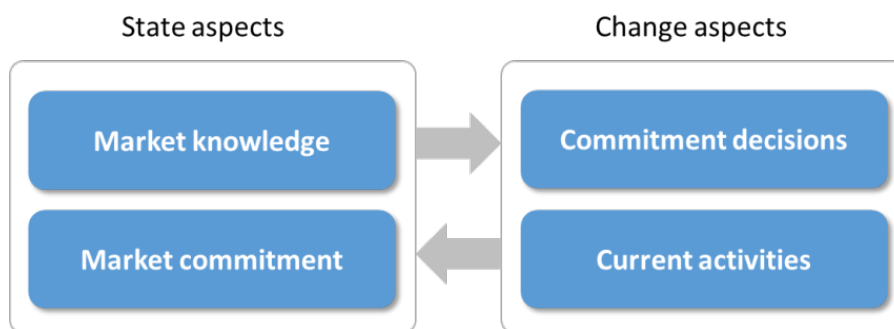


Figure 1: State and change aspects of internationalisation (from: Johanson & Vahlne 1977)

In the process model, internationalisation is taking places in four main stages. The starting point is regular exports to the foreign market, and over time this expands to include sales subsidiaries and finally establishing production in the foreign markets or locations (see Figure 2).

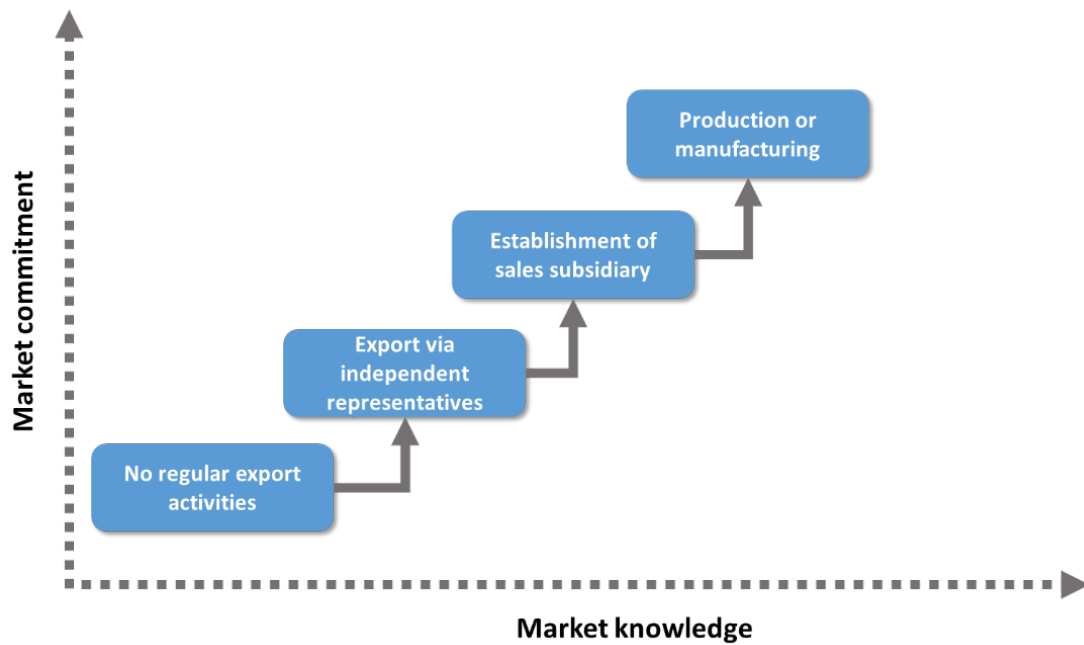


Figure 2: Four main steps of internationalisation (adapted from (Johanson & Vahlne 1977))

Internationalisation as a process which gradually leads to manufacturing in the host country has since then been used as a frame, and internationalisation of manufacturing has since become a popular research topic (Cheng and Johansen 2014). The Uppsala model of internationalisation has more recently been used to frame offshoring of R&D (which is one aspect of GPD, see discussion below) (Demirbag and Glaister 2010). They concluded that as firms learn and increase their knowledge on how to manage an offshore R&D project, the impact of country and political risk diminishes which is in line with the Uppsala internationalisation model. The original authors Johanson & Vahlne (2011) have moreover recently adapted the Uppsala model to explain the globalisation process, and tested a globalisation process variant of the Uppsala model on the globalization of Volvo's heavy truck business. The main conclusion from their study is that globalisation can be explained as similar to the internationalisation process). Another extension to the Uppsala model has been proposed by (Santangelo and Meyer 2011).

The model is still widely used and accepted as a theoretical framework to analyse and explain internationalisation of businesses, and is in this study used as a framework for comparing the internationalisation process of R&D in the studied cases. Despite being more business oriented, the Uppsala model of internationalisation is in this context adapted as a general frame for describing the cases studied and comparing the paths for internationalisation of Danish and Chinese companies.

2.3 Engineering design perspective on internationalisation and globalisation

From an engineering design and management perspective, globalisation of product development has also received considerable attention, especially in the perspective of outsourcing and offshoring of R&D and product development tasks (i.e. (Parida et al. 2013; Zedtwitz et al. 2004; Dekkers 2000; Shishank and Dekkers 2013; Tripathy & Eppinger 2011; Cheng et al. 2015)). For the scope of this paper, the focal points are the different modes of GPD as well as GPD related to the engineering value chain and decision-making. Therefore, the following present a brief summary of the related theories and frameworks.

2.4 Modes of GPD and internationalisation paths

Eppinger & Chitkara (2006) defined four fundamental modes of GPD, based on the ownership of resources and the location of resources. Depending on whether resources are insourced or outsourced, and whether the resources are located onshore or offshore, the four modes of GPD are: 1) centralised (local) where resources are placed onshore (in the home location) and are owned by the company. 2) Local outsourcing, where resources are not owned, but sourced locally in the home location. 3) Captive offshore, where the resources are owned by the company, but in a foreign subsidiary, and finally 4) Global outsourcing, where resources are not owned by the company, and sourced

from a foreign location. Companies can switch between different modes, evolve over time, or have combinations of the different modes for different tasks (see Figure 3). In this case, the four modes of GPD are used as a framework for identifying and explaining different approaches for GPD in the Danish and Chinese globalisation.

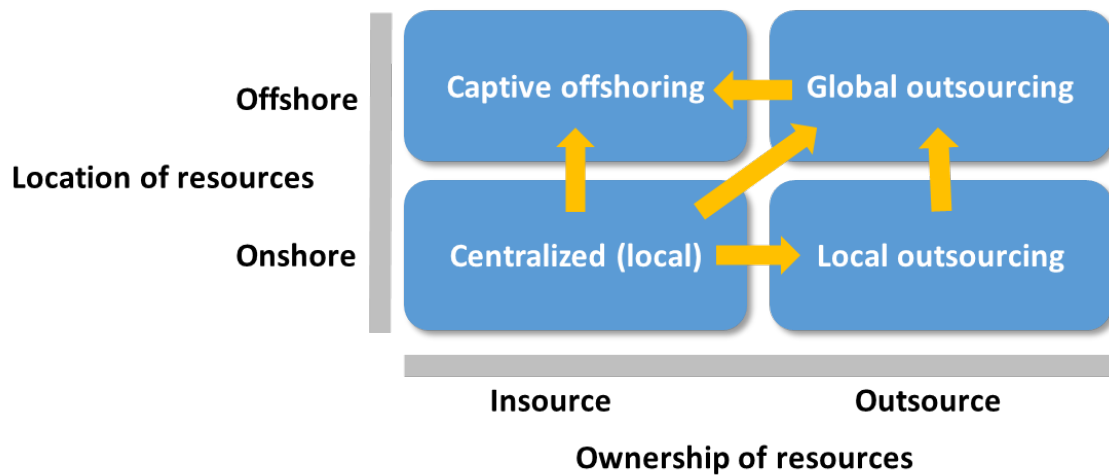


Figure 3: Four basic modes of GPD. From: (Eppinger & Chitkara 2006)

GPD activities can be performed either in captive offshored development sites, outsourced, or a hybrid form combining the modes can be adapted (Tripathy & Eppinger 2011). A key point is that strategic tasks and core competencies are traditionally held close to the headquarters of the organisation. These activities can however still be globalised, but this will most likely be done through offshoring rather than outsourcing, allowing the company to maintain close control over these activities. In the analysis of the case study, the modes of globalisation are used to analyse the different companies.

In a study of internationalisation and externalisation in Danish SME's (Waehrens et al. 2015), the authors found that marketing, sales and manufacturing are usually the first value chain activities being internationalised. However they also

concluded that the internationalisation of production activities can be a starting point for the internationalisation of other parts of the engineering value chain.

2.5 GPD and product development processes / engineering value chain

GPD strategies are typically deployed in stages, which allows for a gradual gaining of experience, by starting GPD with globalisation of simple tasks, and then gradually moving more and more development responsibilities to the foreign locations (Eppinger & Chitkara 2006). When looking at a traditional product development process (Figure 4), 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 of less strategic importance to the company (Hansen & Ahmed-Kristensen 2012).



Figure 4: Generic product development process, based on (Ulrich & Eppinger, 2004)

Once the companies have gained experience with this, earlier stages of the product development process gradually follow. 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 2011). Once experience has been gained with these stages, they gradually outsource or offshore earlier activities and stages in the product development process. 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). A more recent study

by Cheng & Johansen (2014) which explores the internationalisation and externalisations of value chain activities in Danish companies, found that the internationalisation and externalisation of manufacturing activities can also lead to internationalisation of other value chain activities, (including i.e. collaborative engineering and R&D), thus expanding the trajectories of internationalisation and externalisation.

When taking the first steps toward a global product development organisation, many companies have no previous experience or extensive assessment upon which to build their decisions. Hence decisions regarding location and layout of new global development capabilities are often made in relation to the company’s existing footprint (i.e. production facilities) (Christodoulou et al. 2007).

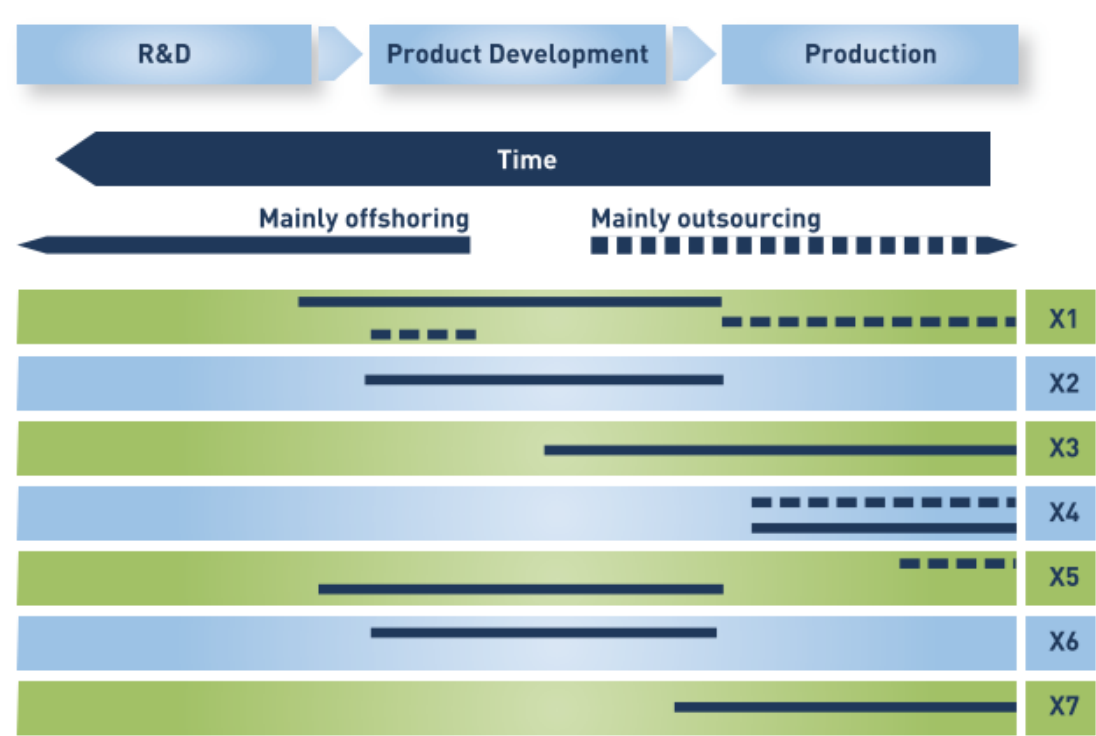


Figure 5: Patterns in the globalisation process in seven cases. Source: (Hansen & Ahmed-Kristensen 2011)

2.6 Summary

This section outlined the concepts of internationalisation as a process, and introduced

the different modes of GPD and the product development process related to outsourcing and offshoring of product development. The internationalisation model and modes of GPD are used in section 6.1 for discussion and further elaboration of internationalisation of product development. Based on the case observations, it is later on discussed how the model can be extended to represent GPD and include further steps than the original internationalisation steps.

3. Research methodology

3.1 Case study

The present research involved five engineering manufacturing firms with global development activities: three Danish and two Chinese. All companies have outsourced or offshored product development activities over the last 10 years. In the pursuit of answers to the research questions stated in the introduction, the study applies an inductive research approach, based on a revelatory single case study with multiple embedded units of analysis (Yin 2009), collecting empirical data related to the internationalisation and globalisation of product development through interviews. The case-study approach is used due to its ability to richly describe the existence of a phenomenon, and suitability for studies of several simultaneous events in a real life context which the researcher has no control over (Yin 2009). Here the case-study is used for building descriptive theory (Christensen 2006), following the first steps: observations (through interviews), and then classification of the observations (codes and categories), in this case the categorisation of the internationalisation process based on the interview data, and suggesting a new model based on these.

3.2 Interviews

Data collection took place through semi-structured interviews with interviewees from different levels in the organisations, spanning from executive managers to project managers and development engineers. Interviews are a highly efficient way to gather rich, empirical data, especially when the studied subject is episodic (Eisenhardt & Graebner 2007). The strength of using the interview as a research method is the possibility to get an in-depth and detailed understanding of the theme being studied. The limitations of using interviews as a research method are that the quality of data being collected is very dependent upon the individual interview, and the information gathered might be biased both by the interviewer and interpreter. The qualitative interview research is appropriate where exploratory work is required before a quantitative study can be carried out (King 1994). Here interviews are deemed appropriate for the type of exploratory study and sense making process that is conducted. The findings from the interviews serve as a first step to explore and understand the internationalisation from different angles in the case-companies. However, such a first step should be followed by more extensive studies, to further support or adjust the conclusions drawn from the exploratory interview study. This issue is further addressed in the concluding section of the paper.

The interviews were based on an interview guideline, this was developed to allow for questions related to different themes within outsourcing and offshoring decisions, depending on the interviewees' knowledge and involvement in the decisions. The interview guide for the Danish cases focused mainly on the decisions, while the interviews in the Chinese companies were of a more general level, asking questions about how and when they had internationalised, which motivations they had to do so, and who had made the decisions. Interviews in the other companies (B, C, D and E) were more general interviews, focusing on general process towards global product

development, motivations and decisions made. The interviewees in company A were development directors, development project managers and development engineers in both Denmark and China. In company B, interviewees were development project managers in Denmark, and project managers and development engineers in China. In company C, the interviewee is a VP of product innovation in Denmark. In the Chinese companies the interviewees were the VP of company D and the Deputy Manager of R&D in company E. More information about the case interviews is shown in Table 2.

3.3 Data coding

All transcribed interview data was coded in ATLAS.ti according to a pre-defined coding-scheme. The coding scheme was developed in two stages; first through a top down approach, where codes and categories were derived from literature, and secondly through a bottom-up approach, where additional codes and categories emerging from the dataset were added. Interviews were coded for single occurrences of i.e. motivational factors for GPD and types of GPD decisions made. Examples of data codes from the interview coding are shown in Table 1.

Table 1: Categories and codes for interview coding

Category	Definition	Codes (examples)
Type of GPD	Whether the project included outsourcing, offshoring or both	Outsourcing Offshoring Outsourcing & offshoring
Motivation	What the main motivation was for the specific decision	Cost reductions Closer to production Scalable resources Access to new markets
Input	Which inputs lead to making the specific decision	Market information Business case Requirements Customer feedback
Decision classification	What type of internationalisation decision the company had made	Offshoring decision Outsourcing decision Location decision Product design decision Process design decision Market/commercial decision

3.4 Decision mapping

Following categorisation and coding of all interviews, single GPD decisions were identified and each decision was mapped. For each decision the motivation, as well as the background for making the decisions, methods used for making decisions and the implementation and results from these decisions were captured. This provides a base for analysis of the drivers for internationalisation decisions in the companies. An overview of the companies included in the case study is shown in Table 2.

Table 2: Information on case study companies

Company	# of inter-views	Location	Industry	# of employees	Key decisions	Key motivations
A	11	Denmark	Medical devices & healthcare products	2.300	Development centres in China and Malaysia	Risk reduction in NPD Overall R&D cost reductions
B	4	Denmark	Industrial pumps and applications	18.000	Re-organise global organisation for scalability	Develop competencies in global sites Scalability for global projects
C	1	Denmark	Analytical equipment (food industry)	1.300	Open development centre in China	Overall R&D cost reductions
D	1	China	Disposable personal care product	240	Strategic alliance with Swedish company Research outsourced to Japan	Gain new technological know-how
E	1	China	Electronic security and RFID technology	1.600	Acquisition and expansion in Europe + development site in Europe	Entry into the western markets Gain competencies and experience

4. Results

4.1 Internationalisation history

The companies in this study all internationalised their product development gradually.

However, internationalisation has happened much faster in the Chinese companies, which are also much younger. A brief overview of the key points in the internationalisation path is provided in Table 3.

Table 3: Internationalisation history of case companies

Company	Year	Key milestones in internationalisation path
A	1937	Company A is founded
	1950-1970	Increasingly exporting products globally
	2001	Acquisition of a large European component manufacturer
	2001-2005	Production established in Asia, production is gradually moved from Denmark to Asia
	2011	All production is relocated to Asia
	2012	First new product developed in global teams is launched
	2012-2014	Establishment of R&D centres in China & Malaysia
	2013	Acquisition and merger with US based company, new development projects across sites
B	1944	Company B is founded as a small family business
	1949	Exports begin to Scandinavia
	1960	First subsidiary founded in Germany with both sales and production
	1973	First overseas subsidiary in the USA
	1995-1996	Production and development centres established in China and Hungary
	2012	New global delivery organisation, with development in Denmark, Hungary, China & USA
C	1956	Company C is founded
	1960's + 70's	Increasing export of products
	1997	Acquisition of Swedish company and establishing production in Sweden
	2009	Production is established in China
	2011	Production is increasingly moved from Sweden to China
	2014	Production and innovation in Denmark & China, Swedish site is closed.
D	1999	Company D is founded as a small family business
	2002	Starts exporting their products to regional markets
	2005	Becomes OEM in Taiwan
	2009	Market expansion into developing countries (Africa, Middle East and India)
	2009	Joint venture with a Swedish company, offshoring of materials science R&D to Japan
	2019-2010	Offshoring of R&D to Japan
E	2009	Company E is founded
	2011	The company goes public on Shenzhen stock exchange
	2011	Acquisition of Italian company
	2012	Acquisition of Swedish company
	2014	All product design activities are offshored to Sweden
	2014	Joint venture with US based company, offshoring of NPD and market research to the US

4.2 Internationalisation decisions

From all interview data, each unique GPD decision was identified and mapped, and

different parameters for each decision were listed, including decision drivers, decision type (outsourcing, offshoring or both), the specific decision, implementation and outcome. A summary of the findings from the analysis is shown in Table 4.

Table 4: Comparison of Danish and Chinese companies

	Danish (Company A,B,C)	Chinese (Company D, E)
Main drivers for GPD	Cost reductions Development closer to production Access to new resources Scalability of resources	Access to new markets Access to new technologies Gain new competencies & knowledge Strategic partnerships
Tasks internationalised	Non-core competencies are outsourced/offshored Core competencies are kept in HQ	Core competencies (R&D) are sourced in from abroad Design and user research outsourced to strategic partners in Europe and Japan
Primary mode GPD	Captive offshoring (mainly by establishing development centres in China)	Global outsourcing (mainly through joint ventures and acquisitions of key suppliers)
Path dependency	High (experience and previous activities determine the decisions, i.e. location decisions)	Low (more strategic exploitation, not dependent on previous commitments)
Globalisation of development process	Start with back-end and gradually move towards front end	Start with front-end and have back end at home location

4.3 Main drivers for GPD

To answer the first research question, motivation for globalisation of product development are summarised for the Danish and the Chinese cases. The results indicate that whereas Danish companies are driven by proximity to production, cost reductions, scalability of resources and improving product quality, the Chinese companies are more driven by market opportunities (expanding into global and industrialised markets) and by gaining new competencies and improve their product quality by taking advantage of technological know-how in global locations (Table 5).

Table 5: Key drivers for GPD observed

	Denmark	China
Scalable resources	X	
Development closer to production	X	

Gain new competencies	X	X
Improve product quality	X	X
Cost reductions	X	
Develop new product	X	
Overall market strategy	X	X
Reduce time to market	X	
Reduce risks	X	
Access to new resources	X	
More control over activities	X	X
Obtain new technologies		X

Across the Danish companies (A, B and C), having development activities closer to their production activities was found to be a strong driver. Across the Chinese companies (D and E), the main drivers were said to get access to new technologies, R&D competences, and knowhow, and both firms had an overall market strategy of entering the western markets (Europe and US). In contrast to the Danish companies, there was no evidence of cost reductions or development closer to production being main drivers, which is plausible since production is already taking place in China at a low-cost level. Despite our limited case studies, these observations are in line with previous studies of Chinese R&D internationalisations, where (Di Minin et al. 2012) in their investigation of motivations for foreign R&D in five Chinese multinationals found that the motives of Chinese R&D internationalisation commonly evolve from pure technology-seeking to (a) home- base augmenting and then (b) home-base exploitation.

4.4 Global product development processes

Observations from the Danish companies: All three companies already have established production sites in the foreign location(s) and they gradually built up development sites at the existing production locations. Over time, these development centres were involved in more front-end activities. In general, the observations show a tendency of globalising product development from the back end, which supports the findings

presented earlier (Hansen & Ahmed-Kristensen 2011). In the observed Chinese companies, a different trend was observed, where both companies globalised product development starting with the front end of the development process. They outsourced and offshored R&D activities and later on product design to overseas subsidiaries or partners with more expertise and experience. This is in contradiction to the pattern seen from the Danish companies (illustrated in Figure 6).

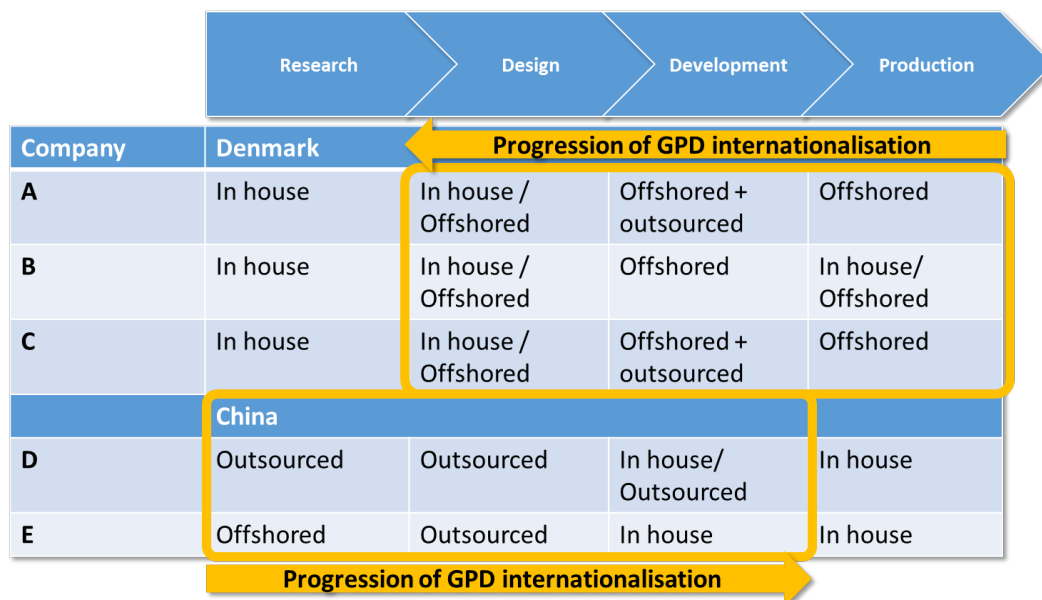


Figure 6: Internationalisation patterns related to product development process

4.5 Modes of GPD in China and Denmark

To explain the different ways the Danish and Chinese cases have globalised product development, the cases are placed in the matrix based on their primary strategies and identified GPD decisions (Figure 7).

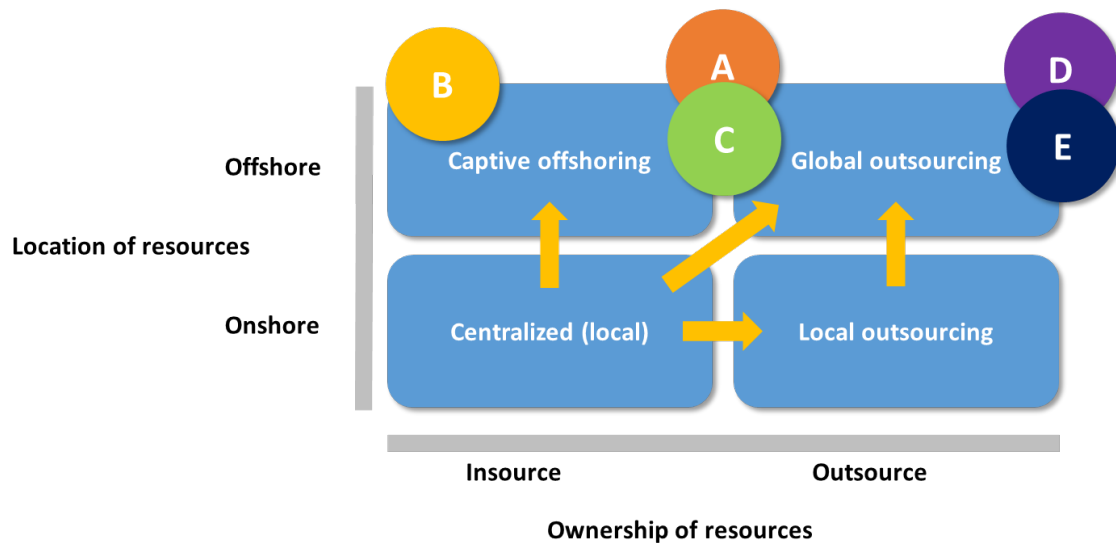


Figure 7: Comparison of the globalisation modes of the case companies

Danish companies mostly do captive offshoring in global development centres. In case A and Case C, some non-core development (i.e. of software or electric components, which were not their core competencies) were outsourced to suppliers, placing them between the two upper quadrants, as they were both outsourcing and offshoring development tasks. Case B on the other hand, has a strategy of keeping all development activities within the control of the company, and consequently they are only offshored. In general, the Danish cases tend to keep a degree of dependency and closer interaction and control with their home base. Chinese companies on the other hand are found to be much less reluctant to move their core activities outside the company through joint venture and acquisitions. In case D, material R&D was fully outsourced to a Japanese partner, and in case E, design was fully outsourced to a Swedish partner (which later was acquired). The Danish companies use offshoring in order to keep control over activities, whereas the Chinese companies do not show the same concerns, and therefore outsource and make strategic alliances in order to extract/gain knowledge). This observation aligns with Di Minin et al. (2012) where foreign R&D departments of five Chinese multinational companies were studied and it

was found Chinese R&D investments in Europe were driven by technology exploitation.

4.6 Results summary

Finding 1: Drivers for GPD are different. Danish companies are focusing on cost reductions, proximity to production and scalability of resources, while Chinese companies are driven by access to new technologies and knowledge, and market entry options in Western markets. **Finding 2:** The Danish firms gradually globalise the development process from the back end to the front end, while Chinese companies globalise from the front end, gradually moving towards the back end. **Finding 3:** Danish companies primarily globalised product development through captive offshoring, while Chinese companies globalised through global outsourcing.

5. Discussion of results

From the findings described earlier it is evident that the drivers for GPD are different in Danish and Chinese companies. Whereas cost reductions are still a main driver for GPD in the Danish companies, the Chinese companies are to a higher degree driven by gaining new competencies and technological expertise from overseas companies in industrialised countries, and getting access to market in these countries. The cases also showed that the tasks being outsourced and offshored are dissimilar. While Danish companies primarily started with outsourcing or offshoring non-core-competencies (i.e. production), the Chinese companies pursued a different strategy, where they sourced key R&D activities from developed countries, and outside the company boundaries.

The mode of GPD consequently also differs across Danish and Chinese cases. Whereas Danish companies had primarily offshored development tasks by establishing new development centres globally (in all three cases in connection with existing

production facilities), the Chinese companies had internationalised primarily through acquisitions or joint ventures with key Western suppliers of technology and expertise.

Looking at the cases from a process perspective, and exploring, which parts of the process they had globalised, reveals that the evolution is almost opposite. The dissimilarities indicate a difference in perceived core competencies. Core competencies in Denmark are primarily considered being the front-end phases of the product development process (R&D, market understanding, concept development etc.), whereas the core competencies in Chinese firms are more related to process and production knowledge, and consequently the later stages of the development process are kept in-house. The findings also indicated that Chinese companies are both resource and knowledge seeking when outsourcing product development, and that they obtain global advantages through acquisitions, joint ventures and outsourcing/offshoring of front end of the value stream. Danish (Western) companies typically start from the back end of the value chain and move towards more high value adding activities as time passes and experience and knowledge increases.

6. Contribution to theory development

Based on the findings from the case study and the different internationalisation processes observed in Danish and Chinese companies, some research propositions are provided, and a new model for the internationalisation of product development is outlined.

6.1 Propositions

- A new process model for the internationalisation of product development, which includes the outsourcing and offshoring of product development.

- Western companies can learn from the Chinese approach, and exploit technology and knowledge globally without the steps of establishing production etc.
- With internationalisation model from international business literature, the model is adapted and expanded to include internationalisation of GPD. The model serves as a theoretical basis to identify and understand different GPD approaches.

6.2 A new internationalisation model for product development

As described earlier, the internationalisation model is to explain the internationalisation process of the firm. However, the model falls short in explaining the phenomenon of internationalisation of development tasks. Looking at the four stages initially present in the model, it can explain only how companies internationalise, and over time establish overseas production (steps 1-4). However, adding the observations of internationalisation seen in the studied company's, additional steps (step 5-6) are added to explain the further internationalisation of product development activities. The extended model is derived from the existing internationalisation model, and includes the steps of globalising R&D. The suggested new framework, the "Internationalisation Process for Product Development model (IPPD model) is presented in Figure 8.

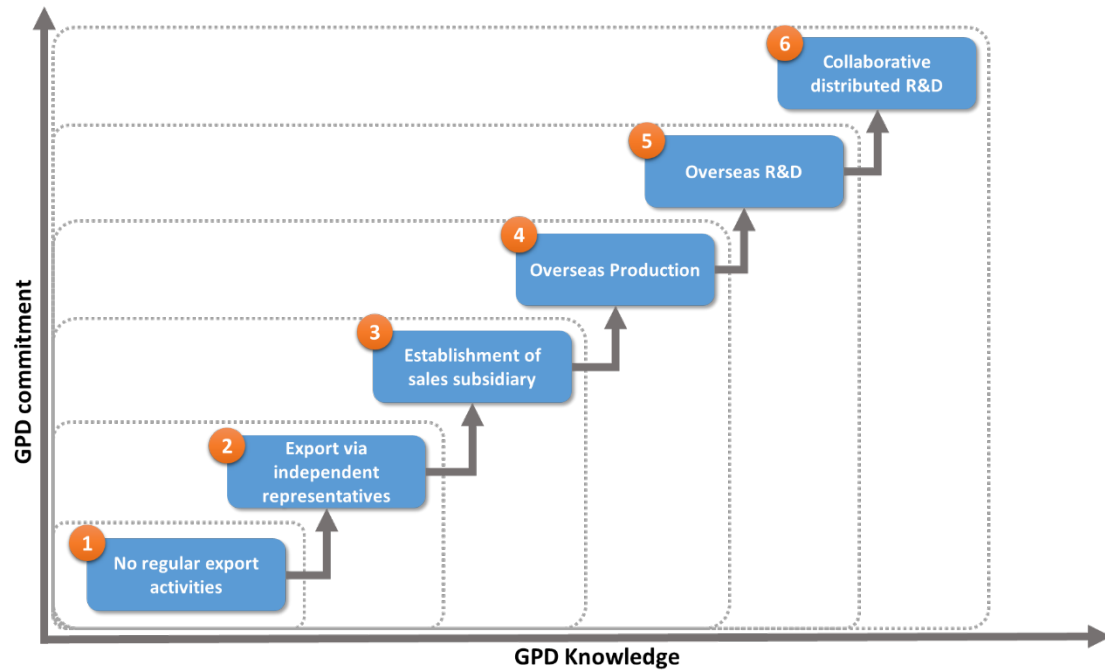


Figure 8: The IPPD model: A model for the process towards global product development

Having extended the model, it can be used to illustrate the internationalisation of the Danish and Chinese companies in the case study. The Danish companies (A,B and C) have proceeded along this process, and globalised R&D / product development, and company A and B are currently moving towards step 6, where they integrate R&D collaboratively across development sites (Figure 8). Company A has established development centres in China, Malaysia, Denmark, UK and US, and development of new products is taking place in collaboration across these sites. Company B has likewise built up development centres in several global locations, and is using their global development sites, each specialised in different areas, when developing new products. Company C has so far established a development site in China, and is running smaller development projects and basic research at this site. The process observed in the Danish companies is illustrated using the IPPD in Figure 9.

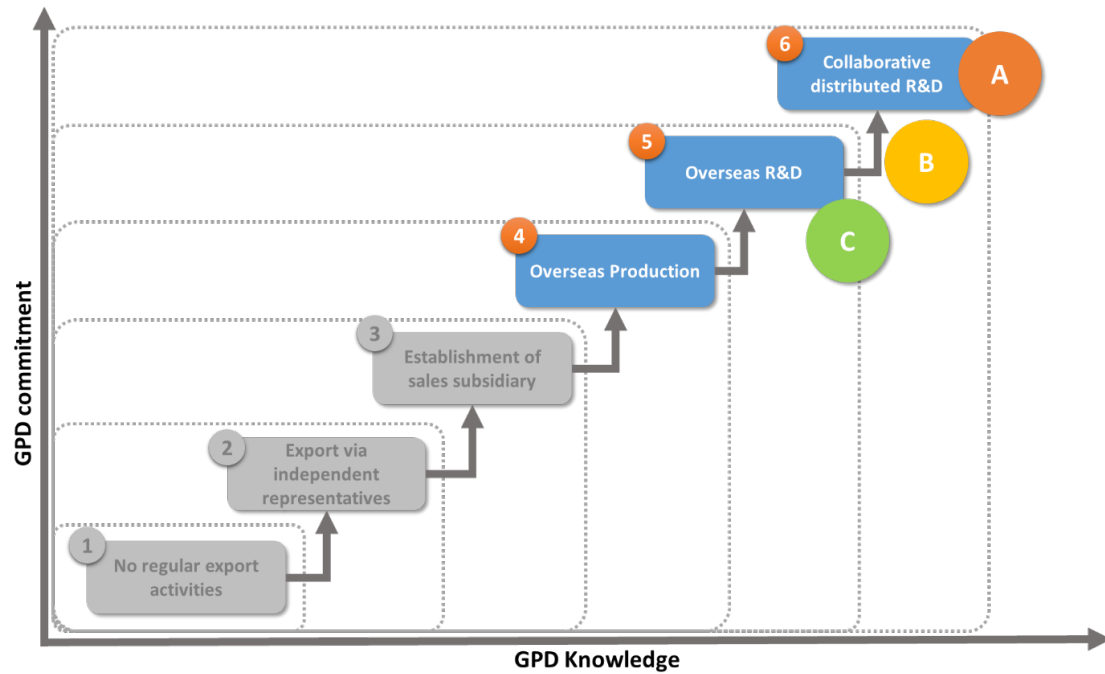


Figure 9: Process towards global development in the Danish examples, using the IPPD Model

In the same way, the IPPD can be used to illustrate the Chinese process towards global product development. The interesting observation to be made here is that Chinese companies are skipping one or several steps (in this case steps three and four). Both company D and E did not establish sales subsidiaries as such and hence partly skipped step 3. They primarily sold their products through online platforms such as Alibaba.com and direct B2B sales). Furthermore they had no incentive for establishing production facilities abroad since there is no incentive for this; the production in China is cost effective. Hence, they skip step four. They are however exploiting the opportunities of getting market knowledge and technological expertise by using overseas partners or subsidiaries for global R&D, and therefore move directly to step five or six in the model. The Chinese companies' process is illustrated in Figure 10.

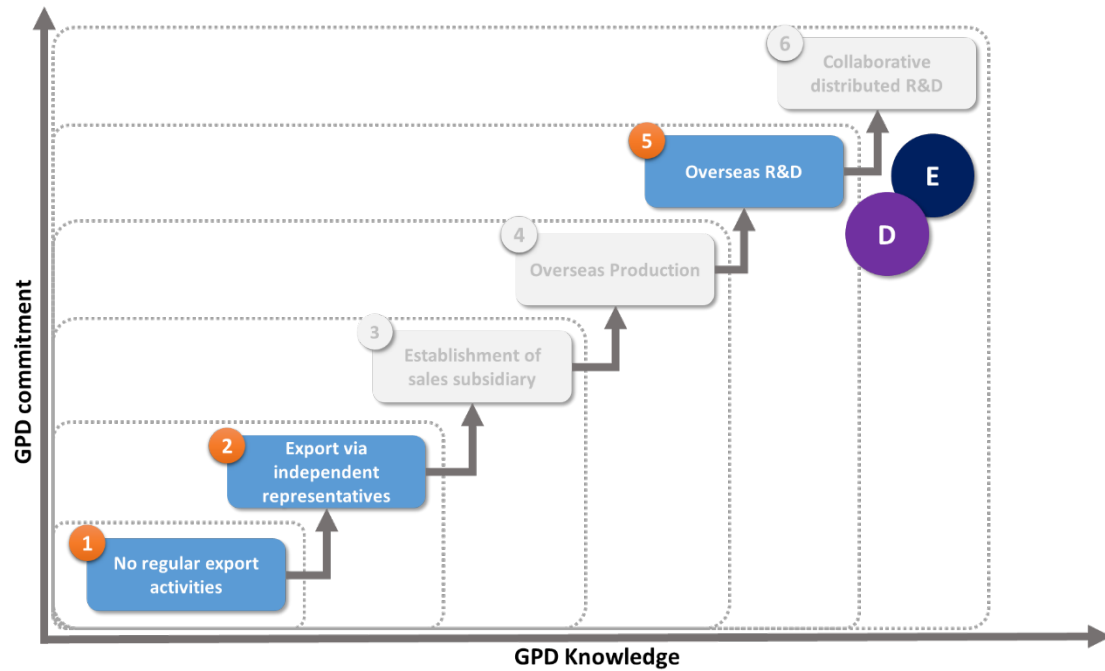


Figure 10: Process towards global development in the Chinese examples, using the IPPD Model

7. Conclusions

7.1 Summary

This paper investigates the drives for internationalisation of product development and innovation across Danish and Chinese engineering companies, and their process towards GPD. The comparison shows that the main drivers are different: While cost reductions, proximity to production and global resources were the main drivers for Danish companies, the Chinese companies are more focused on market and technology access. With a starting point in the internationalisation model, an extension of the model is proposed, including internationalisation steps for R&D activities. By applying the model to the cases, it was demonstrated how some phases can be ‘leap-frogged’ depending on the drivers and strategy for GPD. In this example Chinese firms leap-frogged the process, driven by i.e. technology or knowledge exploitation.

7.2 Limitations and further research

The research presented here has its clear limitations, opening a window for further research needed in order to strengthen and test the validity of the proposed IPPD model. The findings and propositions presented are based on an exploratory study, with observations from just a handful of companies in Denmark and China. An obvious next step would be to extend the studies across more companies. Such studies should include a larger number and broader range of firms, and could include firms in the EU and US, and a larger number of Chinese global companies, in order to confirm whether the patterns observed here are generalizable to a larger sample of cases. The companies represented by this study are from different industry sectors (health care, industrial pumps, sanitary products and electronics). A future step of theory testing of the IPPD model through more quantitative studies may be considered, controlling for factors such as industry type, company size and company age (i.e. established vs new companies).

7.3 Contribution

By combining theories from business and engineering literature in a new way, the frameworks of internationalisation theory, modes of R&D globalisation together with product development process models are used to describe and understand the differences between GPD strategies. The analysis shows commonalities in terms of the internationalisation processes across cases, but also some clear differences in the strategic approach to global innovation, and that the Chinese companies skip over some steps in the internationalisation process normally seen in Danish companies. Thus, the study contributes to a better understanding of how companies can take advantage of different global innovation approaches. For western firms, strategic alliance with Chinese firms (knowledge seeking) could lead to strategic alliances and access to new

markets and production knowledge. For Chinese firms, market knowledge and experience can be gained from working with established international engineering companies, both domestically and abroad.

7.4 Implications

The presented work provides scholars, managers and practitioners with a new framework for identifying and understanding different routes to globalisation of product development from different perspectives. Practitioners in the industrialised countries can learn from the Chinese approach, and follow different internationalisation strategies and i.e. set up collaboration with Chinese companies in their home markets. The new model of GPD also indicates how managers can adapt a knowledge and technology exploitation strategy to enter the Chinese market, sidestepping the long process and path dependency of establishing production facilities in China.

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