Relocation of Nordic Manufacturing

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Tampereen teknillinen yliopisto - Tampere University of Technology

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This research report draws on the insights developed on the research project "Reshoring of Manufacturing (ROaMING): Disruptive Technologies, Business Ecosystems and Performance Information as Key Enablers". The project was conducted during the period 2015-2017. The research pursued increased understanding of the extent and nature of relocation trends in manufacturing in Finland, Sweden, and Denmark. The project scrutinized the status and potential of reshoring of manufacturing as a source of renewal of the manufacturing sector, its prerequisites and consequences. The goal was to establish a state-of-the-art knowledge base of relocation trends in Nordic manufacturing, and to disseminate these practical and theoretical insights to manufacturing industries, policy-makers and the research community.

The ROaMING research project was conducted in collaboration between Tampere University of Technology (TUT), Department of Industrial Management in Finland, and Lund University, Department of Industrial Management and Logistics in Sweden. The project was part of the Innovation research program "Renewal of Manufacturing" jointly financed by Tekes - the Finnish Funding Agency for Innovation and the Swedish innovation agency VINNOVA. We gratefully acknowledge the financial support received for this research, as well as the fruitful discussions with the researchers of the parallel projects and the reference group members in this innovation research program.

The principal researchers on the ROaMING project were Professor Jussi Heikkilä, Professor Miia Martinsuo, Assistant Professor Teemu Laine, and Professor Petri Suomala from TUT, and Professor Jan Olhager from Lund University. The survey data collection was done jointly by researchers in Finland, Sweden, and Denmark. An important contributor to this research effort has been the close collaboration with Professor Jan Stentoft at the University of Southern Denmark, Kolding. We thank Jan for his invaluable contribution. In addition, the following people have had a main role in the research for the project, we owe our thanks to all of them: Petri Ahvonen, Pooja Chaoji, Malin Johansson, Dixit K.C., Samuli Kinnunen, Kirsi Lindfors, Sanna Nenonen, Natalia Saukkonen, Lisa Thoms, and Tommi Valkonen. Finally, we would like to thank all those who helped us in collecting data in the case companies, commented our texts and helped us to formulate the findings and recommendations in this report.

Jussi Heikkilä
Jan Olhager
Miia Martinsuo
Teemu Laine

EXECUTIVE SUMMARY

Manufacturing industries have had an important role in the export-driven economies of the Nordic countries. Manufacturing companies from these countries have increasingly been moving production abroad in recent years. However, backshoring of previously offshored manufacturing is attracting growing attention among researchers and policy-makers. This phenomenon, and its consequences for the renewal of manufacturing, are yet little understood.

The research project "Reshoring of manufacturing (ROaMING): Disruptive Technologies, Business Ecosystems and Performance Information as Key Enablers" focused on increased understanding of production relocation trends in the Nordic countries, Denmark, Finland, and Sweden. The aim was to create in-depth knowledge on the status of and potential for relocating manufacturing as a source of renewal of the manufacturing sector. The research approach consisted of quantitative and qualitative parts utilizing both available databases and new data collected through a large-scale survey and case research.

The report consists of five main content chapters. First, the survey results of offshoring and backshoring trends in the Nordic countries Denmark, Finland, and Sweden are presented. Then we discuss the use of financial information in decision-making regarding manufacturing offshoring and backshoring. Thereafter the results of a study on manufacturing innovations and the adoption and implementation of new manufacturing technologies are reported. The fourth chapter presents the results of a study involving two manufacturing companies on the role of business ecosystems in manufacturing relocation decisions. Finally, the fifth chapter explores the global production investments made during the period 2005-2015 by large manufacturing firms with headquarters in Denmark, Finland, and Sweden.

The results among the Nordic manufacturing firms indicate that offshoring is clearly more common than backshoring. The manufacturing relocations by Nordic firms are geographically wide-ranging. The most important regions for offshoring and of backshoring are Eastern and Western Europe, the Nordic countries, and China. Offshored production is typically cost focused, whereas production relocated to the Nordic countries is relatively complex and technology-intensive, seeking access to technology, skills and knowledge, and proximity to R&D and product development. Movement of production is expected to continue both offshore and back. The reinforcement of the Nordic countries as a strong base for high value-adding manufacturing firms can be influenced by policy measures and future research.

Policy implications, as well as future research proposals are noted as the result of this study. Cost competitiveness in the Nordic countries needs to be ensured in relation to their reference group in the competition. This also exerts pressure for

continuous productivity improvements through technological advances and process improvements. Access to skills, knowledge and technology are important factors for Nordic manufacturers to relocate production. Therefore product, process and supply chain innovation, as well as colocation of R&D and production, need to be promoted. Policy-makers need to pay attention to maintaining the Nordic innovation systems. Many firms seem to lack a clear strategy or analytical capabilities for manufacturing location decisions. Expertise on managing global manufacturing networks should be enhanced. Follow-up on the extent, drivers and benefits of production relocations of the Nordic manufacturing firms is needed to enhance the fact-based understanding of the longer-term trend of manufacturing relocations.

CONTENTS

INTRODUCTION AND BACKGROUND OF RESEARCH

JUSSI HEIKKILÄ, JAN OLHAGER, MIIA MARTINSUO, TEEMU LAINE, AND PETRI SUOMALA

Today, manufacturing enterprises are part of truly global value chains. Parts, components, and products are sourced across several continents, manufactured on other regions, and then shipped forward for further processing, packaging, assembly, storage, and sale (Ferdows, 1997). Manufacturing industries traditionally have been important drivers of employment and export-fueled economic growth in the Nordic countries. Many manufacturing companies from these countries, however, increasingly have moved production abroad, and high costs at home have been among the primary reasons for these decisions. At the same time, backshoring of previously offshored manufacturing is a relatively new but potentially growing trend (Fratocchi et al., 2016; Kinkel, 2014; Tate, 2014). This phenomenon and all its consequences for the renewal of manufacturing have been little studied so far. Backshored activities are assumed to be different from those offshored. Changes are taking place in the configuration of the backshored activity and the related processes, the relationships with the other functions of the firm, and the broader global business network.

This book reports the results of the research project Reshoring of Manufacturing (ROaMING): Disruptive Technologies, Business Ecosystems, and Performance Information as Key Enablers. The project was part of the innovation research program Renewal of Manufacturing jointly financed by Tekes, the Finnish Funding Agency for Innovation, and Vinnova, the Swedish innovation agency. This study was intended to increase understanding of the extent and nature of production relocation trends in three Nordic countries, Denmark, Finland and Sweden. The aim was to create in-depth knowledge on the status and potential of manufacturing relocation as an important source of renewal for the manufacturing sector, its prerequisites, and its possible consequences.

The research focused on the following four research questions:

1. Why and at what rate are manufacturing companies relocating their manufacturing operations, both offshoring and backshoring?

2. How do manufacturing firms decide on production relocation, and what are the roles of accounting and performance information in this decision-making?

3. How can manufacturing technology innovations enable manufacturing relocations and how do companies adopt and carry out these innovations?

4. How do companies' investments in production relocation and manufacturing technology innovations relate to each other and affect business ecosystems?

The research design consisted of quantitative and qualitative approaches utilizing both available databases and new data collected through case research and a large-scale survey. Data collection and analysis were done on the following three levels:

- A large-scale survey to uncover recent trends in relocation of manufacturing. This phase of the data collection utilized a survey instrument developed earlier and used by the University of Southern Denmark (Arlbjørn et al., 2013, 2014a, 2014b). The same survey was administered in Denmark, Finland, and Sweden in 2015 to compare offshoring and backshoring trends in these three Nordic countries.

- Analysis of manufacturing investments from public databases, their classifications, and their potential for the revitalization of manufacturing-based sectors.

- Focused, in-depth case studies and comparative analysis of selected companies, employing different approaches toward manufacturing relocation, manufacturing innovations, use of financial information, and effects on business ecosystems.

Production relocation may result in different outcomes described with varying terminology. For example, *outsourcing* and *insourcing* concern the governance and ownership structure of companies, while *offshoring* and *backshoring* refer to the geographical movement of the activities or functions of a company to a new location in another country or back to the company's home location. However, in the literature, the use of these terms is not always consistent, and especially in practice,

there are different interpretations of these terms. In this study, the following definitions of these key terms were adopted in line with recent advancements in the production relocation literature:

- *Offshoring*: relocation of activities or functions from a company's home country to another country, independent of the ownership of the transferred operation

- *Outsourcing*: movement of activities or functions from the ownership of one company to the ownership of another legal company

- *Backshoring*: repatriation of activities or functions carried out in another country to the home country

- *Insourcing*: movement of activities or functions from another company to be carried out in-house by a company either in its home country or abroad

The rest of this report is organized as follows. The results part of this book contains five content chapters. The first chapter presents the results from a survey on offshoring and backshoring activities of manufacturing companies in the Nordic countries of Denmark, Finland, and Sweden. The second chapter discusses company-level decision-making related to manufacturing offshoring and backshoring. Thereafter, the third chapter reports the results of a study on manufacturing innovations requiring new process configurations with relocated manufacturing and the adoption and implementation of new manufacturing technologies. The fourth chapter presents a qualitative, exploratory study implemented with two manufacturing companies on the role of business ecosystems in manufacturing location decisions. This chapter examines the consequences of manufacturing relocation for business ecosystems. The fifth chapter explores global production investments made from 2005 to 2015 by large manufacturing firms with headquarters in Denmark, Finland, and Sweden. The concluding part of the report includes a discussion of the results and their implications for research and practice.

CHAPTER

1

RELOCATION PATTERNS IN NORDIC MANUFACTURING INDUSTRIES

JAN OLHAGER, JUSSI HEIKKILÄ, MALIN JOHANSSON, AND SANNA NENONEN

INTRODUCTION

This chapter presents the main results from a survey on offshoring and backshoring activities in the Nordic countries of Denmark, Finland, and Sweden administered through a research collaboration between the University of Southern Denmark in Kolding, Denmark (Professor Jan Stentoft); Tampere University of Technology, Finland (Professors Jussi Heikkilä, Miia Martinsuo, and Petri Suomala); and Lund University in Sweden (Professor Jan Olhager). The researchers jointly developed the survey instrument in the spring and summer of 2015. The structure and questions in the survey are shown in Appendix 1. The survey was distributed in September and October 2015, and the data were collected in October and November 2015.

The targeted companies consisted of all the companies with a minimum of 50 employees in all the manufacturing industry categories in Sweden, Finland, and Denmark (SI code 10–33). In total, 4 590 companies belonged to the target group, and 2 015 Danish, 949 Finnish, and 1 626 Swedish manufacturers were contacted. A total of 847 responses were received (Sweden 373 responses, Finland 229, Denmark 245 responses) for a response rate of 18.5%. The analysis in this chapter focuses on the (i) extent, (ii) drivers, (iii) benefits, and (iv) expectations of manufacturing relocations in the near future (i.e., the next two years). These results and comparisons across companies with different relocation profiles are presented and commented in the following sections. First, the research data are described.

RESEARCH DATA

The collected survey data represented a good cross-section of industries in Denmark, Finland, and Sweden in terms of size (number of employees) and industry, and the respondents could be expected to have good knowledge and experience of the issues in the survey. The respondents were all upper- or middle-level managers in areas related to production and thus presumably were knowledgeable about the survey questions. The respondents had an average of 15.8 years' experience in production and operations management and 6.2 years in their current positions.
The size distribution (number of employees at the firm level) was relatively similar in Denmark, Finland, and Sweden, but the Finnish sample included relatively smaller firms, and the Swedish sample relatively larger firms. The industry profiles exhibited some differences. The food industry had the highest share of firms in Denmark, while the machinery and equipment industry was well-represented in all the three countries and had the highest share of respondents in Finland and Sweden. Although the distribution of responses by size and industry was a good representation of the entire population, there was some overemphasis on large companies. Table 1 shows the respondents' characteristics in the three countries in terms of firm size and industry. The highest number in each row is indicated in **bold**.

TABLE 1. RESPONDENTS' CHARACTERISTICS (PERCENTAGES OF THE COUNTRY-SPECIFIC SAMPLES).

CHARACTERISTIC	DENMARK	FINLAND	SWEDEN	ALL COUNTRIES
Number of employees within firm				
Less than 100	24.6	**31.7**	15.5	22.5
101-250	27.5	**31.7**	28.8	29.2
251-500	**14.3**	11.9	9.8	11.7
More than 500	33.6	24.7	**45.9**	36.6
Industry (SI code)				
Machinery industry and equipment (28)	17.1	**22.7**	17.4	18.8
Fabricated metal products, except machines (25)	8.6	**14.8**	10.7	11.2
Food industry (10)	**19.2**	6.1	7.5	10.5
Electrical equipment (27)	5.3	6.6	**7.0**	6.4
Other non-metallic mineral products industry (23)	**9.4**	4.8	4.6	6.0
Rubber and plastics industry (22)	**5.7**	**5.7**	5.6	5.7
Chemical industry (20)	3.3	**7.0**	5.9	5.4
Computer, electronic and optical products (26)	5.3	**6.1**	5.1	5.4
Timber industry (16)	5.3	**5.7**	5.1	5.3
Paper industry (17)	2.4	2.6	**6.2**	4.1
Motor vehicle, trailer and semi-trailer industry (29)	2.0	2.2	**5.4**	3.5
Basic metals industry (24)	1.2	1.7	**4.8**	3.0
Furniture industry (31)	**4.1**	2.2	2.7	3.0
Other industries	11.0	11.8	12.1	11.7

SCOPE OF MANUFACTURING RELOCATIONS

The respondent firms were divided into four groups according to their experience of relocations. Table 2 shows the shares of the respondent firms in four groups of relocation experience. The first column presents firms that had only offshored manufacturing in the past five years (2010-2015), the second column firms that had both offshored and backshored, the third column firms that had only backshored, and, finally, the fourth column firms that had not moved manufacturing at all during this period. We explicitly asked for firms in the last group to respond to the survey even if they had not moved any manufacturing in order to get full picture of firms that

moved and that did not move (a number of questions in the questionnaire were general and did not require that any relocation had taken place).

Manufacturing firms in these Nordic countries were quite active in manufacturing relocations. During the past five years, 275 firms (32.5%) had offshored production, while 160 firms (18.9%) had backshored (these numbers include respondents that did both offshoring and backshoring). A number of the respondent firms (57.9%) had not moved any production in this period, while some firms had both offshored and backshored production (9.2%). Table 2 presents the total number of relocations by these groups and the distribution by country. The highest number in each column is indicated in **bold**, and the lowest number as *italics*.

TABLE 2. DISTRIBUTION ACROSS MANUFACTURING RELOCATION ACTIVITY AND COUNTRIES (NUMBER OF RESPONDENTS/PERCENTAGES).

	ONLY OFFSHORING	BOTH OFF- AND BACKSHORING	ONLY BACKSHORING	NO MOVEMENT	TOTAL
No. of all respondents	197	78	82	490	847
Denmark	**27.3 %**	6.5 %	*6.1 %*	60.0 %	245
Finland	*21.0 %*	*4.8 %*	8.3 %	**65.9 %**	229
Sweden	22.0 %	**13.7 %**	**12.9 %**	*51.5 %*	373
All three countries	23.3%	9.2%	9.7%	57.9%	100%

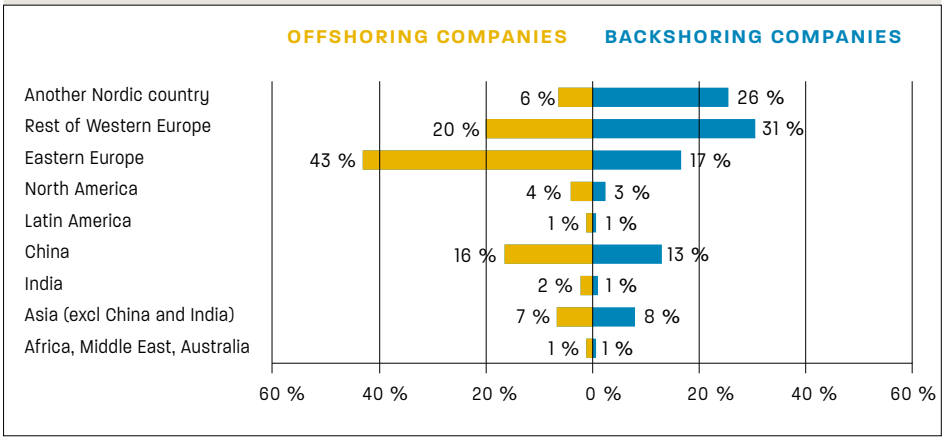
It should be noted that these figures do not reflect the magnitude of relocation in terms of monetary value but only the number of respondents who reported that their companies had either relocated or not relocated manufacturing. Comparing the three countries studied, Denmark had a higher share of offshoring firms (27.3%) than the three countries combined (23.3%). Sweden had relatively higher shares of both backshoring firms (12.9% vs. 9.7%) and bidirectional movers (13.7% vs. 9.2%), while Finland had a higher share of non-movers (65.9% vs. 57.9%) compared to the three countries combined.

REGIONAL PERSPECTIVES ON RELOCATIONS AND MARKETS

The manufacturing relocations made by the Nordic firms were global. The regions for offshoring and backshoring, as well as the markets served by this production, included all regions of the world (see Figure 1). The major regions for offshoring

from these three Nordic countries were Eastern and Western Europe and China, accounting for 79% of all recent significant offshoring projects by the respondent firms. The major regions of origin for backshoring to the Nordic countries were Western and Eastern Europe, other Nordic countries, and China, accounting for 87% of recent significant backshoring projects.

FIGURE 1. GEOGRAPHICAL AREA FROM OR TO WHICH PRODUCTION WAS MOVED.



When comparing production movements across regions within internal and external networks, several differences between external and internal movements were found. In backshoring production to the Nordic home countries, 44% of the firms that had made the movement from one of their own plants made the movement from Western Europe, compared to 19% of those that had made the movement from an external subcontractor or contract manufacturer. In movements from an external party, in contrast, Eastern Europe (22% from an external plant, 13% from the firm's own plant), China (17% from an external plant, 11% from the firm's own plant), and the rest of Asia (13% from external plant, none from the firm's own plant) were found to be more common points of departure for movement back to the Nordic countries.

These results mean that backshoring movements from Western European countries were more common within the company's own plant network, but backshoring movements from Eastern European and Asian countries were more common from the external suppliers or the contract manufacturers. These findings indicated regional production-location strategies within companies' own production networks in Western Europe and potentially disappointing experiences of working with external suppliers in more remote locations, which resulted in backshore insourcing of production. Similar differences were not found for offshoring relocations.

EXTENT OF OFFSHORING AND BACKSHORING

The respondents were asked how many times their company had permanently moved production abroad to another plant (existing or new) within their company or to another company's plant (external supplier or contract manufacturer). Table 3 displays the extent of backshoring and offshoring by number of relocation projects in both directions during 2010–2015. In addition, the average number of relocation projects per respondent firm was calculated. All the data are displayed for Denmark, Finland, Sweden, and the three countries combined.

TABLE 3. DISTRIBUTION OF MANUFACTURING RELOCATION BY ACTIVITY AND COUNTRY (NUMBER OF RESPONSES).

	ONLY OFFSHORING	BOTH OFFSHORING AND BACKSHORING	ONLY BACKSHORING	NO MOVEMENT	TOTAL
Total no. of responses	197	78	82	490	847
Total no. of offshoring projects	651	287	-	-	938
Denmark	218	68	-	-	286
Finland	146	39	-	-	185
Sweden	287	180	-	-	467
Total no. of backshoring projects	-	197	194	-	391
Denmark	-	43	29	-	72
Finland	-	26	36	-	62
Sweden	-	128	129	-	257
Total no. of relocation projects	651	484	194	-	1329
Average no. of projects	3.30*	6.21*	2.37*	-	1.57**

* In each respective category (e.g., both offshoring and backshoring: (287+197)/78=6.21)
** Relative to the entire sample (i.e., 1 329/847=1.57)

Another question was how companies of different sizes (by number of employees) and manufacturing networks (by number of plants) differ in their manufacturing relocations. The differences between the four manufacturing relocation-activity types were analyzed by number of employees and the number of manufacturing plants. The results are shown in Table 4; the highest number in each column is indicated in **bold**, and the lowest number in *italics*.

TABLE 4. DIFFERENCES IN MANUFACTURING RELOCATION-ACTIVITY BY COMPANY SIZE AND NUMBER OF PLANTS (PERCENTAGES).

	ONLY OFFSHORING N=197	BOTH OFF- AND BACKSHORING N=78	ONLY BACK-SHORING N=82	NO MOVEMENT N=490
Number of employees in the company (% within the group)				
51-100	*11.1*	*4.2*	*6.9*	**77.8**
101-250	19.2	6.5	9.8	64.5
251-500	19.4	11.2	8.2	61.2
Over 500	**34.5**	**14.0**	**11.7**	*39.7*
Number of manufacturing plants (% within the group)				
1	*20.5*	*8.2*	*5.5*	**65.8**
2	30.8	8.6	11.9	48.6
3-5	**31.4**	**17.4**	9.3	*41.9*
6-10	28.8	15.0	**14.4**	*41.9*
Over 10	23.1	9.3	9.8	57.8

Table 4 shows that companies of all sizes relocated production, but large companies were considerably more active in doing so than others. Among the smallest companies (51–100 employees), the majority (78%) did not move production, but some small companies moved production in both directions. The largest companies with more than 500 employees were the most active in production relocation; 60.3% of companies in this size group moved production offshore, back home, or in both directions. The same trend shows in the number of manufacturing plants. Companies that had more production plants typically were more active in moving production than those that had only one or a few production plants. There was a gradual increase in the movement activity as company size grew in terms of the number of plants. Interestingly, though, movement activity decreased when the number of plants went beyond 10. This result indicates that companies with a high number of plants in several locations were in a relatively stable situation and perhaps did not need to move production within their geographically distributed networks. Companies with 3–10 plants more actively searched for improvements in their global production footprint. Table 4 also shows that the companies that did not move production were mostly small and/or owned single plants.

There were significant differences in the tendencies of companies in different industries to relocate production (see Table 5). In the timber industry, 86.7% of the responding companies did not do any production location movements. Other industries in which movement activity was low were the other non-metallic mineral prod-

ucts industry (74.5% of the companies were non-movers), food industry (67.4%), furniture industry (64.0%), and paper industry (62.9%). At the other extreme was the electrical equipment industry, in which 61% of companies offshored and/or backshored production. The rate of backshoring was relatively high in industries such as the electrical equipment (20.4%), basic metals industry (16.0%), furniture industry (16.0%), and chemical industry (15.2%).

TABLE 5. DIFFERENCES ACROSS MANUFACTURING RELOCATION ACTIVITY BY INDUSTRY (PERCENTAGES, ONLY INDUSTRIES WITH 25 OR MORE RESPONDENTS INCLUDED).

	ONLY OFFSHORING	BOTH OFF- AND BACKSHORING	ONLY BACKSHORING	NO MOVEMENT
Industry (SI code) a				
Food industry (10)	21.3	4.5	6.7	67.4
Timber industry (16)	4.4	2.2	6.7	86.7
Paper industry (17)	22.9	8.6	5.7	62.9
Chemical industry (20)	15.2	15.2	15.2	54.3
Rubber and plastics industry (22)	27.1	6.3	8.3	58.3
Other non-metallic mineral products (23)	9.8	5.9	9.8	74.5
Basic metals industry (24)	8.0	20.0	16.0	56.0
Fabricated metal products (25)	24.2	9.5	8.4	57.9
Computer, electronic and optical products (26)	37.0	6.5	8.7	47.8
Electrical equipment (27)	27.8	13.0	20.4	38.9
Machinery industry and equipment (28)	28.9	13.2	10.1	47.8
Motor vehicle, trailer and semi-trailer (29)	30.0	16.7	0.0	53.3
Furniture industry (31)	20.0	0.0	16.0	64.0

The highest share of offshoring firms was in the computer, electronic, and optical products industry, with 37% of all companies moving manufacturing offshore. Also, the motor vehicle, trailer, and semi-trailer industry (30.0%), the machinery and equipment industry (28.9%), and the electrical equipment industry (27.8%) had higher than average rates of offshoring. The industries with the highest activity in both offshoring and backshoring included the basic metals industry (20.0%), the motor vehicle, trailer and semi-trailer industry (16.7%), and the chemical industry (15.2%).

DRIVERS OF OFFSHORING AND BACKSHORING OF PRODUCTION

The drivers of decision-making in offshoring and backshoring were clearly different. The respondents were given 21 drivers of manufacturing relocation to consider and were asked to rate the importance of each factor in their recent relocation decisions. The same set of drivers was given for both offshoring and backshoring decisions. Table 6 shows the results of a two-tailed t-test for equality of means. The results regarding the decision drivers for each country (Denmark, Finland, and Sweden) had only small differences, so the results for the full sample are displayed here. The highest number in each column is indicated in **bold**, and the lowest number in *italics.*

TABLE 6. DRIVERS OF OFF- AND BACKSHORING (AVERAGES OF THE RESPONSES).

Drivers of off- and backshoring	OFFSHORING N=275	BACKSHORING N=160
Labor cost [a]	**3.93**	2.43
Logistics cost	3.01	3.12
Other cost	3.23	3.21
Changes in the currency exchange rates	2.27	2.39
Production close to or in the market	2.88	2.90
Access to skills and knowledge [a]	2.50	3.48
Access to technology [a]	2.43	3.24
Access to raw materials	2.45	2.64
Proximity to R&D and product development [a]	1.98	3.10
Flexibility [a]	2.95	3.73
Lead-time [a]	2.95	3.56
Quality [a]	2.94	**3.82**
Risk diversification	2.50	2.59
Country-specific conditions (e.g. subsidies, taxes, duties) [c]	2.37	2.08
Trade barriers (e.g. customs, quotas, local content requirement) [c]	2.30	2.00
Focus on core areas (and outsource non-core)	2.90	2.99
Avoid investments in new equipment	2.67	2.50
Requirement from customer (to move with customer)	2.09	2.04
Follow industry practice	2.09	*1.95*
Shortage of qualified personnel	*1.97*	2.19
Time-to-market (bringing new products to market faster) [a]	2.02	2.58

Statistical significances: a – p≤0.001; b – p≤0.010; c – p≤0.050

Several differences in the drivers of offshoring and backshoring were statistically significant. Labor costs dominated offshoring decisions ($p \leq 0.001$). Country-specific conditions and trade barriers had higher importance in offshoring than backshoring but at a lower significance level ($p \leq 0.050$). Backshoring decisions were based on a broader set of drivers. Quality, flexibility, lead time, access to skills and knowledge, access to technology, proximity to research and development (R&D), and time-to-market were all significantly more important drivers of backshoring than offshoring ($p \leq 0.001$). In sum, it became clear that offshoring had one logic, and backshoring had a different logic.

MANUFACTURING RELOCATIONS INTERNAL AND EXTERNAL TO THE FIRM

Another perspective captured by the survey was whether the relocation projects were executed within the firm or between the firm and an external partner. External offshoring implied simultaneous outsourcing, while external backshoring implied simultaneous insourcing. For each offshoring and backshoring project, the respondents were asked whether the relocation was done within the company's own production network (internal movement) or with an external supplier or contract manufacturer (external movement). After eliminating responses which reported the movement to be both internal and external, the production relocation projects were classified among four alternative situations:

- Internal offshoring: 171 projects
- Offshore outsourcing: 85 projects
- Internal backshoring: 75 projects
- Backshore insourcing: 78 projects

When moving production within the internal and external production network, offshoring production internally (67% of all recent significant offshoring projects) was more common than outsourcing production to external partners (33%). Internal and external movements were more balanced in backshoring: 49% of backshoring projects were internal, and 51% were external movements.

Some of the drivers discussed differed significantly depending on whether the relocation was internal or external. Table 7 presents the results of a two-tailed t-test for equality of means for pairwise comparisons of internal offshoring (retaining ownership) and offshore outsourcing (transferring ownership) and of internal backshoring and backshore insourcing. Only the drivers with differences found to be statistically significant are included in Table 7. The higher number in each pairwise comparison is presented in **bold**.

TABLE 7. DRIVERS OF OFFSHORING / OUTSOURCING AND BACKSHORING / INSOURCING (AVERAGES OF THE RESPONSES).

Drivers of off- and backshoring	OFFSHORING		BACKSHORING	
	INTERNAL OFFSHORING N=171	OFFSHORE OUTSOURCING N=85	INTERNAL BACKSHORING N=75	BACKSHORE INSOURCING N=78
Logistics costs[c]	**3.12**	2.75	-	-
Other costs[c]	-	-	**3.45**	3.06
Production close to or in the market[a]	**3.15**	2.39	-	-
Flexibility[c]	-	-	3.50	**3.93**
Lead-time[c]	-	-	3.28	**3.78**
Risk diversification[c]	-	-	2.39	**2.79**
Country-specific conditions[c]	**2.50**	2.12	-	-
Focus on core areas (and outsource non-core)[b]	2.72	**3.23**	-	-
Avoid investments in new equipment[a]	-	-	**2.85**	2.15
Requirement from customer[c]	**2.20**	1.79	-	-

Statistical significances: a – p≤0.001; b – p≤0.010; c – p≤0.050

Table 7 indicates that logistics costs and production close to or in the market were significantly more important for internal offshoring than external offshoring, and vice versa for focus on core areas. Thus, offshore outsourcing was concerned with non-core areas, while core areas were kept internal. In addition, when proximity to market and logistics costs were important, offshoring was more likely to be kept internally.

In backshoring, flexibility and lead time were the key drivers for insourcing production from external partners. Therefore, if flexibility was poor, and lead times were long at external partners, backshoring insourcing was likely. Other costs, including administration and facility costs, could lead to internal backshoring if these cost elements developed in undesirable directions.

BENEFITS OF OFFSHORING AND BACKSHORING

The respondents were also asked to assess the level of benefits experienced from relocation projects. Overall, data from 275 offshoring firms and 160 backshoring firms were collected. Table 8 shows that 8 of the 10 benefit areas exhibited signifi-

cant differences between offshoring and backshoring. The highest number in each column is indicated in **bold**, and the lowest number in *italics*. The benefits in the table are ordered according to the difference between the mean values for offshoring and backshoring.

TABLE 8. BENEFITS OF OFFSHORING AND BACKSHORING (MEAN VALUES, IN THE ORDER OF OFFSHORING MINUS BACKSHORING SCORE).

Benefits of off- and backshoring	OFFSHORING N=275	BACKSHORING N=160
Labor costs[a]	**4.09**	*2.87*
Profitability	3.75	3.74
Other costs	3.44	3.57
Logistics costs[a]	3.07	3.56
Volume flexibility[a]	3.25	3.79
Product mix flexibility[a]	2.96	3.69
Delivery reliability[a]	2.90	3.85
Delivery speed[a]	2.90	3.87
Process quality[a]	*2.73*	3.83
Product quality[a]	2.79	**3.94**

Statistical significances: a – p≤0.001; b – p≤0.010; c – p≤0.050

Labor costs were the only statistically significantly different benefit for offshoring, whereas backshoring had a broader set of benefits. Logistics costs, volume and product-mix flexibility, delivery speed and reliability, and product and process quality were all significantly more related to backshoring than offshoring. Thus, the benefits were very much aligned with their respective drivers: offshoring resulted in benefits for labor costs, and backshoring in benefits for quality, lead time, and flexibility.

The perceived benefits of production relocations were also analyzed by internal and external relocation. Table 9 shows the results of a two-tailed t-test for equality of means. Only benefits in which statistically significant differences were found are included in Table 9. The higher number in each pairwise comparison is indicated in **bold**.

TABLE 9. PERCEIVED BENEFITS OF OFFSHORING / OUTSOURCING AND BACKSHORING / INSOURCING.

Benefits of off- and backshoring	OFFSHORING		BACKSHORING	
	INTERNAL OFFSHORING	OFFSHORE OUTSOURCING	INTERNAL BACKSHORING	BACKSHORE INSOURCING
Logistics costs	**3.20**[b]	2.73[b]	-	-
Delivery speed	**3.02**[c]	2.68[c]	3.59[a]	**4.11**[a]
Delivery reliability	**3.00**[c]	2.70[c]	3.55[a]	**4.14**[a]

Statistical significances: a: p≤0.001; b: p≤0.010; c: p≤0.050.

Table 10 shows that the mean scores for the benefits logistics costs, delivery speed, and delivery reliability were higher for internal offshoring than offshore outsourcing. One explanation for this result was that internal offshoring, in addition to the cost driver was driven by the need to relocate production closer to the customers and markets, and the mean scores of the perceived benefits indicated that these benefits had been achieved. This observation implied that external offshoring did not lead to any particular benefits for logistics costs, delivery speed, and reliability. In cases when those factors were important, these results clearly indicated that internal offshoring was preferable, for example, permitting tighter control.

In contrast, the scores for delivery speed and delivery reliability were higher for backshore insourcing than for internal backshoring. This result indicated that much could be gained in delivery performance by backshoring production from external partners; in other words, ownership was important for establishing and controlling delivery performance.

FUTURE EXPECTATIONS

The respondents were asked to indicate the extent to which they expected to relocate manufacturing in the next two years through either offshoring or backshoring activities: moving production (i) back to Denmark, Finland, or Sweden (depending on the respondent's country of location); (ii) to another company plant located in the Nordic region; or (iii) to another company plant located in another European country. A 5-point scale was used (1 = not at all, 2 = minor extent, 3 = some extent, 4 = large extent, 5 = very large extent). Table 10 shows the results. All the mean values that exceed 2 are in **bold**. A mean value of less than 2 implied that most respondents in that group did not expect any moves.

TABLE 10. EXPECTED MANUFACTURING RELOCATION IN THE NEXT TWO YEARS (FROM THE TIME OF DATA COLLECTION IN 2016–2017; MEAN VALUES).

	ONLY OFFSHORING	BOTH OFF- AND BACKSHORING	ONLY BACKSHORING	NO MOVEMENT	ALL GROUPS
In the next 2 years, to what extent do you expect your company to move production:					
Abroad from Den/Fin/Swe	**2.68**	**2.46**	1.55	1.45	1.85
Back to Den/Fin/Swe	1.55	**2.56**	**2.33**	1.46	1.71
Back to another plant in your company, located in the Nordic region	1.26	1.57	1.43	1.26	1.31
Back to another plant in your company, located in some other European country	1.63	**2.05**	1.53	1.26	1.48

The results indicated that production relocation would continue in the future and that the expected future activity depended on the type of company. Companies that had not moved production in the past expected to remain passive in the future. Offshoring firms planned to continue to move more production abroad than other company types, and the backshoring firms expected to continue to move production back to the Nordic region. The group of companies that had done both offshoring and backshoring expected to continue to move production in both directions but seemingly moving more back than away from the Nordic region.

CONCLUSIONS

The importance of offshoring and backshoring of manufacturing from and to the Nordic countries has been increasing in recent years. The purpose of this survey study was to investigate the production relocation activities of manufacturing firms being located in Denmark, Finland, and Sweden. Manufacturing firms in the Nordic countries studied were active in manufacturing relocation. More than 40% of the manufacturing firms surveyed had offshored or backshored production or done both during the past five years. Offshoring was more common than backshoring.

The manufacturing relocation by the Nordic firms had a broad geographic scope; the major regions for offshoring and backshoring were Eastern and Western Europe, other Nordic countries, and China. These regions were also the dominant market regions for relocation of production, along with North America. Large companies with many plants in multiple locations were more active in relocating production than others.

Companies in various industries differed in their tendencies to relocate production. Industries with low movement activity included the timber, non-metallic mineral products, and food industries. High shares of offshoring companies were found in the computer, electronic, and optical products; motor vehicle; machinery and equipment; and electrical equipment industries. The rate of backshoring was relatively high in the electrical equipment, basic metals, furniture, and chemicals industries. Overall, the survey results showed that offshored production was characterized as work intensive, whereas backshored production was relatively complex and technology intensive.

The drivers of relocation decisions were clearly different for offshoring and backshoring. Labor costs were the dominant driver for offshoring decisions, whereas backshoring decisions were based on a broader set of drivers. Quality, flexibility, lead time, access to skills and knowledge, access to technology, proximity to R&D, and time-to-market were all significantly more important drivers of backshoring than offshoring. The benefits experienced from the relocation projects were highly aligned with the drivers in both relocation directions (i.e., both offshoring and backshoring).

Offshore outsourcing generally was driven more by cost reduction and a focus on core areas, whereas internal offshoring was motivated more by seeking proximity to customers and markets. Drivers of backshore insourcing that potentially indicated unsatisfactory performance by offshore outsourced production were flexibility, lead time, and risk diversification. These drivers could result in backshore insourcing to the Nordic countries, particularly from far-off locations. Companies with 3–10 plants in multiple locations were more active in relocating production than others. Large firms with more than 10 plants were less active, indicating a more stable situation with less need for relocation activities.

Backshoring movement from Western European countries was more common within companies' plant networks, but backshoring movements from Eastern European and Asian countries were more common when involving external suppliers or contract manufacturers. These findings indicated regional production-location strategies within companies' own production networks in Western Europe and potential experiences of under-performance in working with external suppliers in more remote locations.

Some country differences were identified when comparing the respondents and the responses from Denmark, Finland, and Sweden. The Finnish sample included

relatively smaller firms, while the Swedish sample included relatively larger firms. The countries had differences in their industry structures, and each country has its own particularly strong industries. The Swedish companies in the survey database more often had larger focal plants and higher numbers of plants and plant locations than the Danish and Finnish companies. When comparing the three countries by relocation activity, Denmark had a higher share of pure offshoring firms than the other two, Sweden had a relatively higher share of both backshoring firms and bidirectional movers, and Finland a higher share of non-movers. However, country of origin alone did not explain the differences in the manufacturing companies' relocation activities.

CHAPTER

2

USE OF ACCOUNTING AND PERFORMANCE INFORMATION IN RELOCATION DECISION-MAKING

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INTRODUCTION

This chapter discusses company-level decision-making related to offshoring and backshoring, which is a practically relevant yet under-researched issue (Arlbjorn & Mikkelsen, 2014; Kinkel, 2014). Although financial benefits are seen as key drivers of offshoring decisions, there is limited understanding of the actual role of financial information in shaping such decisions (Gylling et al., 2015). The actual decision-making processes concerning offshoring and backshoring are not thoroughly understood, particularly with respect to the potentially different roles of financial information to provide support in different circumstances (Burchell et al., 1980).

Offshoring and backshoring decisions recently have gained attention as growing business phenomena with wider implications for managing global operations (Lewin & Peeters, 2006; Kedia & Mukherjee, 2009; Arlbjorn & Mikkelsen, 2014). For offshoring decisions, the starting point usually has been shifting production to low-wage or, more broadly speaking, low-cost countries. Cost savings, however, are not necessarily the only or even the primary reason for offshoring, but offshoring requires wider considerations of the sources of competitive advantage for companies in high-cost economies (Lewin & Peeters, 2006).

Backshoring is an increasingly important option in making decisions on production location. The understanding of backshoring could clearly benefit from longitudinal examination of the business context evolution (Arlbjorn & Mikkelsen, 2014). For example, Gylling et al. (2015) studied a case in which offshore production was moved back due to more accurate cost allocation, supplier cost changes, growing sales volumes, and other external factors, as well as network learning. Identifying the antecedents, motivators, and barriers of backshoring, however, requires in-depth examination. Further research is needed, especially to better understand the dynamics of the economic factors underlying backshoring (Kinkel, 2014). The chapter raises the role of financial information in offshoring and backshoring decision-making through the following question:

What is the actual role played by financial information when manufacturing firms make offshoring and backshoring decisions?

Financial information may support managers in their decision-making in many different ways, improving understanding of the economic factors in a given context (Burchell et al., 1980; Hall, 2010). The availability of useful financial information is a prerequisite for supporting decision-making (Pizzini, 2006). Korhonen et al. (2013) argued that performance indicators and financial reporting should continuously respond to current circumstances and enable decision-making accordingly. This is also a valid viewpoint in the offshoring and backshoring context and draws companies' attention to the potential support from financial analyses.

The rest of the chapter is organized as follows. Next, the survey results on the overall role of financial information in offshoring and backshoring are analyzed. The focus then shifts to country comparisons of the availability of cost information at different levels in production relocation decisions and the perceived support of financial information in financial analyses and various decisions related to production relocation. The discussion is deepened with two production relocation cases (offshoring and backshoring) and a detailed analysis of the decision-making processes before the conclusions of the chapter.

OVERALL ROLE OF FINANCIAL INFORMATION IN PRODUCTION RELOCATION DECISIONS

The chapter reports the results of a survey conducted with 847 manufacturing companies in Denmark (245), Finland (229), and Sweden (373) regarding their offshoring and backshoring decisions in the past five years (see descriptions of the data in Chapter 1 and the data collection instrument in Appendix 1). In this chapter, the focus is on one theme of the survey, namely, the role of financial information from different perspectives:

- Availability of financial information for component-, product-, process-, and plant-level analyses
- Perceived support for financial analyses of product full costs, product profitability, and plant profitability
- Perceived support for decision-making regarding the selection of plant location, supplier, and distribution channel

A 5-point Likert scale was used when examining the cost accounting system, financial reporting practices, and support for decision-making. The respondents were asked to what extent a given system or practice supported decision-making (1 = not at all, 2 = small extent, 3 = moderate extent, 4 = large extent, 5 = very large extent).

Overall, financial information was generally available in the companies at the plant (4.06) and product levels (4.04), whereas information on component costs (3.69) and process costs (3.60) was more rarely available. Process costs, in particular, could be an important unit of analysis for production relocation, in which certain production processes are established in a new location with various cost implications. However, this kind of information was frequently not available in companies.

In addition, financial analyses were supported to a relatively high extent regarding plant profitability (3.94) and to a somewhat lesser extent regarding product full costs (3.85) and product profitability (3.72). Moreover, as expected in light of the literature indicating that accounting information supports managerial work (Hall, 2010), the perceived support of financial information in decision-making in general was only moderate. Supplier selection (3.16) had slightly more support than plant location (2.87) and delivery channel selection (2.93).

To gain a more detailed understanding of the topic, the companies were categorized according to their offshoring and backshoring decisions during the period surveyed: (i) no movement; (ii) only offshoring; (iii) only backshoring; and (iv) both offshoring and backshoring. Regarding the specific questions, the number of responses varied quite naturally. Tables 11a, b, and c present the survey results in different

company categories for the means of each specific question on the perceived availability and support of financial information for analyses and decision-making.

The overall pattern of the results was that the more relocation decisions companies made, the more financial information was available to those companies, and thus, the more support for decision-making that companies perceived. The companies that made both offshoring and backshoring decisions and companies that made only backshoring decisions perceived the greatest support from financial information in each category. The highest number in each column is presented in **bold**, and the lowest number in *italics*.

TABLE 11A. AVAILABILITY OF FINANCIAL INFORMATION FOR COMPONENT-, PRODUCT-, PROCESS-, AND PLANT-LEVEL ANALYSES IN ALL THREE NORDIC COUNTRIES COMBINED (MEAN VALUES).

	COMPONENTS	PRODUCTS	PROCESSES	PLANTS
No movement (N = 413-422)	*3.55*	*3.96*	*3.53*	4.05
Only offshoring (N = 209-211)	3.80	4.09	3.69	*3.99*
Only backshoring (N = 68-71)	3.85	4.14	3.68	4.06
Both offshoring and backshoring (N = 91-93)	**3.91**	**4.20**	**3.70**	**4.31**

TABLE 11B. PERCEIVED SUPPORT FOR FINANCIAL ANALYSES OF PRODUCT FULL COSTS, PRODUCT PROFITABILITY, AND PLANT PROFITABILITY IN ALL THREE NORDIC COUNTRIES COMBINED (MEAN VALUES).

	PRODUCT FULL COST	PRODUCT PROFITABILITY	PLANT PROFITABILITY
No movement (N = 420-422)	3.84	3.74	3.95
Only offshoring (N = 209-211)	*3.78*	*3.58*	*3.85*
Only backshoring (N = 72-73)	**4.01**	3.79	4.00
Both offshoring and backshoring (N = 92-93)	3.96	**3.90**	**4.03**

TABLE 11C. PERCEIVED SUPPORT FOR DECISION-MAKING REGARDING SELECTION OF PLANT LOCATION, SUPPLIER, AND DELIVERY CHANNEL IN ALL THREE NORDIC COUNTRIES COMBINED (MEAN VALUES).

	SUPPLIER SELECTION	PLANT LOCATION	DELIVERY CHANNELS
No movement (N = 346-409)	*3.11*	*2.68*	2.92
Only offshoring (N = 196-204)	3.16	3.03	*2.80*
Only backshoring (N = 67-72)	**3.31**	3.00	3.09
Both offshoring and backshoring (N = 86-90)	3.30	**3.14**	**3.10**

Financial analyses, especially product full-cost and profitability analyses, were most frequently available in the companies that were active in relocation decisions. However, the perceived support for analyses was relatively similar across the company categories (means: 3.6–4.0). Perceived support for decision-making was also positively associated with relocation decisions, especially regarding actual plant-location decisions. Quite naturally, the companies without production movement perceived relatively low support for these decisions because some companies might have not even considered production relocation during the period under examination. Overall, the statistical significance of these differences between company categories requires further examination.

The association between production relocation decisions and the availability and support of financial information did not mean increasing the extent of financial analyses increased the number of offshoring and backshoring decisions. The availability of financial information, however, could enable companies to make financially viable decisions.

AVAILABILITY OF FINANCIAL INFORMATION FOR PRODUCTION RELOCATION DECISIONS

As explained, the availability of financial information was associated with production relocation activities. Interestingly, the responses concerning the availability of financial information also differed among the three Nordic countries studied. The Swedish respondents reported the highest availability of financial information, except at the product level, where Finnish respondents reported the highest availability. At all levels, Danish companies reported the lowest availability of financial information, except for plant level, where Finland had the lowest availability. Table 12 summarizes the availability of financial information across countries among different company categories. The highest number in each column is presented in **bold**, and the lowest number in *italics*.

TABLE 12A. AVAILABILITY OF FINANCIAL INFORMATION FOR COMPONENT-, PRODUCT-, PROCESS-, AND PLANT-LEVEL ANALYSES IN DENMARK (MEAN VALUES).

	COMPONENTS	PRODUCTS	PROCESSES	PLANTS
No movement (N = 124-128)	*3.33*	*3.76*	3.28	3.98
Only offshoring (N = 75-77)	3.79	4.06	**3.74**	4.12
Only backshoring (N = 13-15)	*3.33*	3.93	*3.15*	*3.60*
Both offshoring and backshoring (N = 18-20)	3.95	4.10	3.72	**4.30**

TABLE 12B. AVAILABILITY OF FINANCIAL INFORMATION FOR COMPONENT-, PRODUCT-, PROCESS-, AND PLANT-LEVEL ANALYSES IN FINLAND (MEAN VALUES).

	COMPONENTS	PRODUCTS	PROCESSES	PLANTS
No movement (N = 141-143)	*3.50*	*4.04*	*3.51*	3.95
Only offshoring (N = 54-55)	3.84	4.15	3.65	*3.78*
Only backshoring (N = 15-17)	4.00	4.29	3.56	4.07
Both offshoring and backshoring (N = 13)	**4.15**	**4.54**	**3.77**	**4.31**

TABLE 12C. AVAILABILITY OF FINANCIAL INFORMATION FOR COMPONENT-, PRODUCT-, PROCESS-, AND PLANT-LEVEL ANALYSES IN SWEDEN (MEAN VALUES).

	COMPONENTS	PRODUCTS	PROCESSES	PLANTS
No movement (N = 148-150)	*3.77*	*4.05*	3.74	4.21
Only offshoring (N = 79)	3.80	4.08	*3.67*	*4.00*
Only backshoring (N = 39-40)	**3.97**	4.15	**3.90**	4.23
Both offshoring and backshoring (N = 60)	3.85	**4.17**	3.68	**4.32**

Tables 12a, b, and c reveal that, among the Swedish respondent companies, the companies without production relocation decisions had the highest availability of financial information on all levels among the three countries, possibly indicating overall high cost consciousness in Swedish companies. Among the Finnish respondent companies, there seemed to be clear differences in the availability of financial information between the companies with and without production relocation experience. The Finnish companies with both offshoring and backshoring experience seemed to have large amounts of available financial information.

Offshoring companies in Denmark seemed to have more financial information available than those that only backshored production. In contrast, the backshoring companies in Finland and Sweden tended to have more financial information available than those that did only offshoring or that did no production movement. The availability of financial information did not necessarily lead to suitable analyses or perceived support for relocation decisions. Therefore, these aspects were analyzed further across the three countries examined.

PERCEIVED SUPPORT FROM FINANCIAL INFORMATION IN ANALYSIS AND DECISION-MAKING

In general, the perceived support for financial analyses did not vary greatly among the company categories, but some country-based differences seemed to exist. With respect to perceived support for financial analyses, the Swedish respondent companies outperformed the Finnish and Danish companies at all levels of analysis. The Finnish companies had greater perceived support for analyses than the Danish companies at all levels. Tables 13a, b, and c present the perceived support for financial analyses among the company categories across the three countries. The highest number in each column is presented in **bold**, and the lowest number in *italics*.

TABLE 13A. PERCEIVED SUPPORT FOR FINANCIAL ANALYSES OF PRODUCT FULL COSTS, PRODUCT PROFITABILITY, AND PLANT PROFITABILITY IN DENMARK (MEAN VALUES).

	PRODUCT FULL COST	PRODUCT PROFITABILITY	PLANT PROFITABILITY
No movement (N = 126-127)	*3.69*	3.53	3.76
Only offshoring (N = 77)	3.75	3.57	3.69
Only backshoring (N = 15)	3.73	*3.33*	*3.53*
Both offshoring and backshoring (N = 20)	**3.95**	**3.90**	**4.10**

TABLE 13B. PERCEIVED SUPPORT FOR FINANCIAL ANALYSES OF PRODUCT FULL COSTS, PRODUCT PROFITABILITY, AND PLANT PROFITABILITY IN FINLAND (MEAN VALUES).

	PRODUCT FULL COST	PRODUCT PROFITABILITY	PLANT PROFITABILITY
No movement (N = 143-144)	*3.79*	3.67	3.85
Only offshoring (N = 55)	3.80	*3.58*	3.98
Only backshoring (N = 16-17)	4.18	3.94	**4.19**
Both offshoring and backshoring (N = 13)	**4.23**	**4.08**	*3.69*

TABLE 13C. PERCEIVED SUPPORT FOR FINANCIAL ANALYSES OF PRODUCT FULL COSTS, PRODUCT PROFITABILITY, AND PLANT PROFITABILITY IN SWEDEN (MEAN VALUES).

	PRODUCT FULL COST	PRODUCT PROFITABILITY	PLANT PROFITABILITY
No movement (N = 151)	4.01	**3.97**	**4.19**
Only offshoring (N = 77-79)	*3.79*	*3.59*	*3.92*
Only backshoring (N = 41)	**4.05**	3.90	4.10
Both offshoring and backshoring (N = 59-60)	3.90	3.87	4.08

As shown in Tables 13a, b, and c, Finnish backshoring companies perceived high support for their financial analyses, especially for product full cost, a key unit of analysis in production relocation decisions. As well, the Danish companies that did both offshoring and backshoring seemed to perceive high support for their financial analysis, especially compared to other company categories in Denmark. The Swedish respondent companies without production relocation experience had high support for financial analyses both across the countries within this category and across the categories in Sweden. Plant profitability analyses, in particularly, were supported.

As discussed, the financial information supported actual decision-making only to a moderate extent, despite the high availability of financial information and perceived support for financial analyses. The country profiles differed from each other in this respect to some extent. The Danish companies perceived the greatest support for decision-making in two categories: plant location and delivery channel selection. The Finnish respondent companies perceived the greatest support for supplier selection. Tables 14a, b, and c present the perceived support from financial information for decision-making by company category across the three countries. The highest number in each column is presented in **bold**, and the lowest number in *italics*.

TABLE 14A. PERCEIVED SUPPORT FOR DECISION-MAKING IN SELECTION OF PLANT LOCATION, SUPPLIER, AND DELIVERY CHANNEL IN DENMARK (MEAN VALUES).

	SUPPLIER SELECTION	PLANT LOCATION	DELIVERY CHANNELS
No movement (N = 108-123)	3.00	*2.64*	*2.92*
Only offshoring (N = 74-77)	3.08	3.16	3.01
Only backshoring (N = 15)	*3.00*	2.80	2.93
Both offshoring and backshoring (N = 18-19)	**3.42**	**3.53**	**3.28**

TABLE 14B. PERCEIVED SUPPORT FOR DECISION-MAKING IN SELECTION OF PLANT LOCATION, SUPPLIER, AND DELIVERY CHANNEL IN FINLAND (MEAN VALUES).

	SUPPLIER SELECTION	PLANT LOCATION	DELIVERY CHANNELS
No movement (N = 132-142)	*3.11*	*2.68*	2.96
Only offshoring (N = 51-54)	3.24	3.08	*2.67*
Only backshoring (N = 16-17)	**3.65**	**3.25**	3.29
Both offshoring and backshoring (N = 13)	3.62	2.92	**3.31**

TABLE 14C. PERCEIVED SUPPORT FOR DECISION-MAKING IN SELECTION OF PLANT LOCATION, SUPPLIER, AND DELIVERY CHANNEL IN SWEDEN (MEAN VALUES).

	SUPPLIER SELECTION	PLANT LOCATION	DELIVERY CHANNELS
No movement (N = 106-144)	3.19	*2.74*	2.83
Only offshoring (N = 71-73)	*3.18*	2.85	*2.68*
Only backshoring (N = 36-40)	**3.28**	2.97	**3.05**
Both offshoring and backshoring (N = 55-58)	3.19	**3.07**	3.00

The Danish respondent companies that did both offshoring and backshoring and the Finnish companies that did backshoring or both offshoring and backshoring perceived more support for actual decision-making. In Sweden, many companies with no production movement experience perceived relatively high support for decision-making. It should be noted, though, that these differences are relatively small, and the perceived support in general is only moderate.

TWO CASE STUDIES: UNVEILING RELOCATION DECISION PROCESSES IN OFFSHORING AND BACKSHORING

Two production relocation cases are presented here to delve more deeply into the role of financial information in production relocation decisions. The case studies were conducted in Finland in 2016, and the findings are based on in-depth interviews of the parties involved in the decision-making, on company documentation, and on extensive email and phone conversations with the informants. The focus of the cases is on describing the production-relocation decision-making processes and the role of financial information in them. The associated risks and uncertainties are also examined. Case A focuses on offshoring decisions, and Case B on backshoring.

Case company A is a Finnish, medium-sized, family-owned company that manufactures components for heavy industry. Its headquarters and main production facilities have been in their site in Finland since the 1970s. The company recently started a new production facility in an Eastern European country.

Case company B is a Finnish large company that manufactures ventilation products and systems for industrial customers. It has a presence on three continents and in 30 countries. This case focuses on its recent decision to move production from an Eastern European country to Finland.

Company A—Offshoring

Company A's decision-making process regarding offshoring production from Finland to an Eastern European country took place over a three-year period from the first considerations of international expansion in late 2000s to the establishment of a subsidiary in the targeted country in the early 2010s. The decision was made by an informal project group of three decision-makers, including the then-chief executive officer (CEO) of the company. After the final location decision was made, a formal project organization was established, and the construction of a production facility was started. The rest of the executive board contributed to decision-making during the three-year period.

There were no formal, set objectives for the decision. From the very beginning, there was a consensus to find a brownfield investment (purchasing an existing manufacturing facility from its current owners) in Eastern Europe, where the production of high-volume components was less costly than in Finland. At the same time, the idea was to retain the manufacturing of tailored, low-volume products in Finland, where their production was still considered to be more beneficial when taking into account various factors, such as flexibility and proximity to R&D.

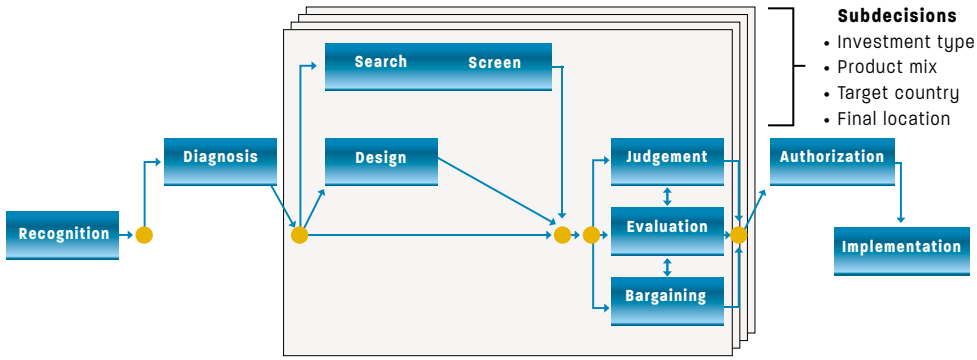
No single factor triggered the decision on the new factory location. The key person in this initiative was the company executive responsible for business development who examined several factors from different sources to formulate the initiative. Some of the most important factors that contributed to the decision included:

- The company's strategic choice to pursue growth even as it already had market leadership and little room to grow in Finland
- Requests and ideas from customers to locate facilities nearer to them
- Preliminary investigations by the company's sourcing team on manufacturing cheaper components in Eastern Europe
- Cost pressure from Central European customers on high-volume–low-mix products, caused primarily by high labor costs in Finland

The decision-making process, shown in Figure 2, started with recognition of the need to consider investment in foreign manufacturing. Next, the company's business development manager made diagnostic investigations. As the explicit commitment to invest abroad was made, the process entered a phase that included four sub-decisions: investment type, product mix, target country, and final location. Each sub-decision had its own decision process moving through information gathering, evaluating, and choosing a solution. No discrete sequence between the sub-deci-

sions, though, could be identified. While some decisions were made before others, the decision-makers pointed out that several sub-decisions were considered simultaneously and that many options were kept open until late in selection of the final location. After all the sub-decisions were made, the team continued to work toward implementation.

FIGURE 2. COMPANY A'S OFFSHORING DECISION-MAKING PROCESS.



Regarding the investment type, investing in an existing facility was initially considered. As the team members gained knowledge of the brownfield candidates and, especially, as they visited the locations, however, they eventually reached the conclusion that the best way to ensure a high standard of quality and reasonable control of the facility's infrastructure was to invest in a greenfield facility.

The selection of product mix was probably the most complex of all four sub-decisions. Several investment calculations were drafted to support different alternatives. The selection of the target country was started by gathering information about possible options and then evaluating them both qualitatively and quantitatively. The selection of the final location was an extension of finding the target country. Several location candidates were identified with the help of FinPro and its network in the target country. The longlist was shortened through quantitative means and personal visits to the sites.

This multiphase process required several financial and non-financial analyses before the implementation. The role of financial information in the sub-decisions varied. The initial search for a brownfield investment was based mostly on gut feeling, while in the later stages, more detailed quantitative analyses were needed for the financing of the greenfield investment. The product-mix decision required calculations that provided clear answers about the boundary conditions for the products to be produced. These calculations informed the decision-makers about the

economic reality of the location candidates' production cost structure and supplied arguments in internal discussions.

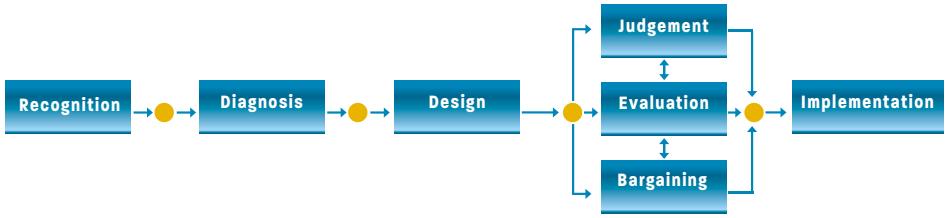
The whole process required a great amount of financial information for various purposes. High uncertainty was perceived because even the extensive financial analyses were considered to have high risk factors when fully supporting informed decision-making. Company A represents a situation in which production relocation was a relatively new issue for the company. During the complex fact-finding and analysis process, the company representatives tried to make sufficient financial information available for decision-making, but at the same time, the required routines to fully support decision-making were not established. This process significantly increased the cost consciousness of the involved parties.

Company B—Backshoring

Company B acquired a Finnish manufacturing competitor in the same industry in the early 2000s, with the intent of gaining synergy benefits, such as shared customers and possibilities for solution selling. Along with the acquisition came a new production facility in an Eastern European country. This facility was not considered to be a strategic asset but provided an opportunity to acquire a presence in Eastern Europe and serve customers in Central Europe. The decision to backshore production from this facility to Finland was made 10 years after the acquisition. The backshoring decision-making process was significantly shorter than in the offshoring decision in Case A, taking approximately a year from first talks to the final decision.

No separate project organization or formal decision processes were utilized to arrive at the final decision, although the backshoring was considered to be a project. Two main reasons to backshore were identified. First, the backshored facility incurred substantial losses for a prolonged period as there was a very limited local market for the plant's products. The company's strategy in Finland was to provide tailored, high-quality products with short lead times to well-known customers. Although this strategy was highly effective in Finland, it did not succeed in Eastern Europe. There, customers demanded low-cost products and were reluctant to establish long-lasting supplier relationships. The second main reason for backshoring was that the plant in Eastern Europe was systematically viewed as not representing the core competence of the company. Company B's decision-making process is visualized in Figure 3.

FIGURE 3. COMPANY B'S BACKSHORING DECISION-MAKING PROCESS.



The decision-making process did not include sub-decisions as it mainly concerned transferring production from one location to another within the current company structure. There were many discussions on what should be brought to Finland (e.g., machinery, information, key persons). There was also the question of what potentially might still be produced in Eastern Europe. This discussion formed the core of the decision-making process, from the design to the judgement, evaluation, and bargaining phases.

The process was described as "straightforward, data-driven and swift." The decision-makers had to deal with little uncertainty. Due to the long-term losses and limited market potential of the Eastern European operations, it was easy to support the relocation decision with financial information. Production costs in Eastern Europe and Finland were discussed in light of the overall financial status of the Eastern European facility. Production costs were higher in Finland, but the profit potential there also remained higher.

The valuable lesson learned from Company B was the need to quantify the benefits of domestic production in terms of quality, flexibility, and supplier reliability. Indicators related to these factors could have important roles in future offshoring and backshoring decisions by Finnish manufacturing firms. In addition to these indicators, professional judgement was a valuable tool in evaluating manufacturing relocation decisions. Financial information played roles in reducing uncertainties and supporting setting boundaries and guiding the production relocation decisions.

CONCLUSIONS

The chapter has examined the role of financial information in guiding production relocation decisions. A survey was administered to analyze the availability and potentially supportive role of financial information in guiding offshoring and backshoring decisions. In addition, two case studies were conducted to gain deeper

understanding of the actual decision-making processes in production relocation. Although financial information is closely related to many drivers of production relocation decisions, the use of such information in different ways in the actual decision-making has not been addressed previously in the literature on this topic.

The survey results suggested that there were still challenges in the perceived availability of relevant financial information, although access to such information was generally sufficient. At the same time, there were significant differences among the company groups with respect to the availability and perceived support of financial information (see Table 15).

TABLE 15. PERCEIVED SUPPORT AND USE OF FINANCIAL INFORMATION BY MANUFACTURING FIRMS ACCORDING TO EXPERIENCE WITH PRODUCTION RELOCATIONS.

Denmark, Finland, Sweden	NO MOVEMENT	ONLY OFFSHORING	ONLY BACKSHORING	BOTH OFFSHORING AND BACKSHORING
Availability of financial information	Medium	High	High	Very high
Support for analyses	Medium / High	Medium / High	High	High
Support for decision making	Low / Medium	Low / Medium	Medium, supplier selection supported	Medium, supplier selection supported

As shown in Table 15, manufacturing companies that both offshored and backshored production perceived financial information as more supportive than other companies. In general, backshoring decisions were better supported by financial information than offshoring decisions. One can assume that backshoring required more accurate analyses at the product and plant levels to anticipate and manage the financial consequences of the decision. At the same time, companies, especially Swedish firms, that did not make production movements were also relatively satisfied with the availability and support of the financial information. This result might have been due to the relative stability of their industries, production location choices, or financial reporting practices.

In the two case studies, the role of financial information was important for decision-making but varied by case. In the offshoring case, the availability and support of financial information was found to increase as the offshoring process moved forward. A great amount of financial information was needed to make the decision, but the data were not sufficiently accurate to clearly support the decisions in advance. In the backshoring case, the role of financial information was quite clearly an answer

machine (Burchell et al., 1980) regarding the need for the backshoring decision. The backshoring decision did not require specific financial information beyond day-to-day reporting. The backshoring case, though, also suggested the need for new, specific financial analyses after the decision was made and the need to quantify the advantages of domestic manufacturing. These cases showed that there was a need for financial information to initiate and guide production relocation decisions. Moreover, the role of financial information could be reinforced by providing economic facts or reducing uncertainties to shape complex relocation decisions (Burchell et al., 1980; Wihinen, 2012).

As a major practical implication, these findings suggest that firms' capabilities for financial analyses regarding production relocation require further development. Offshoring companies need support from financial information to make accurate, informed decisions, while backshoring companies must understand the value of domestic flexibility, quality, and other relevant factors. Increased overall awareness of financial analyses and considerations and enhanced capabilities to design and utilize such analyses are needed. This awareness and capabilities would improve the effectiveness of production relocation decisions.

CHAPTER

3

MANUFACTURING INNOVATIONS AND THEIR IMPLICATIONS FOR MANUFACTURING RELOCATION

MIIA MARTINSUO AND POOJA CHAOJI

INTRODUCTION

Manufacturing innovations require new process configurations with reshored manufacturing and the adoption and diffusion of new manufacturing technologies. New technology adoption has been studied in various contexts in business-to-business settings, particularly concerning advanced manufacturing technologies and information technology in supply chain management. Many studies have associated various firm-level and contextual antecedent factors to the overall degree of adoption of a certain technology (e.g., Patterson et al., 2003, Fuentelsaz et al., 2003). Increasing productivity requires that modernization of technology adoption be complemented with incremental innovations in practices (Ghoshal & Nair-Reichert, 2009). Successful and less successful organizational units undergo quite different collective learning processes when adopting technology (Edmonson et al., 2001). Although the adoption and diffusion of advanced manufacturing

technologies have received some attention from researchers, earlier studies did not explore investments and disruptions in manufacturing technologies in association with manufacturing relocation.

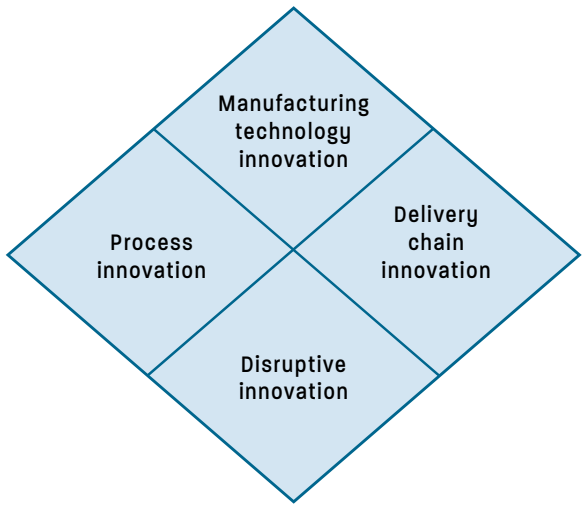
Radical manufacturing technology innovations (RMTI) renew the technology equipment that manufacturing firms use in their core production process and significantly transform that process. The capability to create RMTI is important for manufacturing firms, especially when seeking new directions for growth. Often, the utilization of advances in science and technology involves the creation and adoption of new-to-the-world or new-to-the-industry equipment. Similarly, production capability renewal and new product and business development may demand the creation and adoption of new-to-the-firm technology and equipment. Technology innovations typically entail simultaneous renewal of processes and delivery chains and elimination of outdated technologies, processes, and business models.

In this chapter, a holistic view of manufacturing innovations is adopted for the purposes of increasing knowledge of manufacturing innovations—what they are, what motivates their creation, and how they are created—and identifying ways manufacturing innovations can be linked with relocation activities. The chapter focuses on three main questions, each requiring a different approach and methodology.

Q1. How do the manufacturing innovations and the operational performance of companies with different relocation profiles differ?

To answer the first question, patterns of relocation and manufacturing innovations were investigated using the questionnaire administered in Finland, Sweden, and Denmark. The survey data are described in Chapter 1, and the questionnaire survey used in data collection is found in Appendix 1. Manufacturing innovations were analyzed in four dimensions: manufacturing technology innovations, process innovations, delivery chain innovations, and disruptive innovations (see Figure 4).

FIGURE 4. DIMENSIONS OF MANUFACTURING INNOVATION STUDIED.



Multi-item scales (1 = totally disagree or not at all; 5 = totally agree or to a great extent) were used for the variables of these dimensions, and operational performance was assessed in terms of cost efficiency (CE) and quality, delivery time, and flexibility (QDF) performance. Manufacturing relocation was covered in questions on companies' previous experience in offshoring and backshoring and in a future-oriented, multi-item variable concerning the strategic importance of relocation.

> Q2. What motivates manufacturing firms to initiate RMTI creation, and what kinds of challenges do they experience during it?

For the second question, an exploratory study with manufacturing firms was conducted, with the aim to increase understanding of the practices that initiate and create RMTI. The underlying premise was that some companies use RMTI to enhance manufacturing performance and, thereby, *avoid* manufacturing relocation or successfully *reconfigure* home-country manufacturing in connection with relocation. For this study, companies that had purposely and successfully invested in RMTI in Finland were targeted. The data were collected through interviews with representatives of manufacturing firms in Finland. Firms of all sizes (2 small, 8 medium, 13 large) in different industries were included, primarily in business-to-business settings and product-based manufacturing. The list of RMTI cases is included in Appendix 2. Semi-structured interviews were the primary data-collection instrument, supported with other relevant public data sources, such as company websites. The full results are reported in Chaoji and Martinsuo (2016b), and certain results are available in Chaoji and Martinsuo (2016a, 2016c).

> Q3. How and through what kinds of processes do manufacturing firms create and initiate RMTI?

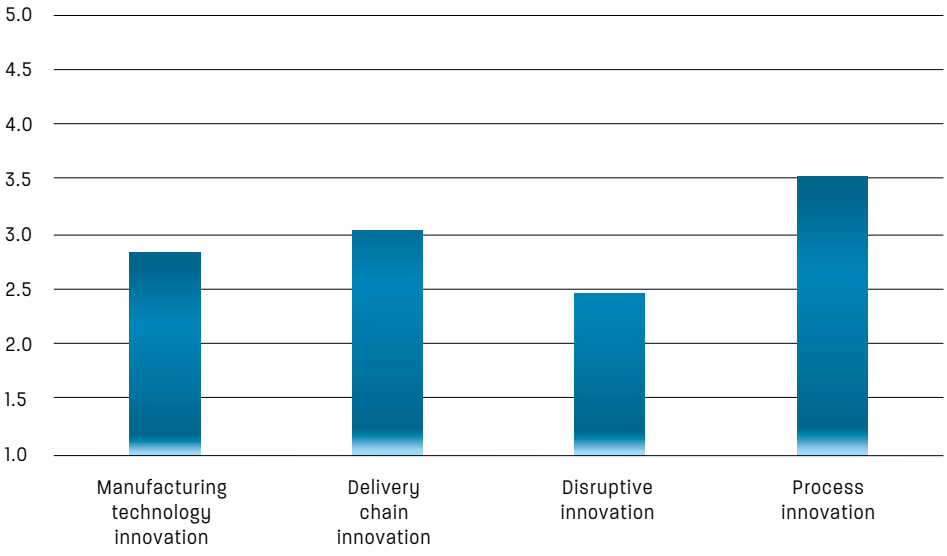
To answer the third question, the exploratory study was complemented with an embedded, multiple-case study with three manufacturing firms, each with three cases of RMTI. In addition to describing alternative RMTI processes, the interest was in learning how RMTI could be initiated efficiently, even if it was challenging and risky. The exploratory study identified three main types of processes for creating RMTI and mapped 23 cases in line with these processes. To build a deeper understanding of the reasons and conditions for implementing certain processes, three cases were selected for an in-depth, multi-informant interview study. The three firms had very different strategies and approaches to RMTI, enabling both within-case and cross-case comparison of RMTI creation.

MANUFACTURING RELOCATION AND INNOVATIONS IN THREE NORDIC COUNTRIES

The research investigated the importance that the respondents gave to relocation and the role of production location choices in company strategy (the attention given to location changes, their influence on the direction of business, and perceptions of offshoring and backshoring as strategic alternatives for the manufacturing footprint). The respondents considered relocation issues to have moderate to somewhat high importance in company strategy (mean: 3.27, s.d. 0.94). There were significant differences between the countries: the respondents in Denmark rated the strategic importance of location changes in company strategy higher than the respondents in Finland and Sweden ($p<0.05$).

According to the questionnaire respondents, the firms on average pursued process innovations (i.e., business process improvements, reorganization of resources, changes in routines and earning logics) to a fairly high extent (mean: 3.54, s.d.: 0.69) and delivery chain innovations (i.e., new customer and supplier relationships, new kinds of services, cooperation with competitors) to a moderate extent (mean: 3.02, s.d.: 0.66). The extent of manufacturing technology innovations (i.e., new process technologies, digitalization, new high-tech materials, automation, robotization) was also moderate (mean: 2.81, s.d.: 0.90). As well, the extent of disruptive innovations (i.e., making obsolete some customer relationships, supply and delivery chains, value propositions, supplier partnerships and processes) was fairly low (mean: 2.46, s.d.: 0.90), as expected. These results are summarized in Figure 5.

FIGURE 5. RESPONDENTS' EXPERIENCES OF THE DEGREE TO WHICH FIRMS IMPLEMENTED DIFFERENT TYPES OF MANUFACTURING INNOVATIONS (N = 793…812)



The country-specific responses on process and delivery chain innovations did not differ at a statistically significant level. The cross-country analysis revealed how countries differed from each other and showed that the respondents at manufacturing firms in Denmark reported a higher extent of manufacturing technology innovations than the Swedish and Finnish respondents ($p<0.05$). The respondents in Sweden reported a higher degree of disruptive innovations than the Danish and Finnish respondents, and the Danish higher than Finnish respondents ($p<0.001$).

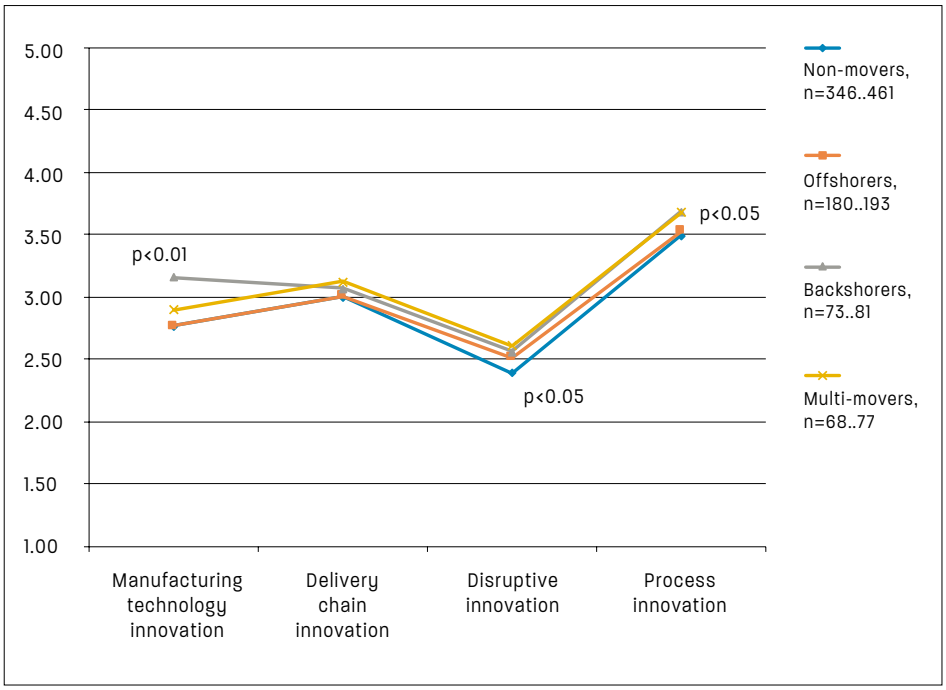
The operational performance of the respondents' manufacturing plants was assessed in terms of cost efficiency (reduction of total costs and unit costs, improved productivity, and product profitability) and QDF performance within the industry (industry leader in product quality, delivery lead times, and flexibility). On average, the respondents rated themselves as rather high in both dimensions (cost efficiency mean: 3.85, s.d.: 0.75; QDF performance mean: 4.13, s.d.: 0.67). There were significant differences between countries: the Danish respondents rated themselves higher in both cost efficiency ($p<0.001$) and QDF performance ($p<0.05$) than Finnish and Swedish respondents, and Swedish respondents had higher scores in cost efficiency than Finnish.

Relocation Decisions and Manufacturing Innovations

The differences between companies that made different relocation decisions (nonmovers, offshoring firms, backshoring firms, and bidirectional movers) were analyzed. The strategic importance of location changes clearly differed across firms ($p<0.001$) in a very logical way: the firms doing offshoring or both offshoring and backshoring assessed the strategic importance of location changes as higher than those doing only backshoring or not moving manufacturing.

Figure 6 reports the comparisons concerning manufacturing innovations. Companies that made different location decisions did not differ in delivery chain innovations, and the cross-group differences in disruptive innovations and process innovations were minor (i.e., the pairwise differences were not significant even if the overall difference was). Those companies that did only backshoring were also more active than the other firms in manufacturing technology innovations ($p<0.01$).

FIGURE 6. COMPARISON OF MANUFACTURING INNOVATIONS ACROSS COMPANIES WITH DIFFERENT RELOCATION PROFILES



The QDF performance measure differed across groups ($p<0.05$). The firms that did only backshoring had higher QDF performance scores than the other groups. Backshoring, therefore, appeared to be linked with both manufacturing technology innovations and QDF performance.

Manufacturing Innovations and Performance

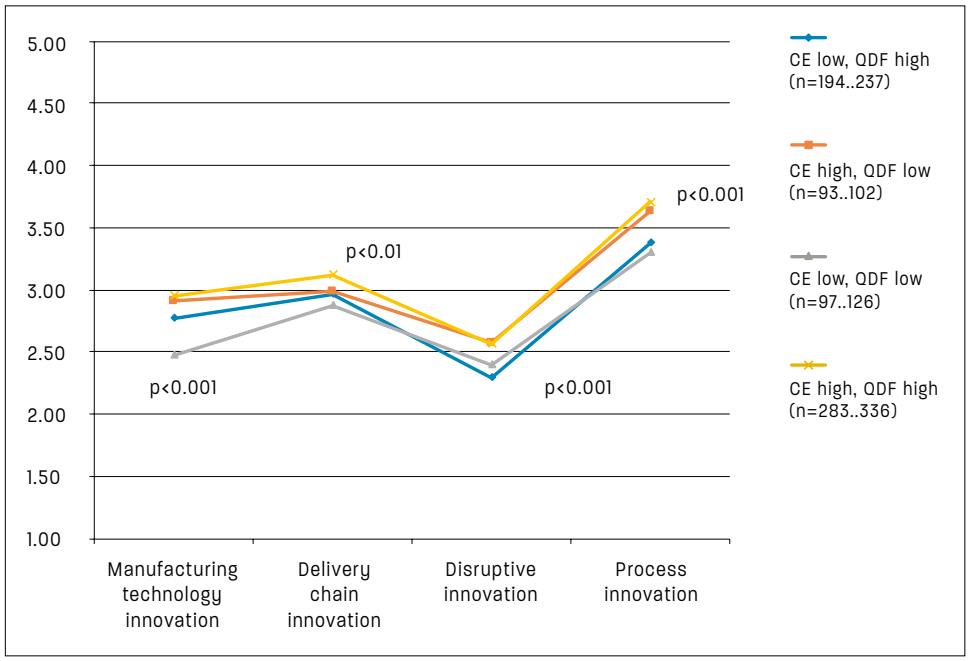
To analyze how firms with different types of performance profiles differed in manufacturing innovations, the firms were clustered based on cost efficiency and QDF performance. Firms with an average performance score of less than 4 were categorized as low, while those with scores of 4 or higher were categorized as high. The clusters and number of firms in each cluster are reported in Figure 7. The manufacturing innovations by these four clusters of respondent firms were then compared.

FIGURE 7. MANUFACTURING FIRMS CLUSTERED BASED ON OPERATIONAL PERFORMANCE.

		COST EFFICIENCY PERFORMANCE: Low	COST EFFICIENCY PERFORMANCE: High
QDF PERFORMANCE	Low	126	102
	High	238	336

This analysis, summarized in Figure 8, revealed a pattern as the firms with high degrees of cost efficiency also reported higher rates of all types of manufacturing innovations. This difference was especially clear in manufacturing technology innovations ($p<0.001$), disruptive innovations ($p<0.001$), and process innovations ($p<0.001$). In delivery chain innovations ($p<0.01$), the companies with both high cost efficiency and high QDF performance had higher levels of innovation than the other performance clusters. These findings suggested that the active pursuit of manufacturing innovations was either justified by or reflected in higher cost efficiency in performance.

FIGURE 8. COMPARISON OF MANUFACTURING INNOVATIONS AND RELOCATION IMPORTANCE ACROSS COMPANIES WITH DIFFERENT PERFORMANCE LEVELS.



Overall, the questionnaire results suggested that being active in manufacturing innovations was closely related with relocation patterns, especially backshoring, and improved cost efficiency performance. Manufacturing technology innovations, in particular, appeared to be a key differentiating innovation dimension. Therefore, it could be interesting to explore the creation of manufacturing technology innovations as a way to identify the mechanisms supporting manufacturing firms staying in their home countries.

RATIONALE AND CHALLENGES IN CREATING MANUFACTURING TECHNOLOGY INNOVATIONS

The qualitative exploratory study on RMTI investigated companies' starting points and rationale for creating manufacturing technology innovations. The initiation of the idea for creating RMTI run contrary to the wisdom of investing in industrially proven, mature production technology and equipment. Creation of RMTI may also be a way to avoid relocation of manufacturing and the related investments and risks or to reconfigure home-country manufacturing operations after relocation. Considerable risks and high uncertainty are associated with the creation and adoption of RMTI. In this research, the interviewees pointed out various factors leading to the initiation of RMTI: research-based new knowledge, firm strategy, strategic operations development objectives, needs within the firm, interaction in professional networks, experience with new or similar equipment in a different context, and the diffusion of new technology. These factors are summarized in Table 16.

TABLE 16. FACTORS DRIVING THE INITIATION OF RMTI.

DRIVER OF THE RMTI IDEA	DESCRIPTION	CASES
Need	Need inside firm led to rationale to consider unproven, novel technology equipment as solutions	**1, 2, 12, 18, 20, 22, 23**
Network	Discussion in a group of people from different firms leading to project for pursuing a potential idea for new equipment. Public funded projects are an instrument in enabling initiation in network and were utilized in each of the cases which were initiated in network.	**1, 3, 4, 7**
Experience	Observation of and experience using the new equipment in another context led to idea for experimenting with similar equipment in core production process. • Systematic and close observation of existing processes in production typical to incremental innovation ideas. • Experience and observation less systematic and more like a chance event, natural event leading to inspiration, or idea originating in new knowledge for individual involved typical to radical innovations.	**2, 13**
Research/ knowledge	R&D Projects led to new knowledge that enabled the RMTI. The new knowledge and R&D projects were pursued with interest in development of future technology, and went through long waiting period before they were taken up for serious consideration. These projects however enabled ideas for new possibilities, and hence were a part of initiation of RMTI.	**1, 3, 4, 7, 9, 14**
Strategy	Customer needs and strategic operations development objectives (e.g. reduce throughput time, new capability demanded by NPD projects) led to initiation of search for solutions that involved RMTI	**5, 6, 8, 11, 12, 15, 16, 17, 18, 19, 20, 21, 23**
Technology	Potential of technologies related to automation, newer components which can be taken to use led to inspiration for creation of better equipment at the time of replacement of previous special purpose equipment, or earlier than end of life of equipment in use when motivated by other initiation factors.	**(8), 10, 20, 21**

Analyses of the rationale for RMTI initiation showed that firms' needs could be categorized by whether they emerged from firm strategy or perceived problems in operations. Strategy was naturally linked with the operational objectives defined for the RMTI. Table 17 summarizes the needs and objectives that the interviewees discussed as the rationale for RMTI.

TABLE 17. OBJECTIVES AND NEEDS AS RATIONALE FOR RMTI.

STRATEGIC NEEDS FOR RMTI	OPERATIONAL NEEDS FOR RMTI	OPERATIONAL OBJECTIVES FOR RMTI
• Change in customer and market needs • Strong strategic values and plans for new business • New business development initiatives	**Strategic operations development needs** • More production capacity (rising volumes) • New production capability for new products **Difficulties in current operations** • Difficult to do manually (operator health) • Difficult to achieve good quality • Equipment difficult to use (e.g. maintenance) • Process too slow • Equipment not available • Persistent problem	• high and uniform quality • improve competitiveness • improve utilization • maintenance easy and cheap • make cheaper • make faster • make flexibly, accommodate variety, random scheduling

Strategy at the firm level guided strategy for operations development. Therefore, strategic alignment of RMTI ideas was necessary to receive resources. In some RMTI cases, the level of investment costs apparently was very high for the firm involved, yet it decided to invest due to the perceived strategic importance for business development and survival. The strategic need for RMTI led to a strong rationale for investment in creating RMTI in these cases and even helped overcome barriers related to expensive equipment.

While a strong rationale based on strategic need and/or operational problems was very important for making the decision to invest in the creation of RMTI, needs within the manufacturing firm did not serve as a starting point for the initiation of RMTI in all cases. In some cases, an exploratory attitude toward investing in process R&D which aligned with the firm's strategic interests did provide a rationale for the initiation of RMTI. Such a change in the strategic significance of RMTI ideas can be seen as a chance event which led to the initiation of RMTI. In some cases, firm personnel came across new knowledge, developed an idea to solve an existing operational need or problem, identified the availability of new technology, or found a reliable partner to develop RMTI. Therefore, in addition to strategic and operational needs, capturing opportunities was a potential path to RMTI.

Barriers to Initiating, Creating, and Implementing RMTI

Potential barriers to the *initiation of RMTI* included disconnection from sources of knowledge about new technology, investment practices and cultures emphasizing low risk and minimization of investment costs, and a lack of customer and market pressure, strategic interest, volume growth in current production, and resources (e.g., time, outside partners, technical experts within the firm and outside partners). Figure 9 summarizes these barriers.

FIGURE 9. SUMMARY OF BARRIERS AND CHALLENGES TO INITIATING RMTI.

The common challenges to *RMTI creation* arose from the first-time nature of the experience for the manufacturing firm and the supplier firm and a lack of clarity about technical specifications and construction. From the perspective of the manufacturing firm, the first-time experience consisted of using technology new to firm members, which required learning and overcoming hesitation about the newness of the technology. Training operators and learning to use the new technology equipment in regular production demanded significant effort in most cases observed. The first-time nature of the experience created uncertainties. There might have been dependencies on other processes used in production before the equipment could be used. With a new technology, achieving this goal might have taken longer.

Development issues could arise when the equipment was put to test in the actual production environment. From the technology provider's perspective, the manufacturing firm managers and operators had learned to use the new equipment or technology once they felt confident in making decisions about the new equipment. From both the supplier's and the manufacturing firm's perspectives, the organization, its strategy, and its culture were important enablers and barriers to the initiation and smooth implementation of RMTI. The barriers and challenges to RMTI creation and implementation from the manufacturing firm's perspective are summarized in Figure 10.

FIGURE 10. MANUFACTURING FIRMS' BARRIERS AND CHALLENGES TO RMTI CREATION AND IMPLEMENTATION.

Related to the first-time experience of the supplier firm, the difficulties included learning about the behavior, designing the use of the new technology, and ordering and incorporating the right components. Another type of challenge was difficulty in construction itself. Over time, with experience, the suppliers learned better ways of planning and constructing the equipment.

DIFFERENT PROCESSES FOR DIFFERENT RMTI CONTEXTS AND CASES

The sample of 23 RMTI cases in the exploratory study was heterogeneous and included examples from different industries and process technologies. Some cases involved shorter creation processes, and some longer processes with more activities and phases, indicating the level of effort put into RMTI creation. The analysis revealed three types of creation processes differentiated by the amount of effort required depending on whether the process involved the creation of new process know-how, new technology for use in a new industrial application, and the design and development of equipment from the concept level:

- In the *procurement type* process of RMTI creation, neither new process know-how nor new equipment concept were created. Instead, this process primarily concerned identifying, ordering, implementing, and learning to use suitable technology.
- The *development type* process of RMTI creation involved the creation of new equipment concepts, engineering work, and specification development.
- The *invention type* process of RMTI creation entailed the creation of new process know-how and new equipment concept development. This process had a longer front end involving basic research followed by application-oriented research to test the feasibility of the new process application for real industrial use.

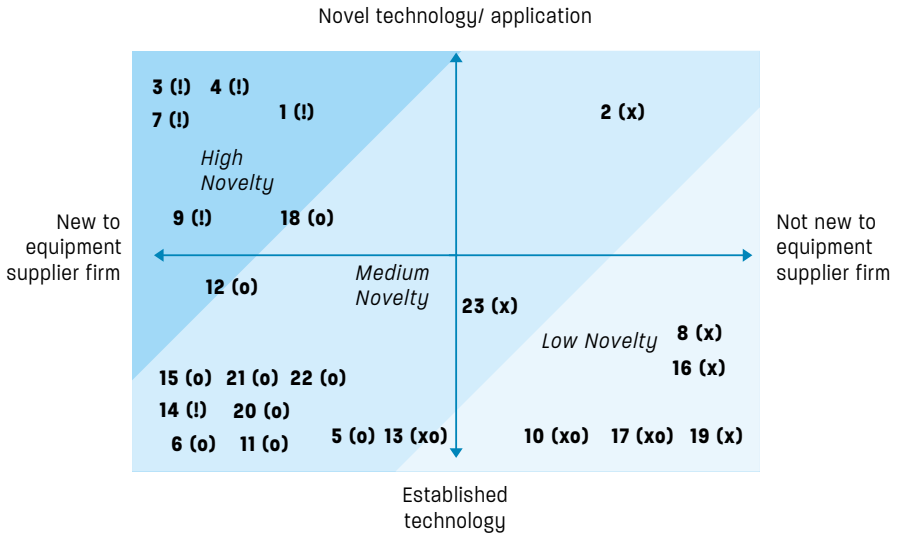
These three types of processes and their phases are summarized in Table 18.

TABLE 18. THREE TYPES OF RMTI CREATION PROCESSES IN MANUFACTURING FIRMS.

PROCESS TYPE	PROCESS DESCRIPTION				
Procurement process	Pre-study	Procurement	Implementation		
	• Process conceptualization • Technology investigation	• Investment planning and decision • Investment preparation • Order equipment • Delivery, installl, trials	• Ramp up • Learn to use		
Development process	Concept design	Development	Implementation		
	• Process conceptualization • Equipment concept development, including technology selection • Equipment prototype (proof-of-concept models)	• Investment planning and decision • Contract • Equipment engineering, designing • Construction, trials, possible re-work • Delivery, installation • Production trials, possible rework	• Ramp-up • Learn to use		
Invention process	Creation of new process know-how	Process concept validation	Investment consideration	Equipment development	Implementation
	• Basic research (technical, lab-scale) • Discussions exploring new process application • Create consortium for development of idea.	• Proof-of-concept level prototype, demo plant • Identify critical areas of risk and uncertainty.	• Address and solve critical areas of risk and uncertainty • Investment planning • Decision, negotiation, contract	• Equipment design and engineering • Construction • Trials, possible redesign, rework • Delivery, installation • Production trials, possible redesign, rework	• Ramp-up • Learn to use, possible adaptations

The results of the exploratory study showed that the manufacturing firms used different processes for their individual RMTI efforts due to uncertainty and novelty in particular. The cases varied in the degree of novelty for the supplier and manufacturing firms and in the degree of the novelty of the technology involved in the new equipment. Figure 11 summarizes these characteristics of RMTI among the studied RMTI cases and indicates the overall level of novelty. The findings showed that the invention process was common in RMTI cases with high novelty, the development process in cases with medium novelty, and the procurement process in RMTI cases with low novelty.

FIGURE 11. COMPARISON OF RMTI PROCESSES IN THE EXPLORATORY STUDY.



Legend:	Process type
x	Procurement process
o	Development process
!	Invention process

Newness to the equipment supplier was important in distinguishing among the process types, especially the procurement and development processes. In some cases, the equipment was a modular or standard product for the equipment supplier, and instead of having a one-size-fits-all applications solution, suppliers were experienced experts in tailoring modules for the unique applications required by the manufacturing firms. This made the individual equipment unique for the manufacturing firm, but the creation effort was not very novel for the professional equipment

supplier. This was a different situation than that of a tool builder that made tailored, stand-alone equipment using components. Even if previously invented technologies were used, the creation process relied on engineering work and feedback from trials and testing to figure out the exact configuration of known technology elements. For a very novel technology, there was no previous knowledge or experience related to the design and implementation of this RMTI anywhere in the world. This increased the importance of trial and error, experimentation, and learning by doing.

The processes of RMTI creation varied in uncertainty and novelty. The risk and opportunity associated with these processes grew progressively greater as uncertainty increased from the procurement and development process to the investment process. Learning by doing was characteristic of the invention and development processes due to the lack of previous know-how. Although many firms might have seen this as a reason to steer away from RMTI, these examples illustrated how leading firms accomplished novelty and managed uncertainty.

Front End of RMTI

To delve deeper into the initiation of and alternative strategies for RMTI, a more in-depth study was conducted with three companies actively involved in multiple different RMTI cases. The cases were selected for contextual diversity and stability. While different companies were included to enable contextual comparison, the exploration of different RMTI cases within each firm made it possible to stabilize the strategic context and compare the RMTI cases within similar business contexts.

Firms had different strategies and approaches to RMTI. In this study, it was observed that some firm owners and senior managers made RMTI part of their strategic focus, whereas other firm owners and managers did not perceive them as strategic priorities. With an operational orientation toward RMTI, the initiation of RMTI occurred at the level of operations development and manufacturing department heads. The cases selected for the in-depth study consisted of two firms (Company C, Company D) where RMTI was initiated with the close involvement of senior management (level of senior vice presidents reporting to the CEO) and one case firm (Company E) where RMTI was initiated at the level of the production and production development departments. In Company E, the role of senior management was budget approval if the RMTI development costs exceeded certain limits. In the first two case firms, the RMTI had a higher level of novelty, and the initiation activities were concentrated in teams of researchers. The chosen RMTI examples studied from all three firms (three examples per firm for a total of nine examples) were quite comparable because they involved the development of unique applications of existing technologies from other industries and contexts. Table 19 describes the three case firms and their approaches to the initiation of RMTI.

TABLE 19. DIFFERENCES IN THE CASE-STUDY FIRMS' RMTI FRONT-END STRATEGIES.

	COMPANY C	COMPANY D	COMPANY E
Size	Small (<500 employees)	Medium (<1000 employees)	Large (>5000 employees)
Industry	Electronics	Pulp and paper	Electrical industrial products
Market position	Niche market leader, among top 10 global firms	Market leader, among top global firms	Market leader, among top global firms
Need for RMTI	• Business survival through product innovation • Customized equipment needed to drive product innovation	• Business development toward emerging markets through superior product performance and image • Co-developing RMTI with like-minded technology suppliers	• Business maintenance and cost reduction through continuous efficiency improvement • Special purpose equipment needed for automation and optimization
Role of senior management	Actively managing new technology projects, together with process engineers.	Initiation of technology projects and organizing development teams to investigate pre-selected solutions.	Setting business and efficiency goals for production departments and stimulating personal passion in production process owners for finding solutions.
Source/ location of RMTI initiation	Products department	Business development department	Operations development and production department
Approach for RMTI front end	• Challenge • Search of technology • Search of supplier • Customization for the company's unique need	• Development priorities • Investigation of alternative technologies • Feasibility study • Negotiation with primary equipment suppliers	• Bottlenecks • Technology solutions for the bottlenecks • Involvement of familiar equipment suppliers and own tool development department e.g. build prototype • Customization for the company's unique need

The three firms' RMTI front-end strategies were slightly different. First, there were differences in strategic priorities. For example, senior management had personal involvement in the initiation of RMTI in Companies C and D, whereas in Company E, the initiation of RMTI had a more operational-level focus. Second, RMTI was linked to present customers and their future needs in Companies C and E, but Company D's RMTI approach was de-linked with current operations and focused on future customers and strategic business development. The findings from this analysis showed that,

in addition to the nature of the specific RMTI, companies' strategies and contexts could cause differences in how RMTI cases were initiated, created, and implemented.

CONCLUSIONS

The premise in this chapter was that, once companies considered relocating manufacturing, they also needed to think about the optimal process configurations for production. This, in turn, would benefit from the development and implementation of new manufacturing technologies and related process and delivery chain innovations. With a holistic view of manufacturing innovations and the purposive exploration of radical technologies, in particular, this study highlighted that companies should jointly consider relocation and manufacturing innovation.

The results of the questionnaire study indicated that backshoring firms and bidirectional-movers appeared to be more active in manufacturing innovations than offshoring firms and non-movers. Companies more active in the different dimensions of manufacturing innovations tended to have higher cost efficiency than other firms. These findings indicated a relevant link among relocation, innovation and performance which deserves further attention in forthcoming research.

The interviewees' experiences in various manufacturing firms revealed that the firms' orientation toward RMTI were driven by different strategic and operational needs and objectives, active research, strategic priorities, technology opportunities, involvement in innovation networks, and previous or parallel experiences with technical innovations. Different barriers and challenges to RMTI arose at the front end of the innovation process and during the innovation creation. Many of these barriers stemmed from first-time experiences with RMTI and limited cultural readiness and support for new technology adoption, emphasizing the need for experienced support for RMTI-oriented manufacturing firms. There was a need to ensure that the companies' manufacturing technology and process innovation efforts were supported with relevant organizational and operational analyses and involvement by partners that already possessed previous experience.

The exploratory study revealed three different types of processes: procurement, development, and invention. The use of these types clearly depended on the degree of uncertainty and novelty involved in the innovation. The initiation of RMTI was highly dependent on the strategic or operational orientation of the firm's strategy and senior managers' priorities. Due to the context-dependence of RMTI creation and implementation, there was a need to develop practices and capabilities for each process type to promote successful RMTI creation across different kinds of companies. It would be worthwhile to continue this exploratory study with more in-depth analyses across different RMTI types and contexts.

CHAPTER

4

MANUFACTURING LOCATION DECISIONS AND RENEWAL OF BUSINESS ECOSYSTEMS

PETRI AHVONEN AND MIIA MARTINSUO

INTRODUCTION

The trend over past decades has been for manufacturing companies in western countries to relocate manufacturing away from their home countries in search of lower costs and other benefits. This has been enabled by digitalization and a dramatic decrease in telecommunication costs. Within the past few years, though, some companies have brought back their manufacturing activities due to various problems related to offshored production and to new opportunities in their home countries. Manufacturing location decisions do not happen in isolation made by one company alone; rather, the network of stakeholders—business ecosystems—needs to be considered in these decisions.

The purpose of this chapter is to increase knowledge of the role of business ecosystems in manufacturing location decisions and to examine the consequences of manufacturing relocation for business ecosystems. The focus is on two questions:

- *How do different business ecosystem actors drive manufacturing location decisions?*
- *How do the various actors and created value within the ecosystem change as a result of manufacturing relocation?*

A qualitative, exploratory study was conducted with two manufacturing companies, one which had carried out offshoring of manufacturing and one which had experience in both offshoring and reshoring. Empirical data were collected through interviews (N = 5) and case-related documentation (N = 15). The results of the thematic analyses revealed the practices and expectations of the different ecosystem stakeholders driving relocation decisions and the consequences of relocation decisions for these stakeholders. In particular, the supply networks and the parent organization's strategies might have promoted relocation, but strong support from the ecosystem more broadly could be more crucial to the success of the relocation. The ecosystem was broadly affected by the decision to relocate, but the findings also emphasized the planning and management of the relocation process as a means to promote the sustainability of the relocation.

MANUFACTURING LOCATION DECISIONS IN BUSINESS ECOSYSTEMS

Manufacturing location decisions have been widely studied both empirically and theoretically within recent decades (e.g., Dunning, 1980, 1998; Kinkel & Maloca, 2009; Dachs & Zanker, 2014; Gylling et al., 2015), and their effects on companies' and national economies are significant. The reasons behind these decisions vary from cost and value seeking to better access to certain resources in other countries (e.g., Dunning, 1998; Kinkel & Maloca, 2009; Fratocchi et al., 2016).

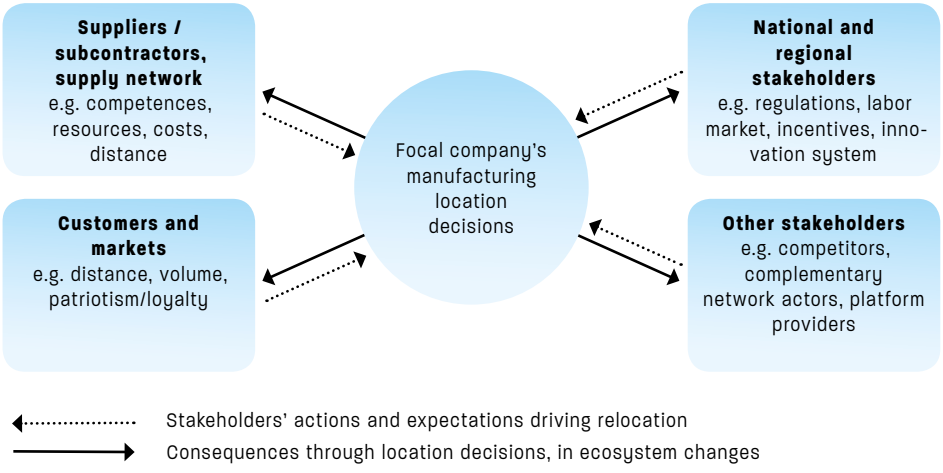
The business ecosystem, a concept introduced by Moore (1993), is defined as a network of companies forming a holistic, integrated system that creates value for customers (Mäkinen & Dedehayir, 2012). In a business ecosystem, companies co-create by combining their resources to create new products, satisfy customers' needs, and produce new innovations (Moore, 1993). The most important actor in the business ecosystem is the focal company, which is also referred to as the ecosystem leader (Moore, 1993). The role of the focal company is to create and share value within the ecosystem (Mäkinen & Dedehayir, 2012). There is no specific restriction on what companies can or cannot be part of a company's business ecosystem

(Moore, 1996; Iansiti & Levien, 2004); rather, it includes all the actors that in some way affect the focal company's business.

The interface of manufacturing location decisions and business ecosystems has not been covered adequately in the existing literature, although some network related studies have been carried out in the context of manufacturing location decisions (e.g., Kinkel & Maloca, 2009). Material flows have been considered to be a relevant factor in location decisions, highlighting the role of suppliers (Ellram et al., 2013; Dachs & Zanker, 2014). The locations of customer firms can drive focal companies to seek to move manufacturing closer to the customer base (Canham & Hamilton, 2013). As well, governmental actors and their strategies can affect manufacturing location decisions. For example, a lack of investment incentives in a manufacturing firm's home country can lead to offshoring (Canham & Hamilton, 2013). In addition, the role of competition varies and can become an important driver of manufacturing location decisions (Porter, 1994).

The renewal of ecosystems through manufacturing relocation has been covered to only a limited extent in previous research. For example, the role of end customers, especially in consumer markets, can change significantly due to manufacturing relocations (Grappi et al., 2015). It is important for the ecosystem leader's perspective to analyze the role of suppliers as part of the firm's manufacturing relocations. For example, Caputo and Palumbo (2005) found that, by backshoring activities, the case company could increase enhance control of its supplier and gain more visibility among its suppliers. Value creation within business ecosystems in the context of manufacturing relocations has not been studied deeply, creating a research gap. Figure 12 presents the key stakeholders in the business ecosystem relevant to the focal company's location decisions and the two-way influence of location decisions.

FIGURE 12. DRIVERS AND CONSEQUENCES IN THE BUSINESS ECOSYSTEM CONCERNING MANUFACTURING COMPANY'S RELOCATION DECISIONS.



ECOSYSTEM STAKEHOLDERS DRIVING RELOCATION DECISIONS

The two studied case companies were in the mechanical engineering industry, and both were platform leaders in their ecosystems. The value within the ecosystem was created by the combination of different components and technologies in the case companies' assembly functions. Company F made an offshoring decision to relocate a 300-person assembly line from Finland to Eastern-Central Europe as a greenfield operation. The relocation was done in multiple phases between 2009 and 2011. Company G offshored part of its assembly process to a Baltic country as a brownfield operation in 2009 and backshored those same activities to Finland in 2014. The relocated activities accounted for approximately 5% of the company's whole assembly process, representing the jobs of four or five persons.

The roles of the ecosystem stakeholders in these relocation decisions are summarized in Table 20. The results suggested that the roles of the suppliers and the owners were important in these manufacturing location decisions. The centrality of enhancing material flows in relocation decision-making was in line the views of Ellram et al. (2013). The roles of competitive forces, governmental actors, customers, and markets were perceived to be somewhat different in the two cases. The interviewees from Company F experienced these stakeholders as more relevant, possibly due to the significant difference in the scale of the relocated functions compared to those relocated by Company G. When relocating a small-scale function, as did Company G, national, competitive, and market stakeholders were not experienced as very significant.

TABLE 20. ROLE OF BUSINESS ECOSYSTEM STAKEHOLDERS IN DRIVING MANUFACTURING LOCATION DECISIONS.

Stakeholders	CASE F - OFFSHORING 2009	CASE G - OFFSHORING 2009	CASE G - BACKSHORING 2014
Supplier network	One of the main drivers behind relocation was moving closer to the main supplier base, which reduced logistics costs.	Supplier base in the offshored country was recognized as a driver in deciding the offshore location.	The main supplier base remained in Finland. There was a need to reduce extra logistics costs coming from excess transportation.
Corporation (i.e. parent company)	Offshoring was a big part of the corporation's integration strategy. The company sought synergy benefits from merging two subsidiaries' operations.	The idea to offshore came from the corporation representatives.	Lack of long term planning and inefficient structure resulted in the backshoring decision.
Competitors	The company acts in global markets. Competitive forces were key drivers in pursuing a better cost structure. Local competitors were already closer to customers.	The company acts in global markets. Competitive forces were not recognized as a main factor in either of the relocation decision.	
Governmental actors	The role of Special Economic Zones recognized as driver in the exact location decision. Tax exemptions and investment incentives were important.	No recognized role of governmental actors behind the offshoring decision.	No recognized role of governmental actors behind the backshoring decision.
Customers and markets	Corporate-level customer-focused strategy drove to move closer to the customers. Recession in 2008 promoted the decision to offshore.	No major role of customers recognized in the location decisions. The broadly spread customer base means lower significance in the manufacturing location.	
Technological disruptions	No major technological manufacturing disruptions explaining the manufacturing relocation.	No major technological manufacturing disruptions explaining the manufacturing relocations.	

CONSEQUENCES OF MANUFACTURING LOCATION DECISIONS IN THE ECOSYSTEM

Table 21 summarizes the changes in the stakeholders' roles the case companies experienced as a result of the relocation decision. The results showed that the changes in the ecosystems after manufacturing relocation somewhat varied between the cases. The evolution of the supply network was more significant in Company F. The interviewees in both cases experienced similar cultural issues and salary-based

turnover within the local workforce in the target countries but had no or only minor quality issues with local workers. After the relocation, the Finnish business ecosystems were perceived to better support knowledge-intensive functions, such as innovation-oriented R&D functions, but this support was not considered to be sufficient for manufacturing operations.

The cases varied also in terms of the created customer value. In particular, company F was able to create and communicate enhanced value through offshoring, whereas the customer value created by relocation was not as obvious for Company G. Comparing possible cases of peaks in production, the interviewees with Company F felt that it was easier to motivate employees to work overtime in the new location than Finland. Company G, in turn, optimized its blue-collar staff and relied heavily on subcontractors during production spikes. The poor financial situation of some subcontractors required the case company to develop ways to help them during times of low demand.

TABLE 21. CHANGES IN THE ROLES OF BUSINESS ECOSYSTEM STAKEHOLDERS AND CREATED VALUE AFTER MANUFACTURING RELOCATIONS.

Viewpoint	CASE F - OFFSHORING 2009	CASE G - OFFSHORING 2009 AND BACKSHORING 2014
Supplier network	The local supply network remained unchanged, and the Finnish suppliers were replaced by local ones. Two strategic suppliers were asked to offshore with the company.	No major changes in the supply network since all of the critical suppliers were located permanently in Finland. Some supply was moved abroad during offshoring.
Customer value	Enhanced customer value through sustained price competitiveness; supply and distribution network optimization, lower cost workforce and lower manufacturing overheads.	Relocations were not perceived to cause changes in the customer value.
Quality of labor	No changes in work quality. Overall quality better due to enhanced facilities.	No major changes in quality of work between the countries.
Cultural aspects of workforce	White-collar employees were perceived better suited for international business than in Finland. Blue-collar workers harder to manage but easier to motivate to work overtime during production spikes.	Harder to train local work force. Some turnover of workers caused minor problems. Workforce required more management effort.
The role of the Finnish business ecosystem	The Finnish innovation ecosystem supporting the company's central innovations was a major factor to keep and develop R&D functions in Finland. Manufacturing ecosystem in Finland was perceived high-cost and not supporting backshoring from the company's perspective.	Finnish manufacturing ecosystem was perceived as high-cost and not supportive. Many critical suppliers and subcontractors in Finland that the company needs to support during low demand.

CONCLUSIONS

A manufacturing firm's location decisions might conceptually appear as a single firm's strategic choice and a straightforward maneuver in the business landscape. This chapter has examined the role of business ecosystems in manufacturing location decisions, both as drivers of such decisions and as targets of their change impacts. The literature has pointed out that the value creation in modern business networks crosses company boundaries and that adopting an ecosystem perspective may be highly relevant for studies on manufacturing relocation.

The qualitative study showed that companies' embeddedness in their business networks was apparent in various ways in relocation decisions. Stakeholders in direct supply chains and parent organizations, which set corporate strategy, were identified as the key driving forces behind relocation decisions. Especially for the large Company F, the corporate strategy was closely linked to the perspectives of other stakeholders—markets, customers, competitors, and governmental actors—which all lent support to relocation. It was possible that the strong engagement of the ecosystem in this particular case could explain why the relocation persisted and succeeded. The involvement of the ecosystem was not equally apparent in Company G, and it fairly soon decided to backshore the offshored manufacturing operations. These results indicated that strong support for relocation from multiple stakeholders in the ecosystem might have been highly essential in making offshoring successful.

The consequences of relocation for the business ecosystem were quite varied in these two cases. Although the previous literature has focused on the quality of work in foreign manufacturing locations, these findings suggested that this concern could be overcome by sufficient training and process development. A variety of effects might have taken place, particularly changes in supply partners, unknown cultural issues, access to labor markets, and innovation support systems, and the companies needed to carefully assess and plan for these issues before the relocation decision. The present results suggested not only that relocation affected the personnel of the manufacturing companies but also that the manufacturing companies needed to invest more broadly in various development and management activities in the ecosystem to promote successful relocation.

This qualitative two-case study has revealed the necessity to understand relocation broadly in the context of the manufacturing firm's ecosystem by pointing out the drivers and the effects among the key stakeholders. Manufacturing firms' relocation decisions cannot be treated in isolation at the level of the single firm, and there is a need to further explore the ecosystem effects. Future studies could investigate how the business ecosystems surrounding various disruptive manufacturing technologies support bringing production back to Finland. Larger firms' governance mechanisms driving business-unit-level relocation could also be investigated. Finally, future research could study how medium-sized and large corporations involve smaller suppliers and subcontractors in keeping or relocating production.

CHAPTER

5

GLOBAL PRODUCTION INVESTMENTS BY LARGE NORDIC MANUFACTURING FIRMS

JUSSI HEIKKILÄ AND JAN OLHAGER

INTRODUCTION

This chapter explores the production investments made by large manufacturing firms with headquarters in Denmark, Finland, and Sweden from 2005 to 2015. The main research strategy was archival research, drawing data from a global news database. The findings of this study complemented the survey results on offshoring and backshoring of Nordic manufacturing described in the previous chapters. The survey explored the number of offshoring and backshoring projects by Nordic manufacturing firms with 50 or more employees from 2010 to 2015 but did not provide information about the monetary value of those projects. This chapter focuses on the global distribution of the investments made by large Nordic man-

ufacturing firms from 2005 to 2015, with an emphasis on the value of large production investments.

A key issue in industrial renewal is how manufacturing firms invest in their future. The economies in Denmark, Finland, and Sweden have been affected by the manufacturing firms' low investment levels. Considerable differences, though, exist in manufacturing firms' investment activity. Whereas many firms suffered after the global financial crisis that began in 2008, others have assumed active roles in renewing their operations through investments, both in their home countries and abroad. The global manufacturing network is predicted to become balanced between offshored, nearshored, and home-country production, rather than favoring a single direction of manufacturing movement (Kinkel, 2014; Tate, 2014). The findings of the present research contribute to the understanding of how Nordic large manufacturing firms develop their global manufacturing footprints.

The manufacturing investments of large manufacturing firms based in Denmark, Finland, and Sweden over a period of ten tears (2005–2015) were analyzed. The six largest manufacturing firms in terms of sales turnover in 2014 from each country were selected for analysis. The selected Danish companies were Arla Foods, Carlsberg, Danfoss, Danish Crown, Novo Nordisk, and Vestas Wind Systems. The Finnish companies were Metsä Group, Neste, Nokia, Outokumpu, Stora Enso, and UPM-Kymmene. The Swedish companies were Atlas Copco, Electrolux, Ericsson, SCA, Volvo, and Volvo Car Group. The Danish companies operated in the food, beverages, pharmaceuticals, and energy industries. Three of the six Finnish firms operated in the forestry and paper industry, and the other three in fuel, steel, and telecommunications industries. The Swedish companies operated in the trucks and industrial engineering, telecommunications, motor vehicles, household goods, forestry and paper industries. Table 22 presents information about the sales volumes, number of employees, profitability, and capital and R&D investments of the manufacturing companies analyzed. Capital expenditure (Capex) refers to expenditure used by a company to acquire or upgrade physical assets such as equipment, property, and industrial buildings.

TABLE 22. SIZE AND INVESTMENTS OF THE COMPANIES ANALYZED.

NAME	COUNTRY	INDUSTRY	SALES 2015/16 (€ BILLION)	PROFITABILITY (%)	EMPLOYEES 2015/16	CAPEX 2015/16 (€ MILLION)	CAPEX INTENSITY	R&D 2015/16 (€ MILLION)	R&D INTENSITY (%)
VOLVO	Sweden	A	34,0	6,0	88 464	1 860	5,5	1 917	5,6
ERICSSON	Sweden	B	26,9	8,8	116 281	907	3,4	3 806	14,2
VOLVO CAR GROUP*	Sweden	C	19,0	4,1	29 000	1 336	7,0	1 210	6,4
NOVO NORDISK	Denmark	D	14,5	45,8	40 638	703	4,8	1 740	12,0
NOKIA	Finland	A	13,6	13,6	55 718	314	2,3	2 502	18,4
ELECTROLUX	Sweden	E	13,4	2,3	55 245	329	2,5	351	2,6
SCA	Sweden	F	12,5	10,5	44 000	826	6,6	123	1,0
NESTE	Finland	G	11,1	5,6	4 856	491	4,4	41	0,4
ATLAS COPCO	Sweden	A	11,1	19,2	43 114	186	1,7	353	3,2
ARLA FOODS	Denmark	H	10,3	3,7	19 025	N.A.	N.A.	116	1,1
UPM-KYMMENE	Finland	F	10,1	7,4	19 578	432	4,3	37	0,4
STORA ENSO	Finland	F	10,0	10,5	25 680	77	0,8	124	1,2
VESTAS WIND SYSTEMS	Denmark	I	8,4	10,8	20 507	223	2,6	156	1,9
CARLSBERG GROUP*	Denmark	J	8,4	7,2	47 500	517	6,1	N.A.	N.A.
DANISH CROWN*	Denmark	H	8,0	N.A.	26 000	N.A.	N.A.	N.A.	N.A.
OUTOKUMPU	Finland	K	6,4	3,9	11 002	120	1,9	22	0,3
DANFOSS	Denmark	A	5,1	10,8	23 594	N.A.	N.A.	216	4,2
METSALIITTO	Finland	F	5,0	10,8	10 117	N.A.	N.A.	18	0,4

Industry sectors: A Industrial Engineering, B Technology Hardware & Equipment, C Motor Vehicles, D Pharmaceuticals and Biotechnology, E Household Goods & Home Construction, F Forestry & Paper, G Oil & Gas Products, H Food Products, I Alternative Energy, J Beverages, K Industrial Metals & Mining

Source: 2016 EU Industrial R&D Investment Scoreboard.
Information for companies marked with an asterisk (*) were collected from company websites.

DATA COLLECTION

The research strategy was archival research, and data were collected from news published in selected media sources. The archival research strategy was used to achieve a longitudinal perspective over 10 years. Secondary documentary data were drawn primarily from the LexisNexis (2015) news archive, a database with legal, news, and business information on 80 million companies around the world from approximately 3 000 newspapers and 2 000 magazines, journals, and newsletters. The search key-

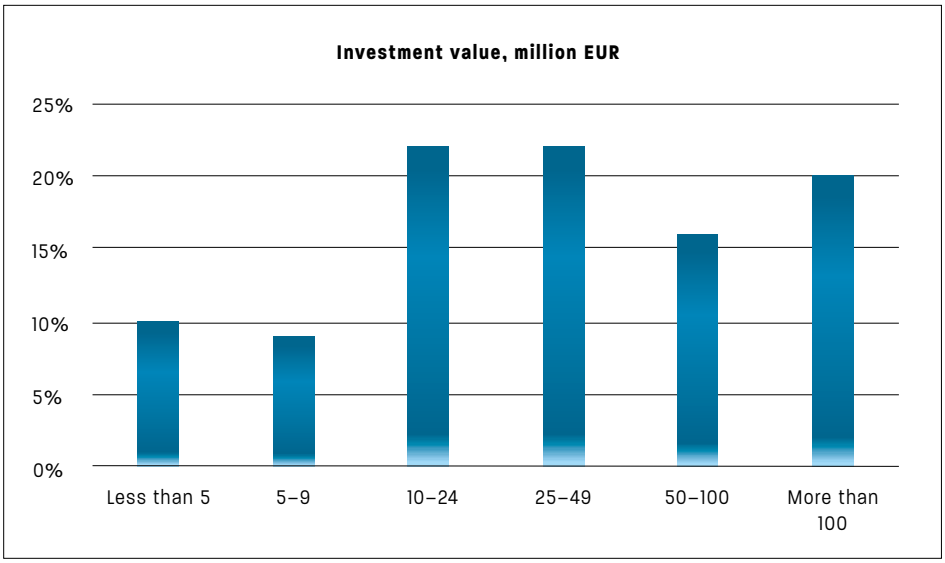
words used for this research were “company name,” “invest,” and “investment.” The search retrieved a long list of news articles describing the investment activities of the selected companies. The key knowledge gathered included investments made globally from January 1, 2005 through December 31, 2015, and the underlying characteristics and motives for those investments as reported in the news.

In total, 320 investments were identified to have been made by the 18 selected large manufacturing companies during the period analyzed. Of these, 104 investments were made by the six Danish companies, 103 by the Finnish companies, and 113 by the Swedish companies. As well, 265 investments were made abroad, and 55 in the companies’ respective home countries. Not all the news items specified the value invested. Information on the amounts invested was available for 235 investments, which together totaled 25.6 billion EUR for all 18 companies over the period analyzed.

INVESTMENT SIZES AND TYPES

The 235 investments with values reported in news articles were grouped into six groups by size: less than 5 million EUR, 5–9 million EUR, 10–24 million EUR, 25–100 million EUR, and more than 100 million EUR. Figure 13 shows the share and number of investments in these groups. The amounts invested are presented partly in groups of smaller investments clearly identified as belonging together.

FIGURE 13. CLASSIFICATION OF INVESTMENTS BASED ON SIZE (SHARES OF THE 235 INVESTMENTS IDENTIFIED).



The largest groups were mid-sized investments (10–24 and 25–49 million EUR) and the largest investments exceeding 100 million EUR. Sixteen of the 18 companies were found to have made one or more investments worth more than 100 million EUR. Smaller investments were in the minority. This could be explained by better reporting of bigger investments; investments of smaller sums were not found as frequently in the news database. The investments identified were assumed to be dominated by relatively large investments made by the targeted firms. Comparing information from different sources we expected to have captured approximately 25%–30% of the total amount of investments made by the selected companies during the period analyzed.

When considering the characteristics of the investments identified, three types of investments were distinguished: new investments, replacement investments, and development investments. New investments referred to new production plants and new production-related units, such as warehouses. The motives for new investments typically were related to business strategy, quality, new business areas, and satisfaction of customer demand. Replacement investments were made to replace existing production lines or facilities. Development investments generally were made to increase capacity, extend plants, and improve operations and processes. The main motives for those investments, as reported, were to meet increased demand and improve operations, quality, efficiency, market position, and global growth efforts. Larger investments in Asia, in particular, were often made to increase companies' local market share.

There was sufficient information available for 257 investments to classify them into these three types. When comparing the numbers of these three types of investments, new investments and development investments were close to each other, with 117 and 129 investments, respectively. The replacement investments identified were found to be a marginal group compared to the other two groups, with only 11 investments.

LARGEST IDENTIFIED INDIVIDUAL INVESTMENTS

The largest identified individual investments were selected for closer investigation. These investments were considered to indicate the main strategic moves that Nordic manufacturing firms made in directing their future manufacturing operations. Table 23 includes the ten largest investments or groups of investments identified in the study. The investments were categorized by value, company, type, location, purpose, and year of announcement.

TABLE 23. TEN LARGEST INDIVIDUAL INVESTMENTS OR GROUPS OF INVESTMENTS.

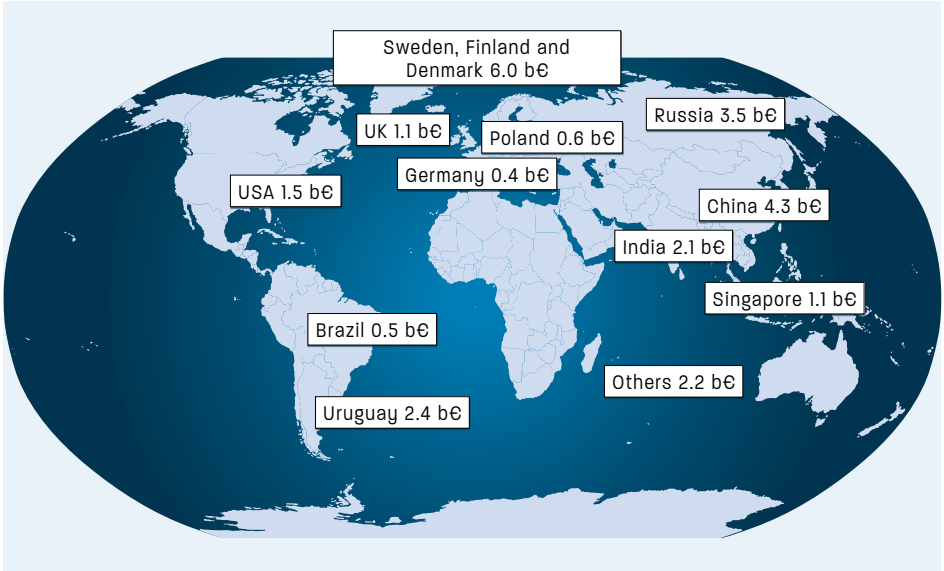
VALUE OF INVESTMENT, mill. EUR	COMPANY	INVESTMENT TYPE	LOCATION	YEAR	PURPOSE
1 400	Stora Enso	New	Uruguay	2011	Pulp mill, joint venture (JV)
1 266	UPM-Kymmene	New	Russia	2007	Pulp and saw mills and wood panel factory, JV
970	UPM-Kymmene	New	Uruguay	2005	Pulp mill, JV
970	UPM-Kymmene	New	China	2005	Paper factory, JV
880	Ericsson	New	China	2005	Manufacturing, R&D, and service operations
736	Carlsberg	New	China	2013	Brewery, JV
715	Danish Crown	New	UK	2014	Meat production
672	Carlsberg	Development	Russia	2015	Restructuring of business
590	Stora Enso	New	China	2013	Board machine and related investments, plantations, JV
550	Neste	New	Singapore	2007	Biodiesel factory

Nine of the 10 largest investments were new. As well, 9 of the 10 were made outside Europe in Uruguay, Russia, China, and Singapore. Five of the 10 largest investments were made by Finnish firms Stora Enso and UPM-Kymmene, which operated in the forestry and paper industry. Both firms invested in pulp production in Uruguay and made major investments in China, UPM-Kymmene in paper production and Stora Enso in mechanical wood production with related plantations. UPM-Kymmene also made a large investment in Russia for pulp and saw mills and a wood panel factory. Swedish telecommunications company Ericsson made a major investment in China for manufacturing, R&D, and service operations. Danish firm Carlsberg invested in a new brewery in China and made a major development investment to restructure its business in Russia. Tulip, a unit of the Danish food processing company Danish Crown, invested in a center of excellence for bacon production in Cornwall in the United Kingdom. Neste built a renewable biodiesel plant in Singapore to support the company's goal to become a leader in renewable diesel production.

GEOGRAPHIC LOCATIONS OF IDENTIFIED INVESTMENTS

The investment values identified over the period analyzed were almost equally divided among Europe, Asia, and the rest of the world; see the distribution of the investments across the most important target countries in Figure 14. The total value of the investments identified in Europe (excluding Russia) was 8.2 billion EUR. In Asia (excluding Russia), the total value was 7.9 billion EUR, and in the rest of the world, the value was 6.9 billion EUR. Individual countries had major influences on the geographic distribution of the investments across major regions.

FIGURE 14. MOST IMPORTANT COUNTRY LOCATIONS FOR THE IDENTIFIED INVESTMENTS BY THE SELECTED NORDIC MANUFACTURING FIRMS.



The total value of domestic investments in Denmark, Finland, and Sweden made by the manufacturing firms analyzed was 6.0 billion EUR. China alone attracted investments worth 4.3 billion EUR, followed by Russia (3.5 billion EUR), Uruguay (2.4 billion EUR), India (2.1 billion EUR), the United States (1.5 billion EUR), Singapore (1.1 billion EUR), and the UK (1.1 billion EUR).

In some countries, the investment volumes identified came from only a few large individual investments. For example, the high investment volume in Uruguay came

from two large investments in new pulp production plants made by the Finnish forestry product companies UPM-Kymmene and Stora Enso in 2005 and 2011. The high volume in the UK was mostly due to a large investment in a meat production facility made by Danish Crown in 2014, while the biggest contributor to the investments in Singapore was Neste's new biofuel plant in 2007.

The three Nordic home countries and the UK were the most popular investment locations in Europe for the manufacturing companies analyzed. The total value of the investments in the Nordic home countries was 6.0 billion EUR, accounting for more than 20% of all the identified investments. Eastern European countries (i.e., Russia, Poland, Romania, Ukraine, Hungary, Bulgaria, Serbia, Croatia, Latvia, and Estonia) typically have been considered to be nearshoring, low-cost production locations for Nordic manufacturing companies. However, with the exception of Russia, the investment volumes in the Eastern European countries were low relative to the companies' home countries and locations outside Europe. Among Eastern European countries, Poland attracted the highest investment volume, with a total of 581 million EUR. The next highest volumes were in Romania (103 million EUR), Ukraine (97 million EUR), and Hungary (92 million EUR).

CONCLUSIONS

This analysis of the investments in global production reportedly made by large Nordic manufacturing firms indicated balanced manufacturing footprints rather than the movement of manufacturing resources in a certain direction, whether offshore, nearshore, or backshore. The findings of this archival study complemented the previous survey results on offshoring and backshoring of Nordic manufacturing (Heikkilä et al., 2016b, 2016d; Johansson & Olhager, 2016b). Whereas the survey results indicated that most production transfers from the Nordic countries were made to Eastern Europe, these archival research results suggested that the major new production investments by Nordic large manufacturing companies were made outside Europe.

Approximately 6 billion EUR of the investments identified were invested in the three Nordic home countries (i.e., Denmark, Finland, and Sweden). This suggested that these relatively small home countries were still important production locations for the largest Nordic-based manufacturing companies. These findings supported the recently articulated research view that manufacturing companies search for a balanced global manufacturing footprint rather than moving manufacturing resources in a certain direction, whether offshore, nearshore, or backshore.

The concept of manufacturing relocation having a certain direction is potentially problematic because it assumes that companies have a clear home-base. Large

companies in particular take a global view of operations and have various roles in a number of locations. Furthermore, many of the changes that might look like offshoring or backshoring from one country's point of view may be the consequences of restructuring after mergers, acquisitions, or divestments.

Investments in fixed assets should also be put in perspective by comparing their volume with that of other types of investments, for example, R&D expenditures. In this research, data from Table 22 show that, in some industries, R&D investments might have been abundant compared to investments in fixed assets. The combined R&D expenditures of Ericsson, Novo Nordisk, and Nokia, which operated in the telecommunications and pharmaceuticals industries, was more than four times higher than their capital expenditures on fixed assets. In comparison, the four companies in the forestry and paper industry (SCA, UPM-Kymmene, Stora Enso, and Metsä Group) invested more than four times in fixed assets than R&D expenditures. In discussing the relation between the location of investments in fixed assets and R&D, these large differences need be borne in mind. The consequences of differences in building companies' global operations footprints are worth further study.

CONCLUSIONS, POLICY IMPLICATIONS AND FUTURE RESEARCH

JUSSI HEIKKILÄ, JAN OLHAGER, MIIA MARTINSUO AND TEEMU LAINE

Offshoring and backshoring of manufacturing from and to the Nordic countries has been increasing in importance in recent years, and this relocation activity is set to continue in the future. The survey results among the Nordic manufacturing firms indicate that offshoring is clearly more common than backshoring. The manufacturing relocations by Nordic firms are geographically wide-ranging. The most important regions for offshoring and backshoring are Eastern and Western Europe, the Nordic countries and China. Large companies with greater numbers of plants at multiple locations, and companies actively pursuing technological innovation tend to be more active than others in production relocation.

Drivers for relocation decisions are clearly different for offshoring and backshoring. Offshored production is typically labor-intensive, whereas production relocated to the Nordic countries is relatively complex and technology-intensive, seeking proximity to technology, skills and knowledge, and to R&D.

Some differences between countries were identified when the respondents and responses from Denmark, Finland and Sweden were compared. The Finnish sample includes relatively more small firms, while the Swedish sample includes relatively larger firms. The countries differ in their industry structures, and each country has its own strong industries. The Swedish companies in the survey had more often larger focal plants, greater number of plants, and greater number of plant locations than did the Danish and Finnish companies.

The use of financial information in production relocation decision-making was explored using the survey-based data, augmented by qualitative case studies. The

results suggest that there are challenges in the perceived relevance of the financial information, although financial information was quite readily available. Manufacturing companies that are active in production relocations perceive their financial information to be more supportive than do other companies. In general, backshoring decisions seem to be better supported by financial information than offshoring decisions. Enhancing the role of financial information would improve the quality of decision-making and reduce uncertainties in complex relocation decisions.

Manufacturing firms considering relocation of manufacturing also have to think about the best process configurations for their production. This will benefit from the development and implementation of new manufacturing technologies and process and delivery chain innovations. The survey study results indicate that companies backshoring production or moving their production, both offshore and back, appear to be more active than other companies in manufacturing innovations. Companies more active in the various aspects of manufacturing innovations also tend to achieve improvements in cost efficiency better than other firms.

Three different processes were identified for radical manufacturing technology innovations (RMTI): procurement, development, and invention. The use of these processes depends on the degree of uncertainty and novelty in the innovation involved. The initiation of radical manufacturing technology innovations is also dependent on the strategic versus operative orientation of the firm's priorities. Due to the context-dependence of RMTI creation and implementation, there is a need to develop practices and capabilities for the processes.

The embeddedness of manufacturing companies in their business networks is apparent in various ways in the relocation decisions. Stakeholders in the direct supply chains were identified as key instigators for the decisions to relocate. The production location choices are closely linked to the perspectives of other stakeholders; markets, customers, competitors, and governmental actors. Engagement of the entire ecosystem may explain relocation persistence and success. Efforts in various development and management activities in the ecosystem are required to promote successful production relocations.

The analysis of individual production investments showed that the main new production investments of major Danish, Finnish, and Swedish manufacturing companies were made outside Europe. Nevertheless, about 20% of the major production investments of these firms identified during the period 2005-2015 were made in the three Nordic home countries. The relatively small home countries still seem to be important production locations for large Nordic-based manufacturing companies. Further, investments in fixed assets should be put in perspective by comparing their volume with, for example, investments in R&D. R&D expenditure in the telecommunications and pharmaceuticals industries is many times higher than capital expenditure in fixed assets. In comparison, companies in the forestry and paper industry invest in fixed assets many times the amount they spend on R&D. These major dif-

ferences between industries and their influence on production location decisions need to be understood. The consequences for differences in building manufacturing companies' global R&D and production footprints would merit further research.

POLICY IMPLICATIONS DERIVED FROM THE RESEARCH

We note several policy implications as the result of this study. The most important factor for offshoring is labor costs. Therefore, policy-makers should ensure the cost competitiveness of manufacturing in the Nordic countries in relation to their reference group in competition. The need for cost competitiveness also exerts pressure for continuous productivity improvements. Particular attention needs to be paid to productivity through technological advances and process improvements.

Access to skills, knowledge, and technology are important factors for Nordic manufacturers to reshore production. They are also necessary for initiating manufacturing technology innovations that keep production competitive. Therefore, product, process, and supply chain innovation, as well as colocation of R&D and production, need to be promoted. Policy-makers need to pay attention to maintaining the Nordic innovation systems.

Manufacturing firms that have backshored their production are active in pursuing manufacturing innovations. Note that the manufacturing industry environment in the Nordic countries remains attractive to knowledge, investments and employment. Firms that have brought their production to the Nordic countries are more inclined to backshore again. Support is needed, especially for small and medium-sized Nordic firms, to take the first step to relocate their production at the home base.

The ecosystem effects of offshoring and backshoring are highly relevant to the competitiveness of manufacturing. Promote companies' networking not only in their direct supply chains, but also with complementary firms, to ensure the persistence of backshored manufacturing in the Nordic countries.

Many firms that relocate their production plants seem to lack a clear strategy or analytical capabilities for manufacturing location decisions. Expertise on managing global manufacturing networks should be enhanced. The capabilities for planning and controlling relocation decisions need to be emphasized.

PROPOSALS FOR FUTURE RESEARCH

Continuing research on the relocation of Nordic manufacturing would increase our knowledge of the transformation in the Nordic manufacturing industries. The following research areas are proposed for the future:

- Follow-up of the survey on the extent, drivers, and performance implications of production relocations of the Nordic manufacturing firms is needed to enhance the fact-based understanding of the longer-term trend of manufacturing relocations.

- Companies require support to make accurate and informed decisions, while backshoring requires an understanding of the value of domestic flexibility, quality, and other aspects. Advanced methods to evaluate alternatives, in financial terms, in complex production location decisions need to be developed.

- In-depth analyses across different radical manufacturing technology innovation types and contexts are recommended as a future research area. Manufacturing innovation is clearly a strong contributor to retaining high-value adding manufacturing in the Nordic countries.

- Global manufacturing renewal is taking place through digitalization that is renewing both manufacturing systems and their control mechanisms. The changes brought about by digitalization may assist in keeping manufacturing operations in the Nordic countries and utilizing the global manufacturing network in new ways. Further research is needed on what digitalization enables in global manufacturing and how the benefits of digitalization can be harnessed for the benefit of Nordic manufacturing industries.

- Manufacturing firms' relocation decisions need to be explored at the business ecosystem level including all relevant stakeholders. Further studies can investigate how business ecosystems around different disruptive manufacturing technologies support bringing production back to the Nordic countries. The involvement of SME suppliers by large corporations to retain or relocate production would be a worthwhile research area.

- In addition to production relocation, investments in R&D, acquisitions and divestments are very important means of building manufacturing firms' global operations footprints. There are considerable differences between industries in terms of the emphases in using these means to establish a global presence. The implications for building manufacturing companies' global R&D and production presence would profit from further research.

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Appendix 1: The questionnaire for survey data collection

Research on offshoring and reshoring of production

This research and the survey consist of the following five sections:

1. The manufacturing network
2. Offshoring of production
3. Reshoring of production
4. Decision making and performance
5. Background information about the company and the respondent

The survey covers three levels of manufacturing related issues in your company: the company, the recent offshoring and/or reshoring decisions, and the focal plant. The company in this survey means either the entire company (in case of a single business firm) or a business area in a multi-business corporation. The focal plant means your plant (if you work at a plant) or a major plant located in Finland that belongs to your company if your work responsibilities cover a broader network of production plants.

Offshoring* and *reshoring refer to transferring production permanently from one geographic location to another location, either from Finland to another country (offshoring) or bringing it back to Finland (reshoring). In both offshoring and reshoring, the ownership of the transferred production may or may not change.

There are two types of questions in the questionnaire: multiple choice questions and questions with perceptual five-point scales. We ask you to answer the perceptual questions intuitively, since they concern the perceived state of things. Please feel free to give approximate responses to the open-ended questions if you are uncertain of the exact answer; research has shown that approximate answers give better results than no answers at all. If the question does not apply to your situation, you have the option of responding N/A (not applicable).

The survey responses are treated as confidential. The responses will only be analyzed at aggregate level, not individually. If you wish to receive a summary of the research results when they are ready, and an invitation for the results seminar, you can leave your e-mail address on the last page of the survey. Push the “Submit” button in the end to send your answers when you have finished.

Section 1: The manufacturing network

This first section of the questionnaire asks about the number and locations of the manufacturing plants, and the manufacturing strategy of your company.

		1	2	3-5	6-10	Over 10	N/A
MFGPLA1	How many manufacturing plants are there in your company?	❑	❑	❑	❑	❑	❑

Where are these plants located? (Please select all those that apply)

MFGLOC1	Nordic countries	❑
MFGLOC2	Western Europe (excl. Nordic countries)	❑
MFGLOC3	Eastern Europe	❑
MFGLOC4	North America	❑
MFGLOC5	Latin America	❑
MFGLOC6	China	❑
MFGLOC7	India	❑
MFGLOC8	Asia (excl. China and India)	❑
MFGLOC9	Rest of World (Africa, Middle East, Australia)	❑

		1-50	51-100	101-250	251-500	Over 500	N/A
MFGEMP1	What is the total number of employees in your company?	❑	❑	❑	❑	❑	❑
MFGEMP2	What is the number of employees in your focal plant?	❑	❑	❑	❑	❑	❑

		Yes	No
MFGSTR1	Is your company's competitive strategy based primarily on low costs?	❑	❑
MFGSTR2	Is your company's competitive strategy based primarily on differentiation from competition?	❑	❑
MFGSTR3	Does your company have a corporate-wide strategy for guiding offshoring and reshoring decisions?	❑	❑
MFGSTR4	Does your company have an explicit corporate-wide manufacturing strategy?	❑	❑
MFGSTR5	Does the focal plant have an explicit plant-specific manufacturing strategy?	❑	❑

Section 2: Offshoring of production

This part of the survey is concerned with permanent offshoring to other plants (new or old) that belong to your company or to external partners (contract manufacturer or supplier).

		Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
OFFNEXT	To what extent do you expect your company to move production abroad from Den/Fin/Swe in the next 2 years?	❑	❑	❑	❑	❑	❑

		Yes	No
OFFHIST1	Has your company permanently moved production abroad from Den/Fin/Swe during the last 5 years, either to another plant in your own company or to an external supplier or contract manufacturer?	❑	❑

If your answer is YES you will continue responding questions in section 2 about Offshoring. If your answer is NO, you move automatically to next section 3.

	In the last 5 years…	None	1	2	3	4 or more	N/A
OFFHIST2	How many times has production been permanently moved abroad to another plant (either existing or new) in your own company?	❑	❑	❑	❑	❑	❑
OFFHIST3	How many times has production been permanently moved abroad to another company's plant (external supplier or contract manufacturer)?	❑	❑	❑	❑	❑	❑

	In the last 5 years…	Reduced by over 30%	Reduced by 10-30%	No major change	Increased by 10-30%	Increased by over 30%	N/A
OFFHIST4	How many jobs have been affected in the domestic production of your company due to production being moved abroad?	❑	❑	❑	❑	❑	❑
OFFHIST5	How has the sales turnover (or output) been affected in your company's domestic operations by production being moved abroad?	❑	❑	❑	❑	❑	❑

Think of the most recent significant movement of production abroad from your company or plant. The questions in the rest of this section refer to this movement of production.

OFFYEAR	In which year did the most recent significant movement of production take place?	...

	Please respond Yes to one of the questions and No to the other question.	Yes	No
OFFTOEX	Did production move out to another company's plant abroad (external supplier or contract manufacturer)?	❑	❑
OFFTOIN	Did production move out to another plant abroad that belongs to your company (either existing or new)?	❑	❑

	What are the characteristics of the production that was moved abroad:	Very low	Low	Neither high, nor low	High	Very high	N/A
OFFCHAR1	Production volume	❑	❑	❑	❑	❑	❑
OFFCHAR2	Production complexity	❑	❑	❑	❑	❑	❑
OFFCHAR3	Labor intensity	❑	❑	❑	❑	❑	❑
OFFCHAR4	Product standardization	❑	❑	❑	❑	❑	❑

To which geographical area was the production moved?
(Mark only one option)

OFFTO1	Another Nordic country	❑
OFFTO2	Rest of Western Europe	❑
OFFTO3	Eastern Europe	❑
OFFTO4	North America	❑
OFFTO5	Latin America	❑
OFFTO6	China	❑
OFFTO7	India	❑
OFFTO8	Asia (excl. China and India)	❑
OFFTO9	Rest of World (Africa, Middle East, Australia)	❑

Where is the output of the moved production shipped to? (i.e. the market for offshored production; mark all the alternatives that apply)

OFFMKT1	Nordic countries	❑
OFFMKT2	Rest of Western Europe	❑
OFFMKT3	Eastern Europe	❑
OFFMKT4	North America	❑

OFFMKT5	Latin America	❑
OFFMKT6	China	❑
OFFMKT7	India	❑
OFFMKT8	Asia (excl. China and India)	❑
OFFMKT9	Rest of World (Africa, Middle East, Australia)	❑

	Please indicate the importance of the following factors in the recent decision to move production abroad: (please choose all the alternatives that apply and give them a rating)	Very low	Low	Neither high, nor low	High	Very high	N/A
OFFIMP1	Labor cost	❑	❑	❑	❑	❑	❑
OFFIMP2	Logistics cost	❑	❑	❑	❑	❑	❑
OFFIMP3	Other cost	❑	❑	❑	❑	❑	❑
OFFIMP4	Changes in the currency exchange rates	❑	❑	❑	❑	❑	❑
OFFIMP5	Production close to or in the market	❑	❑	❑	❑	❑	❑
OFFIMP6	Access to skills and knowledge	❑	❑	❑	❑	❑	❑
OFFIMP7	Access to technology	❑	❑	❑	❑	❑	❑
OFFIMP8	Access to raw materials	❑	❑	❑	❑	❑	❑
OFFIMP9	Proximity to R&D and product development	❑	❑	❑	❑	❑	❑
OFFIMP10	Flexibility	❑	❑	❑	❑	❑	❑
OFFIMP11	Lead-time	❑	❑	❑	❑	❑	❑
OFFIMP12	Quality	❑	❑	❑	❑	❑	❑
OFFIMP13	Risk diversification	❑	❑	❑	❑	❑	❑
OFFIMP14	Country-specific conditions (e.g. subsidies, taxes, duties)	❑	❑	❑	❑	❑	❑
OFFIMP15	Trade barriers (e.g. customs, quotas, local content requirement)	❑	❑	❑	❑	❑	❑
OFFIMP16	Focus on core areas (and outsource non-core)	❑	❑	❑	❑	❑	❑
OFFIMP17	Avoid investments in new equipment	❑	❑	❑	❑	❑	❑
OFFIMP18	Requirement from customer (to move with customer)	❑	❑	❑	❑	❑	❑
OFFIMP19	Follow industry practice	❑	❑	❑	❑	❑	❑
OFFIMP20	Shortage of qualified personnel	❑	❑	❑	❑	❑	❑
OFFIMP21	Time-to-market (bringing new products to market faster)	❑	❑	❑	❑	❑	❑
OFFIMP22	Something else, please specify:	❑	❑	❑	❑	❑	❑

	Please consider if your company benefitted in the following areas from moving production abroad: (please choose all the alternatives that apply and give them a rating)	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	N/A

OFFBFT1	Labor costs	❑	❑	❑	❑	❑	❑
OFFBFT2	Logistics costs	❑	❑	❑	❑	❑	❑
OFFBFT3	Other costs	❑	❑	❑	❑	❑	❑
OFFBFT4	Product quality	❑	❑	❑	❑	❑	❑
OFFBFT5	Process quality	❑	❑	❑	❑	❑	❑
OFFBFT6	Delivery speed	❑	❑	❑	❑	❑	❑
OFFBFT7	Delivery reliability	❑	❑	❑	❑	❑	❑
OFFBFT8	Volume flexibility	❑	❑	❑	❑	❑	❑
OFFBFT9	Product mix flexibility	❑	❑	❑	❑	❑	❑
OFFBFT10	Profitability	❑	❑	❑	❑	❑	❑
OFFBFT11	Something else, please specify:	❑	❑	❑	❑	❑	❑

	Please consider if your company <u>experienced problems</u> in the following areas from the implementation of moving production abroad: (please choose all the alternatives that apply and give them a rating)	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	N/A
OFFPRB1	Labor safety (e.g. accidents at work, work-related illnesses)	❑	❑	❑	❑	❑	❑
OFFPRB2	Labor unrest (e.g. strikes, absenteeism)	❑	❑	❑	❑	❑	❑
OFFPRB3	High labor turnover	❑	❑	❑	❑	❑	❑
OFFPRB4	Natural disasters (e.g. flooding, earthquakes, pandemics)	❑	❑	❑	❑	❑	❑
OFFPRB5	Loss of tacit knowledge (e.g. process knowledge)	❑	❑	❑	❑	❑	❑
OFFPRB6	Incomplete production data (e.g. drawings, parts lists, and bill-of-materials)	❑	❑	❑	❑	❑	❑
OFFPRB7	Product design changes required by legal regulations in the host country	❑	❑	❑	❑	❑	❑
OFFPRB8	Political instability at the receiving location	❑	❑	❑	❑	❑	❑
OFFPRB9	Terrorism, sabotage, piracy, theft, industrial espionage	❑	❑	❑	❑	❑	❑
OFFPRB10	Production competence at the receiving plant	❑	❑	❑	❑	❑	❑
OFFPRB11	Management competence at the receiving plant	❑	❑	❑	❑	❑	❑
OFFPRB12	Lack of cultural understanding (e.g. language barriers, cultural differences)	❑	❑	❑	❑	❑	❑
OFFPRB13	IT security (e.g. attempted attacks on networks)	❑	❑	❑	❑	❑	❑
OFFPRB14	Corporate social responsibility issues (e.g. corruption, child labor, working conditions)	❑	❑	❑	❑	❑	❑
OFFPRB15	Environmental issues (e.g. pollution, carbon footprint)	❑	❑	❑	❑	❑	❑

OFFPRB16	Violation of intellectual property rights (IPR)	❑	❑	❑	❑	❑	❑
OFFPRB17	Something else, please specify:	❑	❑	❑	❑	❑	❑

Section 3: Reshoring of manufacturing

This third part of the survey is concerned with permanent reshoring from other plants that belong to your company or from external partners (contract manufacturer or supplier).

	In the next 2 years, to what extent do you expect your company to move production back …	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
RESNEXT1	To Den/Fin/Swe	❑	❑	❑	❑	❑	❑
RESNEXT2	To another plant in your company, located in the Nordic region	❑	❑	❑	❑	❑	❑
RESNEXT3	To another plant in your company, located in some other European country	❑	❑	❑	❑	❑	❑

		Yes	No
RESHIST1	Has your company permanently moved production back to Den/Fin/Swe from abroad during the last 5 years, either from another plant of your own company, or from an external supplier or contract manufacturer?	❑	❑

If your answer is YES you will continue responding questions in section 3 about Reshoring. If your answer is NO, you move automatically to next section 4.

	In the last 5 years…	None	1	2	3	4 or more	N/A
RESHIST2	How many times has production been permanently moved back to Den/Fin/Swe from another plant in your own company?	❑	❑	❑	❑	❑	❑
RESHIST3	How many times has production been permanently moved back to Den/Fin/Swe from an external supplier or contract manufacturer?	❑	❑	❑	❑	❑	❑

	In the last 5 years…	Reduced by over 30%	Reduced by 10-30%	No major change	Increased by 10-30%	Increased by over 30%	N/A
RESHIST4	How many jobs have been affected in the domestic production of your company due to production being moved back to Den/Fin/Swe?	❑	❑	❑	❑	❑	❑

RESHIST5	How has the sales turnover (or output) been affected in your company's domestic operations by production being moved back to Den/Fin/Swe?	❑	❑	❑	❑	❑	❑

Think of the <u>most recent significant movement</u> of production <u>back to the plant in Den/Fin/Swe</u>. The questions in the rest of this section refer to this movement of production.

RESYEAR	In which year did this movement of production take place?	...

	Did production in this movement come ... (Please respond Yes to one of the questions and No to the other question.)	Yes	No
RESFRMEX	from an external contract manufacturer or supplier?	❑	❑
RESFRMIN	from another plant abroad that belongs to your company?	❑	❑

	What are the characteristics of this production?	Very low	Low	Neither high, nor low	High	Very high	N/A
RESCHAR1	Production volume	❑	❑	❑	❑	❑	❑
RESCHAR2	Production complexity	❑	❑	❑	❑	❑	❑
RESCHAR3	Labor intensity	❑	❑	❑	❑	❑	❑
RESCHAR4	Product standardization	❑	❑	❑	❑	❑	❑

	From which geographical area was production moved? (Mark only one option)	
RESFRM1	Another Nordic country	❑
RESFRM2	Rest of Western Europe	❑
RESFRM3	Eastern Europe	❑
RESFRM4	North America	❑
RESFRM5	Latin America	❑
RESFRM6	China	❑
RESFRM7	India	❑
RESFRM8	Asia (excl. China and India)	❑
RESFRM9	Rest of World (Africa, Middle East, Australia)	❑

Where is the output of this production shipped to? (i.e. the market for reshored production; mark all the alternatives that apply)?

RESMKT1	The Nordic countries	❑
RESMKT2	Rest of Western Europe	❑
RSSMKT3	Eastern Europe	❑
RESMKT4	North America	❑
RESMKT5	Latin America	❑
RSSMKT6	China	❑
RESMKT7	India	❑
RESMKT8	Asia (excl. China and India)	❑
RESMKT9	Rest of World (Africa, Middle East, Australia)	❑

	Please indicate the importance of the following factors in the recent decision to move production back. (please choose all the alternatives that apply and give them a rating)	Very low	Low	Neither high, nor low	High	Very high	N/A
RESIMP1	Labor cost	❑	❑	❑	❑	❑	❑
RESIMP2	Logistics cost	❑	❑	❑	❑	❑	❑
RESIMP3	Other cost	❑	❑	❑	❑	❑	❑
RESIMP4	Changes in the currency exchange rates	❑	❑	❑	❑	❑	❑
RESIMP5	Production close to or in the market	❑	❑	❑	❑	❑	❑
RESIMP6	Access to skills and knowledge	❑	❑	❑	❑	❑	❑
RESIMP7	Access to technology	❑	❑	❑	❑	❑	❑
RESIMP8	Access to raw materials	❑	❑	❑	❑	❑	❑
RESIMP9	Proximity to R&D and product development	❑	❑	❑	❑	❑	❑
RESIMP10	Flexibility	❑	❑	❑	❑	❑	❑
RESIMP11	Lead-time	❑	❑	❑	❑	❑	❑
RESIMP12	Quality	❑	❑	❑	❑	❑	❑
RESIMP13	Risk diversification	❑	❑	❑	❑	❑	❑
RESIMP14	Country-specific conditions (e.g. subsidies, taxes, duties)	❑	❑	❑	❑	❑	❑
RESIMP15	Trade barriers (e.g. customs, quotas, local content requirement)	❑	❑	❑	❑	❑	❑
RESIMP16	Focus on core areas (and outsource non-core)	❑	❑	❑	❑	❑	❑
RESIMP17	Avoid investments in new equipment	❑	❑	❑	❑	❑	❑
RESIMP18	Requirement from customer (to move with customer)	❑	❑	❑	❑	❑	❑

RESIMP19	Follow industry practice	❑	❑	❑	❑	❑	❑
RESIMP20	Shortage of qualified personnel	❑	❑	❑	❑	❑	❑
RESIMP21	Time-to-market (bringing new products to market faster)	❑	❑	❑	❑	❑	❑
RESIMP22	Something else, please specify:	❑	❑	❑	❑	❑	❑

	Please consider if your company benefitted in the following areas from moving production back. (please choose all the alternatives that apply and give them a rating)	Strongly disagree	Somewhat disagree	Neither agree, nor disagree	Somewhat agree	Strongly agree
RESBFT1	Labor costs	❑	❑	❑	❑	❑
RESBFT2	Logistics costs	❑	❑	❑	❑	❑
RESBFT3	Other costs	❑	❑	❑	❑	❑
RESBFT4	Product quality	❑	❑	❑	❑	❑
RESBFT5	Process quality	❑	❑	❑	❑	❑
RESBFT6	Delivery speed	❑	❑	❑	❑	❑
RESBFT7	Delivery reliability	❑	❑	❑	❑	❑
RESBFT8	Volume flexibility	❑	❑	❑	❑	❑
RESBFT9	Product mix flexibility	❑	❑	❑	❑	❑
RESBFT10	Profitability	❑	❑	❑	❑	❑
RESBFT11	Something else, please specify:	❑	❑	❑	❑	❑

	To what extent did your company experience problems at the former plant or company (from where production was moved) in the following areas: (please choose all the alternatives that apply and give them a rating)	Not at all	Small extent	Moderate extent	Large extent	Very large extent
RESPRB1	Labor safety (e.g. accidents at work, work-related illnesses)	❑	❑	❑	❑	❑
RESPRB2	Labor unrest (e.g. strikes, absenteeism)	❑	❑	❑	❑	❑
RESPRB3	High labor turnover	❑	❑	❑	❑	❑
RESPRB4	Natural disasters (e.g. flooding, earthquakes, pandemics)	❑	❑	❑	❑	❑
RESPRB5	Loss of tacit knowledge (e.g. process knowledge)	❑	❑	❑	❑	❑
RESPRB6	Incomplete production data (e.g. drawings, parts lists, and bill-of-materials)	❑	❑	❑	❑	❑
RESPRB7	Product design changes required by legal regulations in the host country	❑	❑	❑	❑	❑
RESPRB8	Political instability	❑	❑	❑	❑	❑
RESPRB9	Terrorism, sabotage, piracy, theft, industrial espionage	❑	❑	❑	❑	❑
RESPRB10	Production competence	❑	❑	❑	❑	❑
RESPRB11	Management competence	❑	❑	❑	❑	❑
RESPRB12	Lack of cultural understanding (e.g. language barriers, cultural differences)	❑	❑	❑	❑	❑

RESPRB13	IT security (e.g. attempted attacks on networks)	❑	❑	❑	❑	❑
RESPRB14	Corporate social responsibility issues (e.g. corruption, child labor, working conditions)	❑	❑	❑	❑	❑
RESPRB15	Environmental issues (e.g. pollution, carbon footprint)	❑	❑	❑	❑	❑
RESPRB16	Violation of intellectual property rights (IPR)	❑	❑	❑	❑	❑
RESPRB17	Something else, please specify:	❑	❑	❑	❑	❑

Section 4: Decision making and performance

This part of the questionnaire is concerned with aspects that can be related to offshoring and reshoring, such as choosing production locations, manufacturing innovations, the use of financial information, and the resulting performance outcomes. Please respond to the questions thinking about your company and the focal plant.

This section deals with your company's strategy of **choosing production locations**.

	To what extent do you agree or disagree with the following statements about the role of production location choices in your company's strategy?	Strongly disagree	Somewhat disagree	Neither agree, nor disagree	Somewhat agree	Strongly agree	N/A
LOCSTR1	Production location choices have a central role in our company's strategy.	❑	❑	❑	❑	❑	❑
LOCSTR2	Offshoring is important to this company's competitiveness.	❑	❑	❑	❑	❑	❑
LOCSTR3	Reshoring is important to this company's competitiveness.	❑	❑	❑	❑	❑	❑
LOCSTR4	Changes in production locations receive a lot of attention in our company.	❑	❑	❑	❑	❑	❑
LOCSTR5	Changes of production locations will influence the direction of this company's business.	❑	❑	❑	❑	❑	❑
LOCSTR6	Offshoring and reshoring are strategic alternatives for our global manufacturing footprint.	❑	❑	❑	❑	❑	❑

Please consider what kinds of **manufacturing innovations** your company and the focal plant is pursuing and what changes have taken place in manufacturing. By manufacturing innovation, we mean **any changes and improvements that are new to the plant, firm or the world**.

	To what extent is your company pursuing the following manufacturing related innovations?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
MFGINN1	Digitalization, (e.g. industrial internet, context-awareness and sensor-based technologies)	❑	❑	❑	❑	❑	❑
MFGINN2	New high-tech materials, (e.g. ultra-light or high-strength materials, post batteries)	❑	❑	❑	❑	❑	❑
MFGINN3	New process technologies, (e.g. additive manufacturing)	❑	❑	❑	❑	❑	❑
MFGINN4	Automation and robotization	❑	❑	❑	❑	❑	❑
MFGINN5	Other, please specify:	❑	❑	❑	❑	❑	❑

	In the last 5 years, to what extent has your company implemented the following?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
INTINN1	Business process improvements	❑	❑	❑	❑	❑	❑
INTINN2	Reorganization of manufacturing resources	❑	❑	❑	❑	❑	❑
INTINN3	Changes in the firm's earnings logic	❑	❑	❑	❑	❑	❑
INTINN4	Changes in manufacturing routines	❑	❑	❑	❑	❑	❑
EXTINN1	New customer relationships	❑	❑	❑	❑	❑	❑
EXTINN2	New kinds of services towards the customers	❑	❑	❑	❑	❑	❑
EXTINN3	Cooperation with competitors	❑	❑	❑	❑	❑	❑
EXTINN4	New supplier relationships	❑	❑	❑	❑	❑	❑

	In the last 5 years, to what extent have the following issues become obsolete or outdated in your company?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
DISRINN1	Some processes	❑	❑	❑	❑	❑	❑
DISRINN2	Some value propositions towards customers	❑	❑	❑	❑	❑	❑
DISRINN3	Some key customer relationships	❑	❑	❑	❑	❑	❑
DISRINN4	Some supply/delivery chains	❑	❑	❑	❑	❑	❑
DISRINN5	Some key supplier partnerships	❑	❑	❑	❑	❑	❑

Next, please consider **the use of financial information** in decision making in your company/focal plant.

	What is the division of the total product cost in your focal plant into direct material, direct labor and overhead? (Sum up to 100%)	
COSSTR1	Direct materials and services	
COSSTR2	Direct labor	

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COSSTR3	Overhead	
	Total	100

	To what extent does your cost accounting system provide data that allow you to analyze costs at the following levels?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
COSTACC1	Component level, i.e. individual items	❑	❑	❑	❑	❑	❑
COSTACC2	Product level, i.e. finished end products	❑	❑	❑	❑	❑	❑
COSTACC3	Process level, e.g. assembly, packaging, parts manufacturing	❑	❑	❑	❑	❑	❑
COSTACC4	Plant level, i.e. total manufacturing costs and cost of goods sold	❑	❑	❑	❑	❑	❑

	To what extent do your reporting practices support accurate financial analysis at the following levels?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
FINANAL1	Product full cost	❑	❑	❑	❑	❑	❑
FINANAL2	Product profitability	❑	❑	❑	❑	❑	❑
FINANAL3	Plant profitability	❑	❑	❑	❑	❑	❑

	To what extent do your financial reporting practices support decision making at the following situations?	Not at all	Small extent	Moderate extent	Large extent	Very large extent	N/A
DECMAK1	Supply base structure (e.g. supplier selection)	❑	❑	❑	❑	❑	❑
DECMAK2	Choosing plant location	❑	❑	❑	❑	❑	❑
DECMAK3	Selecting the most competitive delivery channels	❑	❑	❑	❑	❑	❑

The following questions deal with the **performance** of your focal plant in relation to selected strategic aspects of manufacturing.

	To what extent do you agree or disagree with the following statements concerning the performance of your company:	Strongly disagree	Somewhat disagree	Neither agree, nor disagree	Somewhat agree	Strongly agree	N/A
PERF1	We have reduced our unit costs during the last 3 years, e.g. labor cost per hour.	❑	❑	❑	❑	❑	❑
PERF2	We have reduced our total cost during the last 3 years, e.g. total product cost including overhead.	❑	❑	❑	❑	❑	❑
PERF3	Our productivity has increased during the last 3 years, e.g. labor productivity.	❑	❑	❑	❑	❑	❑
PERF4	We have improved the profitability of our products during the last 3 years, e.g. EBIT% at product level.	❑	❑	❑	❑	❑	❑

PERF5	We are among the leaders in our industry in terms of product quality.	❑	❑	❑	❑	❑	❑
PERF6	We are among the leaders in our industry in terms of delivery lead-times.	❑	❑	❑	❑	❑	❑
PERF7	We are among the leaders in our industry in terms of flexibility.	❑	❑	❑	❑	❑	❑
PERF8	Technological innovations have brought us considerable strategic advantage.	❑	❑	❑	❑	❑	❑

Section 5: Background information about the company and the respondent

		0-5%	6-25%	26-50%	Over 50%	N/A
SALESHAR	What is the share of sales from your focal plant that comes from products that have been introduced during the last two years?	❑	❑	❑	❑	❑

What is the primary manufacturing mode of your focal plant? (Mark only one option)

CODP1ETO	Engineer-to-order	❑
CODP2MTO	Make-to-order	❑
CODP3ATO	Assemble-to-order	❑
CODP4MTS	Make-to-stock	❑

What type of products does your focal plant primarily manufacture? (Mark only one option)

PRODSTD	Standard products	❑
PRODCUST	Customised products	❑
PRODMIX	A mix of standard and customised products	❑

Where is the primary market for the products from your focal plant? (Mark only one)

PLAMKT1	Domestic	❑
PLAMKT2	Nordic	❑
PLAMKT3	European	❑
PLAMKT4	Global	❑

Which of the following alternatives best describes your own area of responsibility?

RESPOND1	Global Operations Director or Manager	❑
RESPOND2	Supply Chain Director or Manager	❑
RESPOND3	Plant Director or Manager	❑
RESPOND4	Production Manager	❑
RESPOND5	Production Expert	❑
RESPOND6	Other, please specify:	❑

RESPOND7	Please give the total number of years that you have worked in production and operations management:	…
RESPOND8	Please give the number of years that you have worked in your current job position:	…

Please give any open comments related to this survey in the space below:

Thank you for completing this survey! If you want to receive summary of the research results and an invitation for the results seminar, please write your e-mail address here:

Appendix 2.
Summary of RMTI cases analyzed

No.	Example of RMTI (Unit of analysis)	Involved shift in production technology (0 →x; x→y)	Novelty	Time of occurrence
1	Anti-tarnish coating equipment for silver jewelry	Chemical bath → ALD coating technology	High	2000-2009
2	3D printing of wax castings for jewelry manufacture	Pressure injection of wax in rubber dies → 3D printed wax mould	Medium	1997-2012
3	Industrial particle coater based on nano-technology	CVD, PVD coatings → ALD coating technology	High	2006 - 2010
4	Continuous deposition process based on thin-film technology	0 → new process enabling industrial application of thin-film coatings in continuous production	High	
5	Automatic testing machine for use in flexible production of smart watches	Manual testing → rigid automated testing equipment → flexible equipment	High	2000-2005-2014
6	Automated furnace for heat treatment of metal products	Manual and smaller → automated and large furnace process line	Medium	2000-2010
7	New process for lignin extraction as side stream in wood pulp manufacture	0 → new process and equipment technology	High	1990 - 2015
8	Implementation of new assembly process for electronic device manufacture	Old → new assembly technology	Low	
9	New concept for heating web in paper manufacture	New heat roll construction, referred to as calendaring roll technology	High	2010-2015
10	Implementation of automated sheet stacking process in transformer core manufacture	Manual stacking of sheets in core → automated stacking	Low	2008-2013
11	Automation of large engine head assembly	Manual operations → automation of process steps (e.g. testing) and robotization	Medium	2007-2010
12	Cheaper cutting tool for slots on circumference of motor plates	high volume equipment available only → create a low volume tool with innovation in blade technology (wire cutting)	High	
13	Automation of spot welding process for round plates in motor	Manual welding → automated, robotized welding; holding tool redesign (big impact)	Medium	2006-2014
14	New pulping technology	Old pulping process using traditional catalyst chemicals → modified equipment and process for using new catalyst	High	
15	New gasification plant for wood bark	0→ new process equipment to enable use of wood bark as gaseous fuel	High	2013-2014
16	Automation of production plant	Manual transfers → robotized	Low	1995 - 2009
17	Automation of production plant	Plasma cutting → laser cutting with automation; manual welding → robotized welding	Low	2001-2014
18	New technology in manufacture of silicon wafer	Interviewee considered names of technologies as confidential	High	2013-2016
19	Implementation of 3D laser technology sheet metal cutting equipment	Old cutting equipment → 3D laser equipment	Low	2000
20	Special purpose equipment: joining machine for large pipe flanges	Old equipment → redesign to include higher load bearing capacity, larger pipe size and advanced controls	Medium	2010 - 2012
21	Special purpose equipment: insulation machine for generator coils	Manual insulation winding → semi-automatic equipment	Medium	1996 – 2002 - 2006
22	Special purpose equipment: Inductive-heating based semi-automatic joining machine for generator coils	Manual gas soldering equipment → semi-automated induction heating equipment.	Medium	2007-2009
23	Dry etching technology equipment for electronics component manufacture	Wet etching technology → dry etching technology	High	2005 - 2011

Manufacturing industries have had an important role in the export-driven economies of the Nordic countries. Manufacturing companies from Denmark, Finland, and Sweden have increasingly been moving production abroad in recent years. However, also backshoring of manufacturing has been attracting growing attention recently.

The research project "Reshoring of manufacturing (ROaMING): Disruptive Technologies, Business Ecosystems and Performance Information as Key Enablers" focused on increased understanding of production relocation trends in the Nordic countries, Denmark, Finland, and Sweden. The aim was to create in-depth knowledge on the status of and potential for relocating manufacturing as a source of renewal of the manufacturing sector.

Offshored production is typically cost focused, whereas production relocated to the Nordic countries is more complex and technology-intensive. Movement of production will continue both offshore and back. Cost competitiveness in the Nordic countries needs to be ensured, exerting pressure for productivity improvements through technological advances and process improvements. Access to skills, knowledge and technology are important factors for Nordic manufacturers to backshore production. Therefore product, process and supply chain innovation, as well as colocation of R&D and production, need to be promoted to reinforce the Nordic countries as a strong base for high value-adding manufacturing firms.