Prerequisites for Successful Production Transfers in the Electronics Industry

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Abstract. The purpose of this paper was to identify prerequisites for achieving expected supply performance targets, and ultimately, for successful Production Transfers. In order to release resources for product innovation and to gain better economies of scale, Norwegian electronics producers may transfer parts of their production to strategic suppliers in their supply chains. The research findings consist of a collection of prerequisites based on a literature study, and a shortlist of nine success factors based on a case research on two production transfers. The prerequisites cover the entire life span of a Production Transfer enhancing research originality, and each of them is assigned to its corresponding project phase. Risk mitigation measures are highlighted along the transfer process, and there are suggested methods and tools for supply chain risk management. These results represent a first step towards configuring a project development model and guidelines for systematic Production Transfers.

Keywords: production transfer, outsourcing, operations management, supply chain risk management, case research

1 Introduction

By focusing on innovation and quality, the Norwegian producers of electronics for the offshore industry (e.g., acoustic sensor systems for underwater navigation) have positioned themselves as leaders within a business segment that has a significant growth potential. Here, customers have been usually willing to pay higher prices than for products with lower performance, manufactured in low-cost countries. However, in recent times, competitors from low-cost countries have been improving the performance of their products and this has urged the Norwegian producers to streamline their supply chains and production systems, yet without compromising their core capabilities, i.e. innovativeness and quality. Hence, in order to achieve an increased cost-effectiveness and at the same time release more resources for product innovation, manufacturers may transfer parts of the production to suppliers. By *production transfer* (PT) there is hereby meant the relocation of the manufacturing of products and components between a *Sender* and a *Receiver*, and it can be divided into three main phases: the preparation for the transfer, the physical transfer of production equipment and inventories (if applicable), and the start-up of relocated production [1]. Further, the *start-up* could be defined as the production phase that lasts until there is reached a full-scale and reliable production, at targeted performance levels [2]- i.e. the *steady state* [3]. PTs are usually carried out as part of relocation (often called *outsourcing*) processes (e.g., outsourcing, insourcing, offshoring, backshoring) [4], succeeding the Make-or-buy decision, and the selection of suitable locations and suppliers [5].The supplier could be either owned by the Sender, or participate as an independent business entity.
Many electronics and other manufacturers chose to transfer production to their suppliers, and in general, transfer of processes to alternative sites occurs at some stage in the life cycle of most products [6, 7]. Apart from releasing resources to focus on core capabilities, companies also pursue several other benefits, such as better economies of scale, or access to current technologies not available internally [8, 9]. Nevertheless, PTs are associated to a high risk level, and may lead to suboptimal performance and negative consequences, like the inability to meet the demand on time, the loss of intellectual property (IP), excessive transaction costs, and even loss of business if not carried out in a systematic manner [8, 10]. Thus, it is important to manage the risk, by identifying and implementing *risk-mitigating measures.* Companies should both identify *preventive measures* aimed at reducing the likelihood of supply chain disruptions, and *corrective measures* to minimise the impact on supply performance of those disruptions that could not be avoided [11]. Potential disruptions may occur either within the supply chain (e.g., machine breakdown) or outside the supply chain (e.g., natural disasters), and they may be related to the sourcing of products (*source risk* upstream the supply chain), to operations (*make risk* at the focal firm), delivery (downstream), or to product return [11, 12]. Further, although several frameworks for systematic outsourcing exist, they either focus solely on the Make-or-buy phase of the process [13], or they end before the PT (literature review by [1]).

Frameworks addressing the PT process either provide a very general overview over PT activities (e.g., [5],[14],[15],[16]), or they only focus on certain PT phases [17].There is a need for further research on frameworks for successful PTs, where all the important activities and their interdependencies are specified, including necessary risk-mitigating measures for supply performance. Based on [18] and [3], one can say that a PT is successful when there is documented evidence that the Receiver can routinely produce the transferred product, process or method at the agreed performance levels with the Sender (e.g., cost, quality, volume, yield). The question that arises based on the described research context is: 'Which are the prerequisites for a successful PT from Sender to Receiver?' The research will focus on the topic of PT from an Operations Management and Supply Chain Risk Management (SCRM) point of view (in particular *source* and *make risk*). The research results represent a first step towards developing a framework and guidelines for systematic PTs.

1.1 Research Method

In order to answer the research question, there has been conducted a comprehensive study of peer-reviewed journal articles, dissertations, and best practices within *production-*, *knowledge-*, and *technology-transfers*, in the electronics and other manufacturing industries, as well as about *outsourcing*, *production start-up*, *ramp-up*, and key publications within the area of SCRM. Moreover, in order to explore and better understand the phenomenon of PTs in electronics supply chains, in their natural setting [19], there have been studied two cases of PTs, both between a Norwegian electronics producer (Sender) and one of its strategic suppliers (Receiver)- a Norwegian company as well. These two cases have provided multiple sources of evidence and enabled pattern matching, thus increasing both construct and internal validity [19]. Both Case A and B illustrate challenges that could have been minimised by some of the prerequisites derived from the literature study. In addition, the case report has been reviewed by key informants. Further, the paper's focus on PTs between just one sender and receiver facilitated a deeper observation of the phenomenon. The empirical data has been collected and triangulated by taking field notes and by performing semi-structured interviews during one tour of Receiver's facilities, during two workshops (one at Receiver and one at Sender), as well as during a follow-up meeting with Sender's representatives. During the workshops, key representatives from the case companies (e.g., quality managers, product developers, key account managers, and process engineers) were interviewed about the above named PTs. Sender's relevant internal documents have been also reviewed. The visit and workshops were performed during the spring and summer of 2015, whereas the meeting was held at the end of 2015. A paper based on the data collected during the second workshop and referred to in section 3 was published as [20] this year.

2 Theoretical Background

In this section, there will be provided a brief overview over interesting findings in the reviewed literature, highlighting the *prerequisites* (i.e. required conditions) for achieving expected supply performance targets, and ultimately successful PTs. The findings have been divided into four categories, based on the PT definition and by combining the above mentioned outsourcing frameworks in [5] and [14]: (1) *Preparations*, (2) *Physical Transfer*, (3) *Start-up*, and (4) *Supplier Relationship Management*. The Preparations include the subcategories *Organisation and Project Management*, and *Pilot Production at Sender*- created in order to group correlated and relevant literature findings. According to [5], the fourth category would succeed the PT phases, but it is worth specifying that this phase may be concurrent with other phases in the outsourcing process, as it will be shown below. Moreover, apart from the *physical transfer*, a PT will comprise three other types of transfers: *knowledge (KT) (tacit/uncodified)*, *administrative (AT)* (documents and data systems), and *supply chain* transfer (SCT) (by establishing relations to material vendors)[4, 21]. Finally, within each category, *risk-mitigation strategies* will be highlighted, together with suggestions of methods and tools for SCRM, i.e. for systematic *identification* of supply disruptions ('What can go wrong?'), the *assessment* of their likelihood and of their impact, and for risk *mitigation* [11].Table 1 presents 26 prerequisites for the Preparations phase.

Table 1: Prerequisites for successful production transfers during the Preparations phase

Id.	Prerequisites	References
	Organisation and Project Management	
P1	Project start-up meeting. Good leadership	e.g., [22, 23]
P2	Multidisciplinary Project team with project managers from both parties	[6, 14]

P3	Product Development team	[2, 6, 14, 17, 24]
P4	Supplier Development team	e.g., [25]
P5	Multidisciplinary teams for Risk Management	[6, 12]
P6	Formal agreement between parties	[26-28]
P7	Addressing the impact of IP on communication of technical matters	[6, 26]
P8	Up-to-date and easily accessible Transfer Protocol (incl. transfer plan and checklist)	[2, 6, 29]
P9	Risk Identification and Evaluating Receiver's preparedness (by e.g., Gap Analysis)	[6, 11, 25]
P10	Risk Assessment for Transfer object (by e.g. Failure Mode Effect Analysis- FEMA)	[6, 11]
P11	Transferability assessment on the production system. Codifying tacit knowledge. Replacing obsolete equipment	[14, 23, 30, 31]
	Pilot production at Sender (occasionally)	
P12	Setting performance targets-to be achieved before Phys. Transfer (first pass yields, etc.)	[2]
P13	Robust forecasts (of physical transfer, start-up time, new lead times, etc.)	[17, 31]
P14	Early problem solving/recalibration on production system/supplied components or materials (by e.g. Root Cause analysis- RCA)	[2]
P15	Defining the Change Control process	[2]
P16	Preparing corrective actions (e.g. safety stock & capacity). Ensure redundancy	[11, 17]
	Knowledge Transfer	
P17	Temporary sending personnel from Receiver to Sender (including FMEA specialists)	[2, 14, 23, 32, 33]
P18	Video-taped review of the production process	[33]
P19	Multidisciplinary Training based on non-standard events. A repository of solutions	[14, 23]
P20	Performing audits at Receiver to verify Knowledge Transfer. Testing personnel	[23]
P21	Perform activities to enhance Receiver's performance (FMEA, RCA, VSM, Lean, Six sigma, Advanced Product Quality Planning (APQP), quality control, etc.)	[25]
P22	Parties jointly review and update the documentation and Planning & Control system	e.g., [2, 17, 23]
	Transfer of Administrative Systems	
P23	Sender and Receiver develop a Communication Plan (part of the Transfer Protocol)	[6, 11]
P24	Receiver reviews information from Sender, identifies gaps (in facilities, systems, etc.) and develops operating procedures and documentation. Provides Receiver information.	[18]
P25	Using a common software for managing information flows	[2, 34]
	Supply Chain Transfer	
P26	Establishing relationships to vendors of necessary materials and components	[21]

Several of the above prerequisites can be related to SCRM theory. Executive level commitment, dedicated multidisciplinary teams, and participants with clear responsibilities are not only important conditions for the success of the PT project, but also for SCRM and for sustained supply performance [11]. For instance, establishing a multidisciplinary team (P5) dedicated to aligning mitigation measures with the overall Risk Management process, would facilitate the SCRM coordination between parties [11]. Further, SCRM should be addressed right from the start, thus the formal agreement could include specifications about the risk assumed by each party, product ownership (e.g. Sender can maintain ownership of part of the equipment, if it has high IP values [8]), and expected performance targets [26-28]. The agreement could also include specifications about information-sharing frequency and formats, technologies used, and processes (e.g., redundant points of contact and their roles, and mobilisation requirements). Details about information sharing could be included in the Communication Plan (P23), along with a crisis procedure to ensure a prompt and appropriate response to disruptions [11]. Moreover, certain types of agreement can reduce the Source risk. For instance, strategic agreements can ensure a continued service in the event of capacity constraints, and 'joint product design and delivery' (with suppliers) reduces the risk of material non-performance and shortages [11]. Details from the agreement could be part of P8, along with an engineering change control system [2, 6, 29], a PT checklist, and a flow diagram with the sequential stages of the PT, decision gates and action responsible [2, 6]. A simple audit checklist can be also used for P9, in order to identify Make risks, such as over (under)-capacity, quality losses, or losses related to CSR. The SCOR mapping, VSM, or looking at historical problems, are some of the most common Risk identification methods applied [11].To perform P10 and organise SC Risk Assessment, there is recommended the use of qualitative and quantitative electronic spreadsheets. One Risk assessment method that can be applied is the FMEA [11]. During Pilot production at Sender (if applicable), parties could meet and set performance targets to be achieved before Physical Transfer (P12). Apart from first-pass yield, they could monitor the rework yield, process induced failures, test time, and tact time [2]. A 'watch-out' list of precursor events could be also used for monitoring, and the Make risk monitoring could be done automatically through a data system such as the ERP. Moreover, the monitoring process should go along the entire SCRM process, and the focus should lie on indicators warning early in a risk event or even before the event occurs. [11]

Table 2: Prerequisites for successful PTs during Physical Transfer, Start-up, and Relationship Management

Id.	Prerequisites	References
	Physical Transfer	
P27	Upgrading, testing, and burning-in the equipment to be transferred	[14]
P28	Temporary sending personnel from Sender to Receiver (including FMEA specialists)	[2, 29]
	Start-up	
P29	Parties meet to review Transfer Protocol and met/not-met performance targets	[2]
P30	Gradual Production Transfer with secondary supply sources (not 'clear-cut')	[1, 2, 31]
P31	Pilot production at Receiver: P14 and full-speed testing	[2, 35]
P32	Parallel experimental line at Receiver and a dedicated process improvement team	[2]
P33	Qualify vendors. 'Vendor matrix' for components that can be used together	[2]
P34	Continuous monitoring of start-up progress, demand, and safety stock level	[11, 17]
P35	Deciding on corrective actions, e.g. subcontracting, expediting part delivery, rescheduling	[17]
P36	Adapting the documentation and the Planning & Control systems	[17, 30]
P37	Deciding on when to transfer component/ material order responsibility to Receiver	[17]
P38	Production verification. Post-transfer audit. Comparing pre-/post-outsourcing costs	[28, 31]
P39	Transfer summary report with deviations, actions, follow-up, and lessons learned	[6, 28, 36]
P40	Continuous operations improvement and monitoring (including audits at Receiver)	[14, 37]
	Supplier Relationship Management	
P41	High communication, collaboration, and coordination requirements for novel, complex, and/or tacit transferred object. Leveraging each other's strengths	[11, 36, 38]
P42	Receiver informs Sender about any process conflict. They have regular meetings	[31]
P43	Long-term commitment. Investing in Supplier Development	[25]

Table 2 presents 17 more prerequisites for the rest of the PT process, until the Steady State is achieved and the continuous production starts [31]. While Physical Transfer should be usually kept as short as possible [14], for Start-up and Relationship Management, there are several strategies that could be applied, many of them related to SCRM. For instance, P29 is related to Monitoring. Production monitoring could be a continuous process along PTs, yet the target levels would vary. Hence, the targets during Start-up are usually higher than during Pilot production [2, 3]. Further, P30 is related to ensuring supply continuity during PTs- one of the SCRM goals- by maintaining a secondary source (e.g. the Sender) in case of shortages [39]. Full-speed testing (in P31) is running the system at the speed equalling the balanced capacity, in order to solve as many problems as possible (by e.g., RCA) and speed up the Start-up [35]. P32 is related to the continuous improvement of supply performance- including after Steady State- and it can be combined with knowledge sharing with other production units [14]. For P34 and P35, one related mitigation strategy could be to shut down a production line or a test station any time the yield is lower than a certain limit, and assess the problems [2]. P38 is a verification of the performance targets at the end of the PT, preventing later much more costly corrections and obsolete material [31].
For Relationship Management, coordination and collaboration with Receiver are also important prerequisites for SCRM. They are at the basis of the 'shared risk' approach, since the Receiver is the one that can directly act on several potential risks [11]. Finally, the higher the uncertainty, i.e. the novelty (e.g. the experience the parties have [1]), complexity (e.g. transferring an integral technology [7]), and tacitness (e.g. high amount of unwritten production knowledge) of the transferred product or process, the higher the requirements for organizational interaction and information processing capability (P41). Thus, PTs with a low degree of uncertainty would require less information processing capability, hence lower investments. [36] In conclusion, based on the research literature, each single activity in the PT process could be looked at with regard to the level of uncertainty and the likelihood of supply disruptions with a negative impact on the performance results, and SCRM is an approach that could well suit managing such unwanted events along PTs.

3 Case Research

The findings from the Case Research on two PTs between a Norwegian producer of advanced maritime monitoring systems (Sender) and one of its strategic suppliers (Receiver) are presented in Table 3.

Table 3: Overview of the studied production transfers and their main activities

Case A- Completed Transfer	**Case B- Ongoing Transfer**
Sender: Norwegian electronics producer for offshore	**Sender:** The same as in Case A

Case A- Completed Transfer	Case B- Ongoing Transfer
Transfer object. Experience: Acoustic sensor. Mature product. High volumes. Not too complex. Little IP. No previous experience with transfers. **Original location:** Sender's production facility in Norway. Short distance from Receiver. Before, Sender had been producing the sensors and assembled them with housings and electronics from two different suppliers. **Receiver:** Norwegian series producer of EMS. Strategic supplier. After transfer, Receiver assembled and tested final products and delivered them to Sender. Receiver asked to come with suggestions for cost reduction. **Preparations:** Parties had no kick-off meeting. Key personnel in the Product Team, Sales, and Test was little involved in the preparations. Product Team misunderstood the reason for the transfer and their motivation to support Receiver was low. It had been unclear who was responsible for what at Sender, and a transfer plan and a risk assessment had not been prepared and conducted before transfer. Initially, it was decided that all test equipment would be moved from Sender to Receiver. When Product Team found this out, they realized that Sender would not be able to run spot-checks anymore, losing the control over the quality of their deliveries. Moreover, initially, Sender had to manufacture the product until Easter and Receiver everything after that. This turned out to be unrealistic. [*KT:*]Receiver participated in VSM at Sender and sent 3 operators to learn the process at Sender. [*SCT:*] Sender's original suppliers of housings and electronics were transferred to Receiver. [20] **Physical Transfer:** Sender copied the test equipment they had and transferred the copy to Receiver. **Start-up:** Receiver experienced that several of their process improvement suggestions had been rejected without a clear justification and the latest ones even turned out to be futile. During the April '15 workshop, to Receiver' surprise, the Product Team revealed their plans to update the product to a new version. Finally, Sender was unaware if the transfer had been profitable or not, but they said that the start-up had been long with high scrap rates and stock levels and they were planning to transfer the assembly to one of Receiver's suppliers in a low-cost country.	**Transfer object. Experience:** Signal converter, part of several of Sender's products. New product version. More complex production than Product A. **Original location:** The same as in Case A. For previous version, Sender installed PCBs from Receiver in cabinets from a supplier. Another supplier installed power supply and wiring. Sender tested the final products. **Receiver:** Same Receiver as in Case A. After transfer, Receiver was to install electronics including own PCBs in the cabinets. Sender was still testing the final products. **Preparations:** The transfer started in Sept. '14, with a kick-off. Sender asked Receiver to secure material from vendors without any formal agreement. A significant amount of this material became obsolete because of BOM changes, and the financial consequences were still unsettled in April '15. The transfer was planned as a Co-development of the new variant together with Receiver, with partially overlapped product development at Sender and process development at Receiver. [*AT:*]Often, BOM and other product design changes came too late (e.g. during continuous production instead of the Pilot phase). 4 BOM changes were sent after Receiver had ordered material. Moreover, Sender had problems with own Change Control system that did not allow purchasing materials for prototypes before design-freeze. Thus, many changes had been unrecorded until Product Developer started to collect changes in a common Excel-file. [*KT:*] No personnel from Receiver was transferred for training at Sender. [*SCT:*] Sender's original supplier of cabinets was transferred to Receiver. Later on, Sender was to replace it by its own subsidiary in a low-cost country. Further, Receiver appreciated having the same contact person at Sender throughout the process (the Product Developer) whereas Sender's Prod. Developer felt that it had been challenging to know whom to contact at Receiver. She had also experienced that two contacts at the Receiver had different BOM revisions. [20] **Physical Transfer:** None. **Start-up:** At the time of the workshop in April '15, the production had been transferred from Receiver's Development department to Manufacturing.

As seen in Table 3, Sender and Receiver had a series of challenges with the two PTs that might have been reduced by some of the actions from Tables 1 and 2. For instance, organizing project teams (i.a. for project and risk management) (P2, P4 in Table 1) and a project start-up ('kick-off') meeting where the reason for the PT is clarified (P1), could have increased Product Team's motivation to share essential information with the Receiver in Case A [40]. The teams could have included PT managers and members of the affected disciplines from both Sender and Receiver, and with clearly defined responsibilities and information access rights (P7) [2]. Moreover, as stated by [6], PTs should be managed by help of a Project Management plan based on Risk Management principles (P8). Hence, all the activities with potentially negative consequences (e.g. transferring the test equipment to Receiver) should have been identified and assessed together with experienced personnel and measures should have been implemented (i.e. performing SCRM) (P10, P11). Further, several authors claim that PTs should be whenever possible, planned as Gradual transfers (P30) (instead of 'clear-cut' as in Case A), and during low season periods [14]. Production at Sender would be then gradually decreased as volumes increase at Receiver. Thus, in case of unexpected demand or major production disruptions during Start-up, one would have a secondary source of supply at the Sender [17]. Other measures that senders could prepare are: ensuring safety stock and safety capacity at their facilities, adjusting safety lead-times, and subcontracting (P16). Redundant corrective measures should be prepared to mitigate the impact of supply disruptions and the dependency on forecasts [17]. Further, parties had several communication issues in both cases, e.g. production improvement suggestions rejected without a clear justification, unclear contact persons, or Receiver's personnel following two different BOMs. Thus, by preparing a communication plan (with e.g. points of contact, their roles, and information access rights) during the Preparations phase (P23), they could have minimized these challenges. The communication plan is a central prerequisite for a coordinated SCRM between Sender and Receiver and it should be included in the Transfer Protocol (P8) along with the PT plan and other tools, such as a checklist with activities, task instructions, a Change Control system, and a flow diagram with decision gates [2, 6]. Moreover, the Transfer Protocol should be continuously updated and an easily accessible platform for both parties. Finally, at the end of the Start-up in Case A, Sender could have conducted a post-transfer audit, comparing the pre- and post-outsourcing costs [28] (and other performance indicators) and evaluating whether the performance targets have been achieved and whether the production should be relocated to another manufacturer or not (P38). Deviations, actions, and lessons learned should be registered in the PT summary report (P39). Nevertheless, Receiver's performance could be monitored along the entire PT and measures should be implemented and reviewed (P40) [6]. Finally, in order to minimize the stock levels, waste, and start-up time, Sender and Receiver could consider implementing KT measures for supplier development and continuous improvement of supply performance (P21, P32), e.g. quality control activities, Value Stream Mapping (VSM), Six sigma, FEMA, RCA, Lean, and an experimental line for process improvement at Receiver.

With respect to Case B, several authors stress the importance of a formal agreement (P6) between parties, signed as early as possible during Preparations. The agreement should include the risk assumed by each party (e.g. who bears the cost of obsolete material), and expected performance targets (e.g., cost, quality, volume, and yield) [2]. Moreover, agreements for longer-term commitment between the two parties could enhance Receiver's willingness to open its facilities for the scrutiny of the Sender [25], facilitating the risk monitoring [11]. Further, to effectively manage engineering changes, parties could also define the Change Control process (P15) during Preparations, and they could create a flow diagram of the PT with necessary decisions gates [6]. For instance, before starting with the continuous manufacturing, the production should have passed a verification gate (P38). Finally, the higher the uncertainty during PTs (e.g., novelty, complexity, and 'tacitness') the higher the requirements for interaction between parties and for information processing (P41). For Case B, the production of product B was relatively complex and also novel for Receiver; the product version was an innovation, and it had a high amount of uncodified knowledge. Thus, parties could have invested more in information management systems (P25) (e.g. a common IT platform) and could have drawn advantage from the geographical proximity by having regular and more frequent joint meetings (P42) [31]. Regular and more frequent meetings and a tighter and more coordinated collaboration between Sender and Receiver are fundamental for a shared risk approach and have a positive impact on supply performance. Meeting notes should be send to each action responsible [28].

During the follow-up meeting with representatives from Sender, there was announced the launching of three programmes: (1) a Supplier Development programme for Lean implementation and for audits carried out by Sender's Lean team, (2) a program for Product Development together with strategic suppliers, and (3) a Supplier Quality programme. Programme specific teams had been established for each of them. The Quality programme included the implementation of a Change Control system, and of the Statistical Process Control (SPC). The CAPA-8D software had been purchased for the management of corrective and preventive actions and integrated change control, and there had been established a dedicated team for this as well (multidisciplinary). The software applies the RCA method. Moreover, Sender had an increased focus on performance monitoring. They had been using three performance indicators (KPIs) for monitoring their suppliers: quality non-conformance less than or equal to 1%, a delivery performance higher than or equal to 99%, and a cost reduction of 5% per year, and they were interested in monitoring the time-to-market within the Product Development programme. There were used scorecards based on the three first indicators, for suppliers' self-assessment and eventually for Sender's own assessment of these suppliers. In addition, Sender's strategic suppliers were expected to implement the above-mentioned systems (i.e., Change Control, CAPA, SPC, KPI's monitoring, and Lean).

4 Conclusions

The purpose of this paper has been to identify required conditions for achieving the expected supply performance targets, and ultimately, for successful PTs - a topic addressed from an Operations Management and a SCRM point of view. Such prerequisites revealed both by the literature and the empirical findings, are: (1) constituting multidisciplinary project teams with Project Managers and other representatives from all the affected disciplines, and from both PT parties (clear roles for each of them); (2) clarifying the reason for the PT and its performance targets during a 'Kick-off' meeting with representatives from all the affected disciplines, and from both Sender and Receiver; (3) signing a formal agreement as early as possible (it should i.a. include the risk assumed by each party, and the expected performance targets); (4) a continuously updated Transfer Protocol (it should be available for both parties and include among others, a Change Control process, and a flow diagram with necessary decision gates such as the production verification gate); (5) preparing a PT plan and a communication plan as part of the Transfer Protocol (with e.g. points of contact, their roles, and information access rights); (6) performing PT risk identification, assessment, and mitigation (i.e. SCRM); (7) planning the PT as a gradual transfer; (8) conducting a post-PT audit, evaluating whether the performance targets have been achieved, and maintaining a register of deviations, actions, and lessons learned; (9) continuous performance monitoring and implementing and reviewing corrective measures. Moreover, the higher the complexity, novelty, or 'tacitness' in PTs (i.e. the uncertainty) the higher the requirements for communication, coordination, and collaboration between PT parties- hence the information processing requirements. Thus, each single activity in the PT process could be looked at with regard to the level of uncertainty and the likelihood of supply disruptions, and the SCRM is an approach that could well suit managing unwanted events along PTs. These nine prerequisites might have a higher impact on the supply performance and the PT success than the remaining ones from section 2. Nevertheless, the performed case research did not aim for an extensive empirical study, nor the two explored PTs can dictate the success factors for each individual PT in the electronics industry. Several PTs of various characteristics should be studied and more extensive data collection should be conducted. Additional data collection and the testing of one preliminary PT development model are planned for this spring, in connection to another of Sender's PT projects.

The theoretical contribution of this paper is represented by the collection of prerequisites from sections 2 and 4, which to the author's knowledge, is the first overview over prerequisites for successful PTs, where the entire project life span is covered. Some of these factors are discussed in section 3 in the light of two case studies, yet further research is required. The findings from Section 2 will serve as input to a PT checklist after their complete validation, and the checklist will in turn serve as input to the final PT development model, and to guidelines on how to carry out PTs in the electronics and other manufacturing industries.

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