A production transfer procedure based on risk management principles

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Received 2 January 2018
Revised 11 May 2018
Accepted 23 August 2018

Abstract

Purpose – This paper aims to develop a procedure for preparing production transfers based on risk management principles. The procedure should help companies reduce the amount of supply chain disruptions during transfers and achieve their outsourcing/offshoring objectives.

Design/methodology/approach – The procedure was developed during a three-year Design Science study. First, a literature review and case studies were conducted to frame the research problem. Second, a preliminary procedure was developed based on preventive risk mitigation actions from the production transfer literature. Third, the procedure was implemented during an electronics-offshoring case and refined during workshops with the sender and receiver's transfer personnel. Fourth, during a seminar, transfer practitioners verified the procedure by applying it to outsourcing/offshoring cases with which they had experience.

Findings – Most of the preventive actions were evaluated as relevant for the transfers the procedure was applied to, regardless of industry and relocation type. Moreover, the electronics-offshoring case showed that the success of a production transfer not only depends on the physical, knowledge and supply chain transfers, as presented in earlier research, but also on the administrative transfer and on the organisation, project and quality management actions. This paper also attempts to enhance the production transfer literature by clarifying transfer risk management.

Practical implications – The procedure can be used during the production transfer phase as a preparation procedure. Moreover, it informs the decision-making process during the relocation-decision and supplier-selection phases.

Originality/value – To the authors' knowledge, this is the first production-transfer-preparation procedure based on risk management principles.

Keywords Manufacturing relocation, Production transfer, Supply chain risk management

Paper type Research paper

This research was conducted with support from the SoundChain project, funded by The Research Council of Norway. The authors would like to thank the project participants for providing valuable empirical data. The Research Council of Norway did not influence the research process.

Journal of Global Operations and Strategic Sourcing
Vol. 12 No. 1, 2019
pp. 103-150

2398-5364
DOI 10.1108/JGOSS-01-2018-0001

1. Introduction

Nowadays, the relocation of production activities is a common phenomenon among manufacturing companies, which in the pursuit of higher competitiveness try to reap the benefits that different locations and suppliers provide (De Backer *et al.*, 2016). Companies relocate production to external suppliers (*production-outsourcing*) or to suppliers in foreign and often low-cost countries (*production-offshoring*) (Jahns *et al.*, 2006). Furthermore, relocation decisions can be motivated by goals such as reducing production costs, pursuing an emergent customer market and accessing new technologies or materials (Mykhaylenko *et al.*, 2015; Beckman and Rosenfield, 2008). Nevertheless, the supply chain management literature recognises that production relocations lead to an increased risk in supply chains; hence, the achievement of pursued goals may be challenging (Vikram, 2013; Chopra and Meindl, 2013). The existing literature reports a number of production relocations that failed and led to unexpectedly high costs, reshoring or even factory close down (Kinkel and Maloca, 2009; Fratocchi *et al.*, 2014; De Backer *et al.*, 2016).

The success of production-relocation not only depends on companies' ability to select the most suitable production for relocation and the right supplier but also on how well the relocation decision is implemented (Aaboen and Fredriksson, 2016), which refers to the *production transfer* (PT). Figure 1 depicts the main phases of a production-relocation process.

As shown in Figure 1, the PT is divided into three main phases: *preparation*, *execution* and the *start-up* of production at the supplier's site (Madsen, 2009). The execution phase usually consists of a *physical transfer* of equipment and inventory from the production site (hereafter denoted as *sender*) to the supplier (hereafter denoted as *receiver*).

A PT is considered successful if the receiver achieves a full-scale and stable production output (*steady state* in Figure 1) according to schedule and at targeted levels of performance, which can be indicated by the cost and the yield level (Terwiesch *et al.*, 2001; Almgren, 1999). However, production-relocations are often associated with an increased risk of supply chain disruptions, such as quality non-conformances (Dachs and Zanker, 2015; Manuj and Mentzer, 2008) and material shortages (Manuj and Mentzer, 2008). Furthermore, companies may experience different types of losses, e.g. the loss of flexibility to respond quickly to demand changes, excessive transportation costs (Dachs and Zanker, 2015), a reduction in brand value, the loss of intellectual property and even the loss of their entire business (Vikram, 2013; Chopra and Meindl, 2013; Kinkel and Maloca, 2009). The European Manufacturing Survey from 2012 shows that between 2010 and mid-2012, ca. 25 per cent of the 3,500 participating firms reshored production to their home countries (Dachs and Zanker, 2015) because they incurred these types of losses. Moreover, an analysis of 39 German companies that relocated production highlights that on average, start-up times were 2.5 times longer than originally planned, and the period between start-up and steady state ranged in almost all cases from two to three years (Kinkel and Maloca, 2009).

In line with the supply chain risk management literature (McCormack *et al.*, 2008), to avoid costly disruptions and losses during later process stages (i.e. execution and start-up),

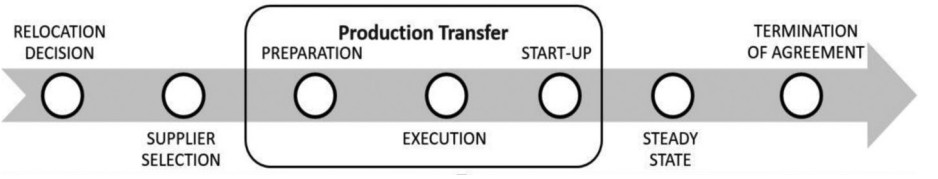


Figure 1.
The production-relocation process [adapted after (Fredriksson, 2011; Madsen, 2009)]

companies should focus on identifying and implementing preventive actions during earlier process stages (i.e. preparation). The PT scholars also acknowledge the importance of preparing PTs thoroughly (Grant and Gregory, 1997a; Minshall *et al.*, 1999; Terwiesch *et al.*, 2001; Madsen, 2009) and based on risk management principles (Cheng *et al.*, 2010; Malm, 2013; Fredriksson *et al.*, 2015). However, to the best of the authors' knowledge, a detailed procedure for preparing PTs carefully and based on supply chain risk-management principles is lacking within the literature. Taking into account the significant amount of resources that companies invest in production relocations and the risk to which they expose themselves, this is a surprising finding, providing an intriguing research opportunity. PT procedure consists of a series of PT actions, which are conducted in a certain order and are necessary to achieve production relocation goals (based on Fredriksson (2011)).

Although many production relocation procedures exist, only few of them address the PT process. Furthermore, those procedures either provide a rather vague overview of PT activities (Zeng, 2003; Momme, 2002) or they only focus on certain parts of the PT process [e.g. the physical transfer during the execution phase in Kowalski *et al.* (2018) or the materials planning and control during preparation and start-up in Fredriksson *et al.* (2015)].

Furthermore, although some of the PT scholars acknowledge the importance of managing the risk during PTs, they do not provide clear guidelines for this (Madsen, 2009; Malm, 2013). Malm (2013) presents a PT risk analysis performed by SAAB Aeronautics. This is an interesting example of how PT risk management is performed in practice. However, Malm does not describe the preventive actions implemented by SAAB to prepare for the studied PT. In 2015, Fredriksson *et al.* published the first paper explicitly recommending preventive actions during PTs. This paper has a focus on the preventive actions that might be necessary to avoid shortages of raw materials and components (e.g. forecast the start-up time and new lead times, update the planning and control systems and prepare a safety stock and safety capacity) and on actions that are necessary to avoid incomplete or irrelevant transfer documentation. However, there are additional risk areas during PTs that should be handled by practitioners, such as the management of the PT project (Terwiesch *et al.*, 2001; Madsen, 2009), receiver's training (McBeath and Ball (2012) and Cheng *et al.* (2010)) and the transfer of sub-suppliers (Aaboen and Fredriksson, 2016). Finally, World Health Organisation has published detailed guidelines for the preparation of PTs in the pharmaceutical industry (WHO, 2011). However, similar to the other publications, WHO (2011) acknowledges the importance of risk management during PTs, without clearly describing how it should be performed. In addition, WHO (2011) provides mainly practitioner-based and not research-based guidelines, and a significant amount of the recommended preparatory activities are arguably only applicable to the pharmaceutical industry (e.g. activities related to active pharmaceutical ingredients and the contamination of the pharmaceutical products).

In 2008, Busi and McIvor published a comprehensive literature review on the topics of outsourcing and offshoring. The review highlights that hitherto, the literature payed little attention to the PT preparation process and to PT risk management, and only few outsourcing/offshoring frameworks were developed by applying theoretical frameworks in a practical setting (Busi and McIvor, 2008). Nevertheless, the knowledge transfer, an important PT area, and the outsourcing/offshoring risks are presented as emergent themes, whereas the implications of applying well-known operations management techniques, such as change management, knowledge management and performance management during outsourcing/offshoring are proposed as future avenues of research. Implementing such techniques during PT projects is highly relevant, as will be shown later.

As presented above, the PT preparation process and the PT risk management continued to receive limited attention in the following decade, despite their importance for the success of production relocations. However, through the supply chain risk management lens, several of the preparation activities recommended in the PT literature can aid in avoiding supply chain disruptions. Therefore, the purpose of this research is to identify potential preventive actions in the PT literature and synthesise them into a procedure for preparing PTs and for preventively mitigating the risk of supply chain disruptions during PTs. The procedure should aid companies in meeting their targeted performance outcomes during production-relocations.

2. Methodology

To develop the PT preparation procedure, the design science research strategy, as described by Holmström *et al.* (2009), was adopted. This strategy is recommended both for the development of procedures with enhanced practical relevance and for theory development (Holmström *et al.*, 2009; Van Aken and Romme, 2009). Moreover, according to the design science strategy, the cross-disciplinary nature of this paper is an advantage when developing procedures (Holmström *et al.*, 2009).

Table I presents the four phases of this study's research process: problem framing, procedure incubation, procedure refinement and explanation. The last three phases are based on Holmström *et al.*'s (2009) recommendations. The first phase is inspired by Van Aken and Romme's (2009) recommendations for design science, and its purpose is to present how the field problem was identified.

The remainder of this section presents the methods of data collection and analysis during the problem framing, procedure incubation and procedure refinement phases, as well as the rationale behind the case selection. The explanation phase discusses the empirical findings collected during the previous research phases, in the light of the PT-literature, and is presented in Section 6. The empirical data were collected during a period of three years, between April 2015 and April 2018.

Phase 0: field-problem framing. According to Van Aken and Romme (2009) "a field problem is a problematic state in a social or material reality". To gain an in-depth understanding of the field problem, the research was initiated with two exploratory case studies (Yin, 2004). The multiple case study enabled a fruitful cross-case analysis and a higher internal and external validity (Eisenhardt, 1989). The cases were recent transfers of electronics production from the domestic site of a Norwegian multinational producer (hereafter denoted as *Sender*) to a domestic electronics supplier. The empirical data were collected in April 2015 through semi-structured interviews conducted during one workshop at the supplier and one at sender. During the workshops, key transfer personnel (managers, purchasers, product-developers, process engineers and operators) from both companies were interviewed about the challenges they experienced during the PTs and possible causes of these. Thereafter, the interview data were triangulated with field notes taken during a tour of the supplier's factory and with relevant internal documents from the sender. The authors prepared a case-report based on the collected data, and to increase the accuracy of the empirical findings and the construct validity, this report was reviewed by informants (Karlsson, 2009).

The logical approach used during the field problem framing phase was abductive (as described by Karlsson, 2009, p.30). The starting point was the field problem, which was the suboptimal supply performance during the studied PTs (long start-ups). Thereafter, it was identified that one of the potential root causes for the field problem was the lack of a PT preparation procedure, which could be implemented by practitioners to mitigate the PT risk

Table I. The research process

Research type	Exploratory research			Explanatory research
Research phase	*0.Field-problem framing*	*1.Procedure incubation*	*2.Procedure refinement*	*3.Explanation*
Objective	Identify, understand, frame the field-problem	Develop an initial transfer-preparation procedure	Refine the transfer-preparation procedure; solve the field problem	Develop substantive theory; establish theoretical relevance
Means	Collecting and triangulating empirical data by taking field notes during site tours at both transfer-parties, performing semi-structured interviews and reviewing company documents and secondary data	Identification of potential preventive actions in the production transfer literature, through the lens of supply-chain risk management. The review included: peer-reviewed journal articles, dissertations, best-practices within the topics of "production transfer", "knowledge transfer" and "technology transfer", as well as publications about different types of production-relocations, "start-up" and "ramp-up" Moreover, seminal supply chain risk management publications were studied	Implementation of the procedure during a production offshoring case 7 iterations between procedure implementation, evaluation and refinement during 19 workshops with the case-sender and receiver Confirmation of intended consequences; co-optation of unintended consequences By help of a questionnaire, transfer practitioners applied the procedure on 3 production transfer examples with which they had broad experience and verified it. The examples were from distinct industries	Analysing the refined procedure in light of the literature findings from Phase 1 Addressing the theoretical and practical implications of the procedure
Research approach in this paper	Exploratory Case Research on 3 retrospective production transfers	Literature review, conceptual analysis	Action Research, survey	Discussion

Source: Based on (Holmström *et al.*, 2009) and (Van Aken and Romme, 2009)

(Section 1). Thus, the authors decided to develop a PT preparation procedure based on risk management principles and implemented it during an ongoing PT to study its effect on supply performance.

Phase 1: procedure incubation. This phase focussed on developing a preliminary version of the PT preparation procedure. First, the authors conducted a systematic literature review (as recommended by Karlsson, 2009, p.48) to identify potential preventive actions in the PT literature. The authors studied peer-reviewed journal and conference articles, dissertations, monographs, books and guidelines on the topics of *production*, *knowledge* and *technology transfers* in manufacturing industries, as well as about *production relocations*, *start-up*, *ramp-up* and key publications in the area of supply chain risk management. The literature search was conducted on a university's internet library (Oria), which provides access to the main databases for peer-reviewed literature, and on Google Scholar. Second, the identified preventive actions were synthesised into a preliminary procedure (Table II, Section 4). To this end, the most comprehensive frameworks and guidelines found in the literature were taken as a starting point (Fredriksson *et al.*, 2015; Terwiesch *et al.*, 2001; WHO, 2011). Third, the preliminary procedure was presented and discussed at a major Operations Management conference (EurOMA 2016).

Phase 2: procedure refinement. In this phase, the PT-preparation procedure developed in Phase 1 was implemented and iteratively evaluated and refined during a PT of acoustic sensors from sender to their Spanish subsidiary (hereafter denoted as *Receiver*). Figure 2 depicts the organisation chart of this PT and the personnel that was involved in the procedure refinement process. As recommended by Holmström *et al.* (2009), this phase applied an action research approach, and for this, the strategy described by Coughlan and Coghlan (2002) was followed. The action research approach allowed the authors to both implement the procedure at the case company to solve the field problem and affect the way the procedure was modified by the case company (Coughlan and Coghlan, 2002).

As indicated in the organisation chart (Figure 2), the lead author was part of Sender and Receiver's PT organisation and had the role of transfer facilitator. However, the lead author was not used by the transfer parties (i.e. the author was an "outside agent"). Thus, it was relatively easy to analyse not only the progress of the PT but also the research itself (Coughlan and Coghlan, 2002). Moreover, the lead author had a steering committee with members from Sender and Receiver, who enabled the author to build insider knowledge. The committee members were the person responsible for action plan and sourcing, project owner, quality assurance and risk manager and the project manager.

Furthermore, after implementing the procedure developed in Phase 1 during the PT to Spain, the authors verified its external validity during an international one-day seminar on the topic of PT. The seminar was organised by the lead author's research group in March 2017. The main purpose of the verification was to corroborate how relevant the procedure was for PTs with contrasting characteristics compared to the PT to Spain. During the seminar, three international PT practitioners applied the procedure on a PT (each on a different one) and verified it. The practitioners were an external PT consultant who applied the procedure on an offshoring PT of food production (with 8 years of PT experience), a PT manager who applied the procedure on an offshoring PT of thruster production (6 years of PT experience) and a PT facilitator who applied the procedure on an outsourcing PT of aircraft production (7.5 years of PT experience). Table II presents the PT experience and degree of involvement of all the informants during the procedure refinement phase. Although only three PT practitioners tested the utility of the procedure, the introduction of a potential solution in several contexts is a significant step towards theory development (Holmström *et al.*, 2009). Moreover, according to Gregor and Hevner (2013), when a

Informant (transfer role)	Transfer experience (years)	Participations at workshops/meetings
Action Research during a production transfer from Norway to Spain:		
From Sender		
Division Managing Director	2	N = 3
Action Plan and Sourcing responsible	2	N = 8
Project Owner	3	N = 14
Product Owner	0.5	N = 5
QA and Risk manager	2.5	N = 12
Lean Manager	1	N = 2
HSE responsible	0.5	N = 1
Planning and Forecasting responsible	0.5	N = 2
ERP Economics Transactions responsible	0.5	N = 1
Order and Delivery responsible	1	N = 2
Documentation and test responsible	1	N = 2
Process Technology responsible	1	N = 3
Production Manager and ERP-Production Planning responsible	2	N = 4
Pre-moulding Assembly operator	0.5	N = 1
Moulding operator	0.5	N = 3
Test System responsible	0.5	N = 1
Final Test and Assembly responsible	0.5	N = 1
Logistics responsible	1	N = 1
From Receiver		
Project manager	2.5	N = 7
Production Manager and QA& Risk& Lean responsible	2	N = 5
HSE responsible	1	N = 1
Procurement, logistics and planning responsible	2	N = 2
ERP Economics Transactions responsible	2	N = 2
Documentation responsible	2	N = 2
R&D, process control and chemical hazard responsible	0.5	N = 4
Moulding operator	0.5	N = 4
Assembly operator	1	N = 4
Survey at an international seminar		
Production Transfer consultant	8	N = 1
Production Transfer manager	6	N = 1
Production Transfer facilitator	7.5	N = 1

Table II.
The experience and involvement of the informants during the procedure refinement phase

researcher has expended significant effort in developing the solution design in a project, often with much formative testing, the final testing should not necessarily be expected to be as full or as in-depth as evaluation in a research project where someone else developed the solution design (Gregor and Hevner, 2013).

First, each participant presented her/his selected PT. Thereafter, the lead author presented the PT procedure and administered an electronic questionnaire to the PT practitioners. The questionnaire was prepared in Google Forms and consisted of several closed questions with space for open-ended comments. The authors applied the Likert scale, with three alternatives: (the action has) "no or low relevance", "medium relevance" and "high relevance". Further details about the data collection and analysis during Phase 2 are provided in Sections 5.2 and 5.3, respectively.

Case selection: According to a survey of 847 Nordic companies with over 50 employees, 48 per cent of the surveyed production companies had relocated production (Heikkilä *et al.*, 2017).

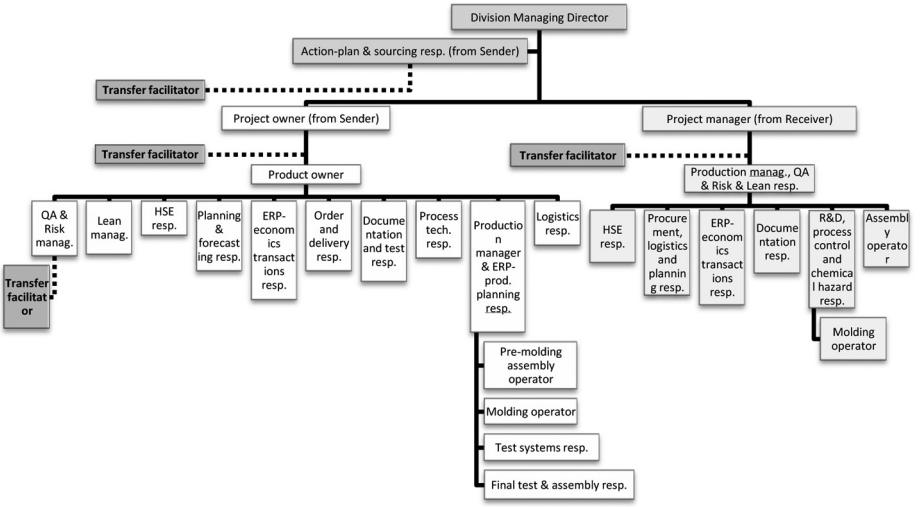


Figure 2.
The organisation chart of the production transfer to Spain

Production relocations are arguably more frequent among Nordic companies than among other European companies. For instance, only 21 per cent of the companies participating in the European Manufacturing Survey relocated production in the period 2000-2012 (Dachs and Zanker, 2015). Moreover, in Heikkilä *et al.*'s (2017) study, electronic companies were among those that relocated production most frequently. Consequently, based on these findings and on Karlsson's (2009, p. 172) recommendations about sample representativeness, the main case company (a Nordic electronics company) and the selected cases during Phase 0 and Phase 2 can be regarded as representative.

As earlier mentioned, the survey PTs belonged to different industries and to both offshoring and outsourcing processes, because the main purpose of the survey in Phase 2 was to verify the external validity of the procedure. Moreover, while the senders were all located in Nordic countries, the receivers were located in three distinct geographical areas (Estonia, China and India). In addition, the complexity of the transfer object varied across the PTs, including both "simple" transfer objects (a production line for bread) and complex (aircraft production). Finally, the number of survey PTs was a result of a trade-off between "adequate" external validity and study depth, in the context of a one-day seminar. The authors decided that three cases should be sufficient to achieve both goals.

3. Research Phase 0: field problem framing

This section briefly presents how the field problem and its potential causes were identified during Phase 1 of the design science research process. As already mentioned, during this research phase, we studied two PTs of electronics from the domestic site of a Norwegian multinational producer (Sender) to a domestic electronics supplier. During the workshop-interviews (Section 2), the informants from Sender and the supplier agreed that during the two studied PTs, they experienced sub-optimal supply performance results in the form of excessive start-ups, scrap-rates and inventory levels (i.e. the field problem). During the first PT, which was also the first PT project between Sender and the Norwegian supplier, as the Norwegian supplier could not achieve a steady state of production, Sender had to re-relocate the production to a supplier in a low-cost country. The supplier's informants reported that

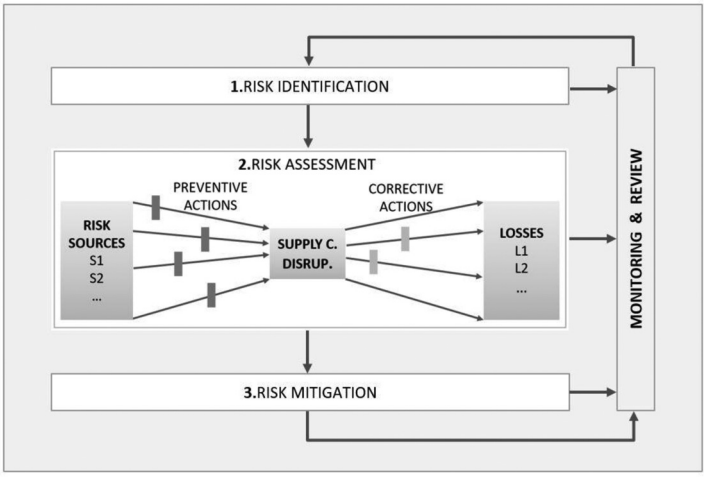
they accepted to participate in the first PT because they were willing to initiate a close collaboration with Sender, but eventually the transferred production turned out to be excessively labour-intensive and unprofitable for them. Overall, the informants' responses indicated that the challenges they had experienced were caused by the lack of thorough preparation of the PTs and of risk management, because of a lack of established PT procedures that they could apply. Moreover, as the existing research shows (Section 1), the challenges described by the informants are common for many companies. In addition, just as the informants reported, there is a lack of established PT preparation procedures in the literature, based on which the production can be adapted to the receiver's environment (i.e. not "copy exactly"). Thus, it determined that a PT preparation procedure based on risk management principles could address both the field problem and the literature gap. Note that a detailed description of the two PT cases is provided in the authors' earlier papers [Sjøbakk *et al.* (2016a) and Mogos *et al.* (2016b)].

4. Research Phase 1: procedure incubation

This section presents the preliminary version of the PT preparation procedure based on risk management principles. First, it is shown how the supply chain risk management theory can be applied during PTs. Second, there are presented the potential preventive actions identified in the PT literature, and it is explained how these actions have been synthesised into the preliminary procedure.

4.1. The relationship between the supply chain risk management theory and PTs

The supply chain risk management literature shows that in general a risk management process is organised into three steps: risk identification, risk assessment and risk mitigation (Kern *et al.*, 2012; Bode and Wagner, 2009; Kleindorfer *et al.*, 2005). The risk management process depicted in Figure 3 is used as the starting point for how the preventive risk mitigation during PTs is viewed in this research.



Source: Based on Kern *et al.* (2012) and McCormack *et al.* (2008)

Figure 3.
The risk management process during production transfers

First, one should proactively identify potential supply chain disruptions, as well as the risk sources triggering these disruptions and their consequences (*losses*) (McCormack *et al.*, 2008) (*Step 1 – risk identification*, Figure 3). In other words, one should address the question "What can go wrong?" A *supply chain disruption* is an abnormal situation in comparison to everyday business, which leads to negative deviations from certain performance targets and can result in losses for the affected companies (McCormack *et al.*, 2008). Examples of possible supply chain disruptions during PTs are material shortages (Fredriksson *et al.*, 2015), fires (Norrman and Jansson, 2004), machine breakdowns and quality non-conformances (Almgren, 1999). *Risk sources* are tangible or intangible elements, which alone or in combination with other risk sources have the intrinsic potential to give rise to supply chain disruptions (Norrman and Jansson, 2004). Examples of risk sources during PTs are the transfer parties' experience with PTs, receiver's experience with similar production, the complexity and maturity of the transfer object (Tatikonda and Stock, 2003), the relation and geographical closeness between the transfer parties (Terwiesch *et al.*, 2001) and the motivation of the sender's personnel (Fredriksson *et al.*, 2014). For instance, a risk-source such as a receiver's inexperience with the transferred production equipment can trigger machine breakdowns and consequent capacity deviations. Furthermore, these breakdowns may eventually lead to significant losses, such as the receiver's inability to deliver on time (Chopra and Meindl, 2013; Fredriksson *et al.*, 2015).

Second, the risk level should be assessed qualitatively or quantitatively, based on the likelihood of each potential supply chain disruption and its negative impact on performance (*Step 2 – risk assessment*, Figure 3). The supply chain disruptions can be visualised in a risk matrix with the dimensions probability of occurrence and negative impact. The matrix should clearly display supply chain disruptions with the risk level that is unacceptable for the companies (McCormack *et al.*, 2008).

Third, actions aimed at mitigating the risk of those supply chain disruptions with an unacceptable risk level should be identified and implemented (*Step 3 – risk mitigation*, Figure 3). However, this should be only done after a cost-benefit analysis for the alternative risk mitigation actions. Risk mitigation strategies during PTs include:

- removing the risk source (e.g. by not changing sub-suppliers during Start-up to avoid the increased risk of quality deviations, as seen in Aaboen and Fredriksson (2016);
- implementing preventive actions to reduce the likelihood of supply chain disruptions (as seen in Minshall *et al.*, 1999);
- implementing corrective actions to reduce the losses caused by supply chain disruptions that could not be avoided (as seen in Madsen, 2009).
- accepting the risk (Zhu *et al.*, 2001); and
- sharing the risk (Zhu *et al.*, 2001).

As illustrated in Figure 3, the preventive and corrective actions are barriers between risk source(s) and the unwanted supply chain disruption and between the disruption and losses. Finally, the performance level should be continuously monitored to promptly identify deviations and implement risk mitigating actions (Kern *et al.*, 2012; McCormack *et al.*, 2008).

4.2. Potential preventive actions during PTs

The potential preventive actions (referred to as *A no.* in Table AII) identified in the PT literature are synthesised into the preliminary version of the PT preparation procedure, as presented in Table AII. All the preparatory actions can mitigate the likelihood of supply

disruptions (Norrman and Jansson, 2004; ISO, 2009) during the execution and start-up phases of the PT (Figure 1). Thus, all the preparatory actions identified in the PT literature were included in the procedure. The actions are classified into the following categories: organisation and project management (C1, Table AII), quality management (C2), knowledge transfer (C3), transfer of administrative systems (C4) and supply chain transfer (C5). C3, C4 and C5 are based on Fredriksson and Wänström's (2014) classification of PT activities, whereas C1 and C2 are added based on WHO's (2011) recommendations. The procedure suggests a certain sequence of the actions which is based on descriptions of the PT process from the literature. Nevertheless, the exact sequence of the actions is expected to vary from case to case. The preventive actions from each category are described below.

Organisation and Project Management (C1). This category comprises two types of actions that senders and receivers should implement. The first type are actions for establishing the PT organisation (i.e. creating a project-team and any other necessary sub-teams). The project team should include a general coordinator for the entire project, and both transfer parties should assign one project manager to the transfer (A1, Table AII). Moreover, all the disciplines affected by the PT should be represented, and the team members should have clear roles and responsibilities. According to the Supply Chain Council, these factors are essential for risk management (McCormack *et al.*, 2008). Moreover, the PT process adds new responsibilities to existing job positions. This should be clearly communicated to the affected personnel, and appropriate skills and capacity levels should be ensured (McCormack *et al.*, 2008).

WHO (2011) recommends creating a cross-locational risk management team with representatives from both PT parties (A4). In line with the Supply Chain Council, if the sender and receiver have two separate risk management teams, their risk activities should be always aligned (McCormack *et al.*, 2008).

The second type of actions in the organisation and project management category (C1) are related to project management. A project start-up meeting should be organised as early as possible during the PT process and should include representatives from both transfer parties and all the affected disciplines (A5). During this meeting, the transfer parties should explain the reason for the transfer, discuss what performance outcomes are expected and clarify the business relationship between them (Dudley, 2006; McBeath and Ball, 2012).

Furthermore, if the transfer parties had not signed a formal agreement prior to the PT process, they should do this during preparations. For this, the transfer parties should evaluate the regulatory requirements (e.g. import duties and quotas) in their countries and in any country where the product is to be delivered (A6). Some of the issues that the agreement should include are emphasised in the supply chain risk management literature, including the specifications about profit sharing, the risk assumed by each transfer party (e.g. who pays for obsolete and scrapped materials), the PT personnel's rights to access information containing "intellectual property" (IP) and the specifications about product ownership (McCormack *et al.*, 2008; Chopra and Meindl, 2013). For instance, the sender could maintain ownership of the transferred equipment with a high IP value (Chopra and Meindl, 2013).

Other elements that the transfer parties should agree on are the expected performance targets (e.g. key performance indicators [KPIs]) and how to continuously monitor them at the receiver (A7). Examples of performance indicators that could be monitored during start-up are measures of first pass yield, process induced failures, test time, tact time, downtime and overall equipment effectiveness (Terwiesch *et al.*, 2001; Almgren, 1999). The continuous monitoring of performance is also important according to the supply chain risk management literature, as it facilitates the detection of supply disruptions and the prompt implementation of corrective actions (Blackhurst *et al.*, 2008). The monitoring of the production risks during

the start-up could be done through the enterprise resource planning (ERP) planning system. In addition, the transfer-parties can use a "watch-out" list of precursor supply disruptions (McCormack *et al.*, 2008). Furthermore, certain types of agreements can reduce the supply risks. For instance, strategic agreements could ensure a continuous supply in the event of capacity constraints at the receiver, and a "joint product design and delivery" with the receiver could reduce the risk of quality non-conformities and supply shortages (McCormack *et al.*, 2008).

Other project management actions are to prepare a thorough PT plan and to hold regular status meetings with the project team (A9-A10). Furthermore, whenever possible, PTs should be carried out during periods with lower customer demand (A14), and the production volume at the sender should be only gradually decreased as outputs increase at the receiver (A13). This implies having parallel production activities at the sender and receiver for a certain period. In this way, the sender would act as a secondary supply source in case of shortages (McCormack *et al.*, 2008).

Apart from the project management plan, the PT parties should prepare a communication plan (A12). By providing information about whom to contact when problems arise and how, this plan facilitates a prompt response to disruptions. In addition, the communication plan should describe crisis scenarios, the media-relations strategy during crisis events and the corrective actions identified when performing the risk assessment (McCormack *et al.*, 2008). When preparing the communication plan, the impact of confidentiality on the open communication of technical and risk matters should be addressed (Danilovic and Winroth, 2005; WHO, 2011).

All the PT documents should be gathered into one common directory, also known as transfer protocol (A11), and the directory should be continuously updated.

Quality management (C2). First, the sender should evaluate the receiver's readiness (A15, Table AII), which is highly relevant for risk identification (Step 2, Figure 3). Examples of risk sources are the qualification of the manufacturing and packaging rooms and of the equipment, the quality control procedures (WHO, 2011) and the personnel's production-capability (Malm *et al.*, 2016). One method that could be useful for this evaluation is the gap analysis, as it highlights the capability gaps between the transfer parties (Malm *et al.*, 2016; WHO, 2011). Other risk identification methods are SCOR mapping, value stream mapping (VSM), surveys, site visits at supply chain partners, the Delphi method with experts from the organisation, a review of historical problems with a high risk of recurrence and a review of supply disruptions from other organisations (McCormack *et al.*, 2008). Useful tools include checklists of risk-sources and Gantt charts, which help identify bottleneck processes (McCormack *et al.*, 2008).

The second action in this category, the transfer risk assessment (A16), is related to the risk assessment steps in Figure 3 (Steps 2-4). As Figure 3 indicates, the risk sources identified when evaluating the receiver's readiness (A15) should inform the risk analysis, together with any other relevant risk sources. For instance, the PT parties should assess the risk related to the customs clearance, e.g. to ensure that shipments are allowed outside or inside the receiver's country (Minshall *et al.*, 1999). Suggested tools for the risk assessment are qualitative and quantitative electronic spreadsheets that contain information about risk sources, risk analysis and evaluation, as well as mitigation actions and their impact (McCormack *et al.*, 2008).

Risk mitigation, the last step in Figure 3, involves the identification and implementation of preventive and corrective actions to mitigate risks of supply shortages (A17). Prior to PT execution, the transfer parties should select and implement preventive actions to avoid material shortages. Such actions include building up safety stock, arranging safety capacity,

over-planning and adjusting safety lead times. Preferably, more than one preventive action should be implemented. Corrective actions that the transfer parties could plan during Preparations and implement in case of material shortages are subcontracting, expediting part delivery, re-scheduling, overtime and express transports. (Fredriksson *et al.*, 2015).

The last action in the quality management category, improving the transferability of the transfer object (A18), is also related to the risk mitigation step in Figure 3. Several scholars recommend mitigating the PT risk by adapting the production system (i.e. production technologies, methods and processes) to the receiver's production environment (Madsen, 2009; Grant and Gregory, 1997a). The adaptations can span from minor changes, such as translating documentation, to more significant changes, such as changing components to cope with the new sub-suppliers' capabilities. After significant adaptations, the sender should pilot the new processes to ensure appropriate performance levels (Minshall *et al.*, 1999).

Knowledge transfer (C3). This category includes preventive actions related to training and other interactive activities between the PT parties. Naturally, the sender and receiver should start by preparing a training plan (A19), whose starting point should be the receiver's evaluation (A15) (Malm *et al.*, 2016). The training should include the transfer of personnel from the receiver to the sender's site for "hands-on" training and the fine-tuning of the production processes (Terwiesch *et al.*, 2001) (A20). For certain types of knowledge, one could use lower-cost training means, such as videotaped reviews of the production processes and photographs (A21). Other activities that could improve the receiver's performance include VSM or root cause analyses (RCA) (A23).

Furthermore, a change control process by which proposed engineering and other changes are validated should be always implemented at the receiver (A22). Finally, knowledge transfer is a cornerstone of the PT; hence, it is recommended to verify its outcomes (A24). This could be ensured by probing the receiver's knowledge about the processes and by requiring the receiver to run the operation autonomously for a defined period prior to Start-up (McBeath and Ball, 2012).

Transfer of administrative systems (C4). This category includes preventive actions related to the transfer of necessary documentation from the sender to the receiver and the preparation of the planning and control systems (A28, A30). Before transferring the documentation, overviews of what documentation is needed for the production and of required items, means of transfer and lead times should be prepared. One should also specify if any equipment purchase is required and its approximate cost. Thereafter the documentation should be updated and translated, and missing documentation should be created (A25). Furthermore, the sender should provide required health, safety and the environment (HSE) information to the receiver, such as the information needed for emergency planning (A27).

The receiver should always review received information and notify the sender about any incongruences with their production environment (i.e. their facilities, systems, capabilities, testing methods and equipment) (A28). Then, operating procedures and other necessary documentation should be prepared based on the sender's documentation (WHO, 2011). Moreover, the planning and control systems, such as the ERP, should be updated based on robust forecasts and other data (A29-A30).

Supply chain transfer (C5). The main action in this category is to ensure the necessary relationships to sub-suppliers of materials, parts, etc. (A31). This often means that new agreements are signed with both existing and new sub-suppliers. Sometimes, the transfer-parties change the sub-suppliers to more advantageous ones (e.g. to suppliers near the receiver) to reduce logistics and other production costs. However, it is also common that

transfer-parties maintain existing sub-suppliers during the PT to avoid introducing new risk-sources connected to the quality of the supplies (Aaboen and Fredriksson, 2016).

5. Research Phase 2: procedure refinement

This section describes how the PT preparation procedure from Table AII was refined with the case company into the final procedure presented in Table AIII. First, the offshoring PT case is introduced. Second, it is described how the procedure was implemented during the PT phase of the studied offshoring and refined during workshops with PT personnel from both Sender and Receiver. Finally, it is presented how PT practitioners from other companies and industries verified the procedure by applying it to three distinct PT examples with which they had broad experience.

5.1. Introduction of the PT case

Sender was the same as in the two exploratory cases in Phase 0 (Section 3), the domestic production site of a large Norwegian producer. Receiver was the Spanish site of a subsidiary of the Norwegian producer. The case company is briefly described in Table III.

The companies were part of and international technology group, which was a market leader within the production of advanced maritime electronics. Sender and Receiver had been experiencing good collaboration for over 20 years and had transferred one assembly process between them before. In the spring of 2016, Sender and Receiver decided to offshore the manufacturing of a product family with four acoustic sensors and nine variants from Norway to Spain.

Over the years, Receiver had developed a large customer network that Sender wanted to access. By transferring the production to Receiver, the customer delivery time was expected to decrease. The labour costs in Spain were lower than those in Norway, which was an advantage for the transferred products, as they required a high level of manual labour. Nonetheless, Sender only expected moderate profit margins and thus had to manage their resources carefully.

Moreover, because Receiver's area was known for its material technology specialists, Sender also transferred part of the development activities, and Receiver was commissioned to develop a new material for the transferred products. To this end, Receiver used a material technology researcher. Moreover, to cope with the increasing amount of production activities, Receiver needed to move to a larger building, and this building's layout had to be modified. In addition, Sender's ERP production module had to be implemented at Receiver

Table III.
A Description of the case company

Main case company	Norwegian technology company
Industry	Maritime supply
Area served	Global
No. of employees	Ca. 4,000
Revenue	Ca. €1,000m
Sender	Production site in Norway
Products	Electronics
Core competency	Innovative products
Product variety	Ca. 1,000
Product volumes	Usually less than 1,000 items
Receiver	The Spanish production site of a subsidiary
Transfer object	Acoustic sensors

before start-up. These processes added several extra actions to the PT procedure (further details in Section 5.4).

Although Sender had transferred production several times before, they had yet not achieved satisfactory start-up times, inventory levels and scrap-levels during PTs (Section 3). Therefore, together with Receiver, Sender decided to participate in the procedure refinement process and develop a thorough procedure for PT preparation.

5.2. The refinement of the procedure during the PT to Spain

The preliminary procedure from Table AII was implemented during the above-described PT, and it was evaluated, tailored to the PT-case and refined seven times in total. For this purpose, 19 workshops were organised in which Sender and Receiver's PT personnel participated either live or via video. The procedure refinement process is presented in detail in Table AI, along with data collection methods, the date when the data were collected, main events during the procedure refinement activities and workshop participants.

Prior to the first workshop with Sender and Receiver's personnel, the preventive actions from Table AII were transferred to an Action plan prepared in Excel (Id.2, Table AI). The headlines of the Action plan are presented in Figure 4, with an example of how the actions

(a)

Id	Area	Action	Relev-ance	Status	Open/ Closed	Sub-action	Owner	Start date	End date	Duration [working days]	Gantt chart
1	Organisation & Project Management	Organize a project start-up meeting with representatives from both Sender and Receiver and all affected disciplines. Announce the transfer object, reasons for the transfer, the relationship between Sender and Receiver, expected performance targets, etc.	High	We have not organized the kick-off meeting yet	Open	**1a.** Organize a kick-off at Sender with Sender's transfer personnel	NN	NN	NN	NN	NN
						1b. Organize a kick-off at Receiver with Receiver's transfer personnel	NN	NN	NN	NN	NN

(b)

How is the action performed? (steps)	INFORMATION REQUIREMENTS (Communication plan)			What can go wrong (supply disruptions)?	Causes (human/ technological/ organizational errors)	Losses	Risk level			Sub-actions	Residual risk		
	What	Why	Where to get it				Likelihood (L:1-low to 4-high)	Impact (I:1-low to 4-high)	Risk level (=L+I)		Likelihood (L:1-low to 4-high)	Impact (I:1-low to 4-high)	Risk level (=L+I)
Sender organizes a kick-off with their transfer personnel	-	-	-	Relationship, profit and risk sharing, and the KPIs are not clear for all transfer personnel at Receiver; may lead to Steady state delay	Organizational	Cost overrun	4	3	7	**1a.** Organize a kick-off with both Sender and Receiver's transfer-personnel	1	3	4
Sender announces the transfer object …	Transfer Strategy and Goals document	To present transfer reasons, targets…	Transfer Protocol							**1b.** Announce transfer object and clarify t. reason, relationship, risk-sharing…			
Receiver organizes kick-off with their transfer personnel	-	-	-							**1c.** Present Sender's existing KPIs			
Receiver announces the transfer object…	-	-	-							**1d.** Define transfer KPIs			

(c)

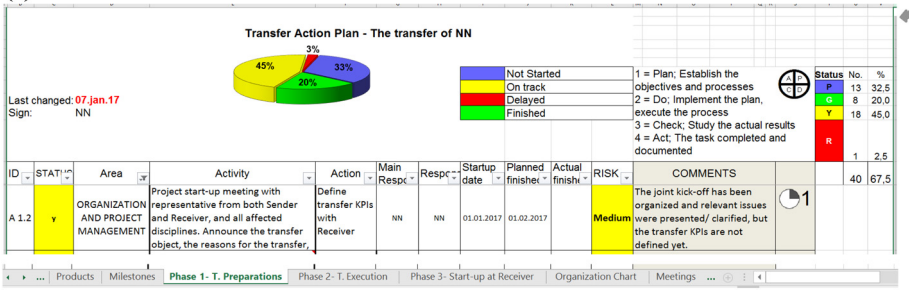


Figure 4.
(a) The transfer action plan used during the procedure refinement process (with an example); (b) the columns that replaced the sub-action column in the Transfer Action plan, in order to break down the actions into necessary steps, assess the risk and plan the communication during the transfer (with an example); and (c) the transfer action plan, as implemented by the case company (with an example)

were evaluated during the workshops. During both the live-workshops and the videoconferences, the Action plan was projected to a common screen. The workshop-participants were asked to evaluate whether the preventive actions had low, medium or high relevance for the studied PT. Consensus was achieved on each action before proceeding to the next. For those actions evaluated as having low relevance, the participants were asked to provide explanations. For medium or highly relevant preventive actions, the participants were asked if the actions had been implemented (*Status*) and whether any sub-actions were needed to implement them (*Open* action) or not (*Closed* action). If necessary, new sub-actions were identified, together with their action-responsible (*Owner*), start date, end date, amount of working days and Gantt chart. Sender and Receiver's personnel easily embraced this meeting format, maintaining it throughout the entire Procedure Refinement process.

As seen in Table AI (Id.8-10), the procedure inspired Sender's personnel to schedule a transfer risk assessment (Figure 3). For this, the lead author added two tools to the Action plan: one to assess the risk and one to plan the communication during the PT (A12 and A16, Table AII). Based on the job safety analysis (as in Rausand, 2013) and on Supply Chain Council's recommendations (McCormack *et al.*, 2008), the sub-action column (Figure 4a) was replaced with a number of new columns (the columns from Figure 4b). The risk assessment columns (light grey columns in Figure 4b) contained items that were meant to aid in breaking down the preventive actions into sufficiently detailed sequences of steps, as well as in identifying what could go wrong during each step (i.e. supply disruptions), including risk-sources, potential losses, the risk level and the residual risk after implementing the identified sub-actions (Rausand, 2013). The items in the communication plan columns (darker columns in Figure 4b) were aimed at helping the risk assessment participants identify what information was necessary to implement the sub-actions, where the information could be found and if the information did not exist, when it had to be ready (McCormack *et al.*, 2008).

Eventually, Sender's personnel transferred the data in the action plan to an excel template (presented in Figure 4c) they had prepared (Id. 14, Table AI). It can be seen that Sender's personnel assigned risk levels to the preventive actions (*activities* in this template). Actions evaluated as indispensable for the ability to produce during start-up were assigned a high-risk level, whereas other actions were assigned medium or low risk levels. Moreover, a plan-do-check-act tool was included in the template, indicating to what extent the actions had been implemented (i.e. planned, executed, checked, or completed and documented). Several documents were also included in the template as separate Excel sheets, which contained user-instructions, an overview of the transferred product-variants, the PT organisation chart, a record of the status-meetings, as well as project milestones and their deadlines.

The milestones included central actions for the PT project that needed to be implemented in a certain order. Sender and Receiver identified three project milestones as the most important:

(1) Milestone 1
   - Verify shipping requirements
   - Plan for overproduction to cover needs during execution and start-up phases
   - Make robust forecasts (of start-up time, new lead times, new quality levels, etc.)
   - Update the planning and control systems (ERP)
   - Verify the readiness of the test system for the transfer (software, equipment, documentation, access rights to the sender's systems, etc.)
   - Verify knowledge transfer at receiver (e.g. check documentation)

(2) Milestone 2
- Sender and receiver jointly develop a training plan
- Prepare documentation for the newly developed material
- Establish relationships to sub-suppliers of raw materials and parts

(3) Milestone 3
- Validate receiver's facilities
- Validate the purchasing, warehousing and receiving structure at Receiver

Furthermore, as shown in Figure 4c, two separate sheets with the actions during the execution and start-up phases were added to the template. These Excel sheets had a similar structure to the action plan for the preparation phase. The execution and start-up processes were developed by the lead author during the same three-year research project as the preparation process. The new template with all the different sheets was given the name "TAP" (*Transfer Action Plan*).

The first time the action plan-responsible (from Sender) used TAP during status-meetings with the PT organisation, the plan worked smoothly and helped the company to prepare the PT thoroughly. Moreover, the plan continued to do so for the next year when the lead author followed the PT (Id. 17-19, Table AI). In April 2018, at the end of the in-depth study, the authors conducted an evaluation of the users' experience (Id. 20, Table AI). Key informants from Sender and Receiver were interviewed about their experience with the PT-preparation procedure and its implementation. Prior to the interviews, the authors sent a questionnaire to the informants and their answers were used as a starting point for the interview discussions. In the questionnaire, the informants were mainly asked to evaluate the utility of the procedure and its implementation (in the form of an action plan), as well as the start-up time and delivery precision compared with the two transfers to the Norwegian supplier (Section 3) and to the previous transfer to Receiver (Section 5.1).

The project owner (from Sender) reported the following:

> There is no doubt that the methodology we have followed during the transfer to Spain has been very useful and an appropriate procedure and method to follow. [. . .] The activities in the procedure are very important and the production transfer processes benefit a lot of such process tools.

Furthermore, the action plan-responsible (Sender) and the QA and risk manager (Sender) reported that the PT procedure ensured that important preventive actions were implemented, and it reduced the amount of disruptions. Moreover, Sender's key informants reported that the start-up had been relatively short, compared to earlier PTs, and the on-time delivery better.

Receiver's personnel expressed their satisfaction with how TAP worked, too. Receiver's production manager (also responsible for quality assurance, risk and Lean) wrote in an e-mail sent to the lead author: "without the transfer plan, the sonars transfer would have been more complicated". The project manager (from Receiver) also made similar remarks on several occasions throughout the PT. Almost at the same time as the studied PT case, Receiver was taking on the production of another product offshored by Sender. According to the project manager and to the production manager, although the PT to Spain was more complex than the other PT, due to the use of the action plan, the tempo of the PT to Spain was considerably faster and Sender's assistance was more substantial and timely.

5.3. The verification of the procedure

As described in Section 2, during a seminar in March 2017, three international practitioners with extensive experience with PTs (Table II) applied the PT preparation procedure (Table AII) to three distinct PTs. Note that the preventive actions added by Sender and Receiver (in *italics* in Table AIII) were appended to the procedure that the practitioners applied.

The verification process was conducted using an electronic questionnaire, which was administered to the practitioners. The questionnaire mainly consisted of questions related to the relevance of each preventive action for the selected PT-examples ("no or low relevance", "medium relevance" or "high relevance"). The practitioners' evaluations of the actions are included in Table AII (the literature-based actions) and Table AIII (the actions added by Sender and Receiver). Based on the data in these appendices, the authors calculated the percentage of actions that were evaluated as having low/medium/high relevance per PT-example. The results are listed in Table IV, along with a brief description of the PT examples. As this table shows, each PT practitioner evaluated ca. two-third of the actions as highly relevant. In total, 94.62 per cent of the actions were evaluated as highly or at least medium relevant.

5.4. The refined version of the procedure

The final version of the PT-preparation procedure that emerged from the procedure refinement process (Section 5.2) is presented in Table AIII. Furthermore, Table AII and Table AIII also present how Sender and Receiver evaluated the potential preventive actions during the workshops and how they evaluated the risk of the actions in the TAP plan.

During the refinement process, 18 new preventive actions were added to the procedure (in *italics* in Table AIII). Several of these actions could be rather case-specific, such as the modification of the layout in the newly bought premises (A12*; Table AIII) and the development of the new material (A23*, A24*; Table AIII). The other actions that were added (e.g. A5.2*, A10.1*, A14*, A14.1*, A22* and A22.2*; Table AIII) and the two new action categories (*Test* and *HSE*) are of a rather general nature and should be applicable to other PT cases. For instance, A22*, which refers to verifying that all the preparation actions are closed before preceding to the execution phase, could be useful during any PT case.

Six of the potential preventive actions identified in the literature (Section 3.2) were not included in the TAP plan (A3, A9, A12, A13, A14, A18; Table AII) in most cases because

Table IV.
The evaluation of the procedure actions' relevance for three distinct production transfers

	Example A	Example B	Example C
Production Transfer characteristics			
Sender	Swedish subsidiary of a large food company	Finish production site of a large technology producer	Swedish production site of a large aircraft producer
Transfer object	Production line for bread	Thruster production	Aircraft structural production
Receiver	Subsidiary in Estonia	Subsidiary in China	External supplier in India
Actions with low/medium/high relevance per production transfer (%)			
Low-relevance	6.45	3.22	6.45
Medium-relevance	19.35	32.26	16.13
High-relevance	74.19	64.52	77.42

they were addressed or replaced by other actions. For instance, A9 was removed because the TAP plan fulfilled the function of a project management plan.

In the same way as in Section 5.3, based on the data in Table AII and Table AIII , the authors calculated the percentage of actions that Sender and Receiver evaluated as having low/medium/high relevance and low/medium/high risk level. The results are listed in Table V. During the earlier stages of the procedure refinement process, the participants evaluated most of the preventive actions in the PT preparation procedure as having high-relevance for the transfer to Spain (77.41 per cent, or 24 out of 31). However, later during the research process, when the TAP plan was created and the action owners were appointed, only 25.8 per cent of the same actions were considered to be indispensable for the ability to produce during Start-up, and were thereby assigned a "high-risk level" (Section 5.2). Therefore, only 22 out of 31 actions were transferred to the TAP-plan and assigned risk levels.

As earlier mentioned, Sender and Receiver added 18 new preventive actions to the PT preparation procedure (Table AIII). The PT practitioners evaluated all of these actions but two, as highly or medium relevant for the PT examples. The PT manager evaluated A10.1* (verifying shipping requirements, e.g. customs requirements and trade agreements applicable when shipping from the sender vs. the receiver) and A21* (ensure that the equipment to be transferred is registered and marked with the sender's property) to be little relevant for the offshoring to China. For instance, he evaluated A10.1* as little relevant because "international shipping and customs are generally straightforward except for few special locations".

Finally, 77.55 per cent (38 out of 49) of all of the preventive actions (the actions in Table AII and those added by Sender and Receiver in Table AIII) were evaluated to either have high or medium relevance for the four PTs studied. Sender, Receiver and the PT practitioners unanimously evaluated 16 of these to have high relevance (Table VI).

6. Research Phase 3: explanation

In this section, the significance of the results from the procedure refinement phase are interpreted in light of the paper's purpose, and the results are compared with those of earlier research.

The purpose of this paper was to develop a procedure for a thorough preparation of PTs that should aid companies in preventively mitigating the risk of supply chain disruptions during PTs and thereby meeting their targeted performance results during production relocations. The PT-preparation procedure (refined procedure in Table AIII) was developed

Production transfer characteristics	
Sender	Norwegian production site of a large electronics producer
Transfer object	Sensor production
Receiver	Subsidiary in Spain
Actions with low/medium/high relevance [%]	
Low relevance	19.35
Medium relevance	3.22
High relevance	77.41
Actions with low/medium/high risk level [%]	
Low risk level	0
Medium risk level	45.16
High risk level	25.8

Table V.
The evaluation of the relevance of the procedure actions for the in-depth case

Id	Preventive actions
A1	Establish a project team with project managers and representatives from all the disciplines affected by the transfer and from both the sender and receiver. Assign a general project coordinator. Clarify the role and responsibilities of each member
A5	Organise a project start-up meeting with the sender's and receiver's personnel involved in the transfer. Announce the object of the transfer, reasons for the transfer, the relationship between the sender and receiver, expected performance targets, etc.
A9	Prepare a project management plan
A11	Create a Transfer Protocol that includes all the transfer documentation and is easily accessible to all the sender and receiver's personnel involved in the transfer. The protocol should be continuously updated
A15	Evaluate the receiver's readiness with regards to facilities, equipment and support services (e.g. by a Gap Analysis)
A16	Assess the transfer risk. Include customs clearance and material supply risks
A17	Identify and implement preventive actions to mitigate the risk of supply shortages (e.g. safety stock and safety capacity). Identify corrective actions to mitigate the risk of supply shortages (e.g. overtime and express transports)
A24	Verify Knowledge Transfer at the receiver (e.g. check documentation, test personnel)
A25	Prepare a list of items and documentation to be transferred. Specify transfer mechanisms, if purchases are required, costs and lead-times to the receiver
A26	Review, update and create missing documentation. Translate documentation, if necessary
A29	Make robust forecasts (of start-up time, new lead times, new quality levels, etc.)
A30	Update the planning and control systems (e.g. ERP)
*A14**	*Validate the receiver's facilities (after the implementation of sub-actions for improving the receiver's "readiness" for transfer)*
*A27**	*Send personnel from the sender to the receiver to perform training on testing methods*
*A32**	*Implement ERP at the receiver. Train the receiver's personnel on ERP use*
*A32.1**	*Verify that ERP is functional at the receiver*

Note: *Preventive actions that were added by Sender and Receiver

Table VI.
Actions that the informants unanimously evaluated to have high relevance

during a three-year design science study. First, a preliminary procedure was developed based on preventive actions from the PT literature. Through the supply chain risk management lens, all the salient preparatory actions in the PT literature were regarded as preventive actions and included in the procedure, as all of them can mitigate the likelihood of supply chain disruptions (Norrman and Jansson, 2004; ISO, 2009) during the execution and start-up phases. Thereafter, the procedure was thoroughly validated by both Sender and Receiver's personnel involved in the PT to Spain and by international PT practitioners.

The PT practitioners verified the procedure by applying it to three PTs with which they had worked (Table IV). The main purpose of the verification was to corroborate how relevant the procedure was for PTs with contrasting characteristics compared to the PT to Spain. Thus, the three selected PTs belonged to different industries (food, power technology and aerospace production) and had been conducted between different countries. While all of the senders were located in Nordic countries, the receivers were located in three distinct geographical areas (Estonia, China and India). Furthermore, PT-A and PT-B were part of offshoring processes, while PT-C was part of an outsourcing. In addition, the complexity of the transfer object varied across the PTs, including both "simple" transfer objects (a production line for bread) and complex (aircraft production). As shown in Table IV, despite of these differences between the PT examples, each PT practitioner evaluated 94.62 per cent of the actions as highly and medium relevant. In total, 74.19 per cent of the preventive

actions were highly relevant for the food production PT, 64.52 per cent for the power technology PT and 77.42 per cent for the aerospace production PT. This indicates that the PT preparation procedure should be useful for different types of production-relocations and production industries.

The refined PT preparation procedure informs the risk assessment during the PT risk management process (Step 2 in Figure 3). To reduce the likelihood of potential supply chain disruptions with an unacceptable risk level, PT practitioners should implement all the preventive actions in the procedure, which they deem relevant (e.g. based on a cost-benefit analysis). The preventive actions should be implemented in the early phase of PTs. Moreover, based on the procedure refinement process (Section 5.2), practitioners should break down the actions as much as practically needed when applying the PT-preparation procedure.

Furthermore, the procedure developed in this paper should not only be used during PT preparation but also during the relocation-decision and the supplier selection phases (Figure 1) as an example of what the preparation of a PT implies (e.g. the amount of actions the sender and receiver must implement). For instance, the procedure could inform a total cost analysis of producing in-house vs. at a supplier (Fredriksson, 2011). If the cost of the PT exceeds the benefits, it may not be worth proceeding with the relocation process.

To the authors' knowledge, the procedure proposed in this study is the first PT preparation procedure based on risk management principles, which arguably addresses all the risk areas during the preparation phase. As earlier mentioned, although many production relocation procedures exist, only few of them address the PT process. The existing PT procedures either provide a rather vague overview of PT activities (Momme and Hvolby, 2002; Zeng, 2003) or they only focus on certain parts of the PT process. The PT scholars have hitherto focussed on the physical transfer of equipment and inventory (Kowalski *et al.*, 2018; Tatikonda and Stock, 2003) on the knowledge transfer throughout all the PT phases (Madsen, 2009; Malm *et al.*, 2016; Cheng *et al.*, 2010) and on the transfer of sub-suppliers (Aaboen and Fredriksson, 2016; Fredriksson and Wänström, 2014). The PT literature only recently started to pay more attention to the transfer of administrative systems (Fredriksson and Wänström, 2014; Fredriksson *et al.*, 2015), and to the organisation, project and quality management (WHO, 2011). The authors argue that these areas are as important for the success of the PTs and of production-relocations as the physical and knowledge transfers are. Furthermore, although some of the PT scholars acknowledge the importance of managing the risk during PTs, Fredriksson *et al.* (2015) is the only identified paper that explicitly recommends preventive actions during PTs. Nevertheless, this paper focusses on the preventive actions that may be necessary to avoid shortages of raw materials and components, which relates to part of the transfer of administrative systems. Thus, the proposed PT preparation procedure supplements Fredriksson *et al.*'s (2015) procedure with the preventive actions related to organisation, project and quality management, knowledge transfer, supply chain transfer, and with other relevant administrative transfer-actions from the PT literature. Finally, this study addresses Busi and McIvor's (2008) call for production relocations frameworks developed by applying theoretical frameworks in a practical setting.

In the remainder of this section, there will be presented a few salient empirical findings for the organisation and project management, quality management and transfer of administrative systems, as these preventive actions categories received limited attentions in the existing PT literature.

6.1. Organisation and project management

The organisation and project management preventive actions resulted to be fundamental during the in-depth study, facilitating the execution of the other preventive actions in the PT preparation procedure. Three salient examples are A1, A10 and A11 (Table AII).

Based on A1 in the PT preparation procedure (Table AII), the transfer parties in the in-depth study established a project team, defined the roles of the team members in the action plan (the TAP-plan) and named a project owner at Sender and a project manager at Receiver. However, the transfer parties did not name a cross-locational project manager, fearing that this additional management layer could backfire on the information flow. Although, later, the transfer parties did name an action plan administrator, his responsibilities were not clear to all the transfer personnel. According to the administrator, "many are thinking that I'm the captain of this ship because I update the TAP, but I'm just sitting with the map!". Sometimes, transfer personnel believed that the administrator was the PT manager while on other occasions action owners only closed their actions after he reminded them to do so, or they even disregarded closing them. At the end of the in-depth study, informants from both transfer parties acknowledged that a cross-locational project manager should have been named in the early phase of the PT. This would have accelerated the transfer considerably. Furthermore, A1 was unanimously evaluated as highly relevant by the PT practitioners during the international seminar.

The existing PT literature shows that dedicating employees to the PT (Fredriksson *et al.*, 2015) and having a project manager at the receiver's site (Terwiesch *et al.*, 2001) have a positive effect on the PT-outcome. However, surprisingly, the PT scholars have so far payed little attention to the role played by the cross-locational project manager during PTs.

During the procedure refinement workshops, the participants evaluated that holding regular cross-locational status meetings and sending meeting notes to all affected personnel after those meetings was highly relevant for the transfer to Spain (A10, Table AII). However, in a later phase of the refinement process, Sender's personnel assigned a "medium risk" to this action, as it was not considered indispensable for the ability to produce during start-up (Section 5.2). At the end of the in-depth study, Sender and Receiver's informants reported that meetings had not been held regularly, notes had not been sent to affected personnel and the tasks had not been sufficiently well coordinated. The action plan-responsible (sender) and QA and risk manager (Sender) reflected that during future PTs, the action plan-responsible should meet the action owners (one department at a time) weekly or every other week to update the plan. The meetings could be either physical or via videoconferences. QA & Risk Manager and Project Owner (Sender) reported that holding frequent and regular meetings with the receiver accelerated the transfer tempo, and it was one of the success factors during an earlier PT to an Asian subsidiary. Moreover, on several occasions, Action plan- responsible experienced that the action owners postponed their actions because other action owners were late. Thereby, at times, it was difficult to comply with the PT schedule. Therefore, according to him, during future PTs, the action plan-responsible should hold general status meetings with the transfer-team once a month. During these meetings, the team should review whether relevant milestone actions (Section 5.2) are closed and if the project is on track. As shown in Table AII, the PT practitioners also evaluated A10 as relevant. It was evaluated as highly relevant for the food industry and aircraft transfers and medium relevant for the thruster transfer. For the thruster transfer, the PT manager explained that the sender relied heavily on expats working at their Asian subsidiary throughout the PT, one of them being the manager himself. Thus, the cross-locational status meetings were less critical during this PT.

These results provide support to Zhu *et al.*'s (2001) study, which emphasises that it might be appropriate to hold weekly status meetings during production relocations, and that meeting notes should be sent to each action owner. In addition, the in-depth study shows that the transfer parties could consider organising two types of status meetings to economise working hours: weekly (or bi-weekly) detail meetings with each department to review all their actions, and monthly general meetings with the entire transfer team, to review the milestone actions.

Creating a directory (also known as transfer protocol) for all the transfer documentation, which is easily accessible to the entire transfer organisation and is continuously updated (A11, Table AII), is one of the actions that was evaluated as highly relevant by both the Sender and Receiver's informants and the PT practitioners. However, Sender's personnel assigned a medium risk to A11 in the TAP plan, as they did not regard this action as indispensable for the ability to produce during start-up. Even though Sender's personnel prepared an electronic directory and required the transfer personnel to store all the relevant documentation in that directory, later, informants from both parties reported that the transfer personnel did not actively use this directory. Moreover, on several occasions, Receiver's informants reported late or missing documentation that lead to significant schedule disruptions. For production manager (Receiver), the main challenge during the PT to Spain was to "receive the correct information at the correct time". Furthermore, apart from the transfer protocol, Sender used a product lifecycle management-system for document handling. Nevertheless, Sender could not grant Receiver the permission to access the transfer documentation in this system, as Sender could not protect the IP connected to the documentation that was not related to the PT.

This empirical evidence supports WHO (2011) and Zhu *et al.*'s (2001) findings. According to these authors, the PT directory should, among other things, include the PT's objective and scope, a cost-sharing agreement, the roles and responsibilities of the transfer personnel, the project management plan, systematic instructions for all the tasks, a change control procedure and an assessment of the finished products. Furthermore, the in-depth study shows that organisation and project management activities such as A11 have a clear impact on the outcome of the administrative transfer and of the entire relocation project. A common directory with all the necessary transfer documentation that is rigorously used by the Sender and Receiver's personnel is a minimum requirement for a smooth transfer of documentation and for systems integration (e.g. the Sender and Receiver's production planning and control systems). Moreover, it can significantly mitigate the risk of schedule disruptions and futile costs.

6.2. Quality management

Similar to the organisation and project management actions, the *quality management* actions resulted to be fundamental during the transfer to Spain. Moreover, the authors argue that these actions enable or facilitate the achievement of expected supply performance targets during PTs. Two salient examples are A15 and A16 (Table AII).

Evaluating the readiness of the Receiver's facilities, equipment and support services (A15, Table AII) was assessed as highly relevant by both the Sender and Receiver's informants and the PT practitioners. Moreover, Sender's personnel assigned a high risk level to A15, as they considered that it was an indispensable action for the ability to produce during Start-up.

According to QA and risk manager (Sender), in the beginning of both the transfer to the Spanish subsidiary and to the Asian one, Sender's personnel focussed very much on the knowledge transfer connected to the transferred products. In his opinion, before starting

with the knowledge transfer, Sender should make sure that an appropriate quality management system is in place at the Receiver; Sender and their Receivers need to have a positive "quality and safety culture". Even though Sender evaluated receiver's readiness for transfer soon after the kick-off, part of the necessary preventive actions was implemented late during the preparation phase (e.g. the warehouse routines). Thus, QA and risk manager stressed that during future PTs, Sender should conduct a Gap analysis and implement necessary actions in the very beginning of the PTs. Furthermore, Sender and Receiver's personnel added one related milestone action to the TAP-plan. This was A14*, and it refers to the validation of the Receiver's facilities after the implementation of necessary sub-actions for improving Receiver's "readiness" for transfer. The PT practitioners at the international seminar unanimously evaluated A14* as highly relevant (Table AIII).

These results are in line with Malm *et al.* (2016) and WHO's (2011) recommendations about conducting a Gap Analysis to identify potential risk sources at the Receiver (the risk identification step in Figure 3). According to WHO (2011), the risk sources can be, among others, connected to the manufacturing and packaging rooms, to the equipment and to the quality control procedures.

Similar to A15, assessing the transfer risk (A16, Table AII) was evaluated as highly relevant by all the informants. As earlier mentioned, A16 is related to the risk assessment step in Figure 3 and the risk-sources identified when evaluating the Receiver's readiness (A15) should inform the assessment, together with any other relevant risk-sources. During the transfer to Spain, both Sender and Receiver conducted PT risk assessments and added a series of sub-actions to the TAP-plan to mitigate the risk of potential disruptions. For instance, Sender's personnel who had the experience of being retained at the customs office "for two days" because they did not possess all the required documentation for the shipped equipment, stressed the need to carefully validate the transportation documentation of all the equipment and inventory prior to the physical transfer. This payed off as no goods were stopped at the customs office during the transfer to Spain.

Furthermore, Sender's personnel added a separate category for the HSE actions and sub-actions in the refined procedure (Table AIII), and the HSE actions were evaluated to pose a high risk for the ability to produce during start-up. To ensure that all the critical HSE risk-sources were identified and the associated risk was properly mitigated, Receiver contracted an accredited HSE consultancy company to perform a comprehensive HSE assessment of the premises. No HSE disruptions (e.g. occupational accidents or chemical hazardous events) occurred during the construction project at the new premises, the relocation from the old premises to the new ones, or otherwise during the in-depth study.

The findings are in line with Fredriksson *et al.* (2015) and WHO's (2011) recommendation about ensuring a thorough risk assessment and mitigation (Steps 2 and 3 in Figure 3) during production relocations. Moreover, the results provide additional support to Minshall *et al.*'s (1999) findings about the importance of assessing the risk related to customs clearance.

6.3. Transfer of administrative systems

The in-depth study showed that the administrative transfer actions should have received more attention during the transfer to Spain. The authors argue that the integration of the Sender and Receiver's systems and the transfer of documentation is getting more and more critical in an era of increasing digitalisation.

During the transfer to Spain, the transfer parties decided to implement Sender's ERP at Receiver, as Receiver's planning and control system could not cope with the increasing production activities. Half a year after signing the PT agreement, Sender started to implement the ERP at Receiver and provided thorough training to Receiver's personnel on

ERP use. Receiver's informants reported that the ERP implementation was a complex endeavour and one of the greatest challenges during the transfer to Spain. Several of them meant that Sender and Receiver should have allocated more time to the implementation and initiated it earlier. Furthermore, the informants during this study unanimously evaluated the ERP related actions as highly relevant. Both the literature-based actions (A29 and A30 in Table AII) and the actions added by the Sender and Receiver (A32* and A32.1*; Table AIII) were evaluated as highly relevant for the food, thruster and aircraft PTs alike. This can indicate that the implementation, update and verification of the ERP system, as well as the training of the Receiver's personnel on ERP use are important and commonplace actions during production relocations of various types.

These results are in line with Fredriksson *et al.* (2015) and Minshall's (1999) findings about the importance of updating the production planning and control systems during PTs. The transfer parties can for instance update the customer order fulfilment strategy (e.g. made-to-order or made-to-stock) and materials planning method (e.g. reorder point or Kanban), as well as the planning frequency, time fences and the planning periods (Fredriksson *et al.*, 2015). Moreover, the planning data should be also updated based on robust forecasts of e.g. start-up time, new lead times and new quality levels (Fredriksson *et al.*, 2015; Minshall *et al.*, 1999).

Apart from the ERP system, Sender implemented their test system at Receiver. Thereby, the transfer parties added the test category to the refined preparation-procedure. The actions included in this category (A25*-A27*; Table AIII) were related to the verification of the readiness of the test system for transfer (software, equipment, documentation, access rights to Sender's test data management system, etc.), the test update and the test training. The implementation of the test system only started at the end of the preparation and the informants reported that this led to a delay of several weeks. Thus, similar to the ERP implementation, the Sender and Receiver's informants acknowledged that the implementation of the test should have been initiated in the earlier phase of the preparation; the test system was only to a limited extent dependent on the other preparatory activities. Furthermore, the PT practitioners during the international seminar evaluated the test actions as having high or medium relevance for the three PT examples. Thus, other PT practitioners could also take into account the test actions during the preparation phase, along with the actions related to the integration of the ERP or other relevant systems at the Receivers.

Another example of administrative transfer action that should have received more attention, in particular from Sender, was A26 ("Review, update and create missing documentation. Translate documentation, if necessary"). All of the informants during this study evaluated A26 as highly relevant, and Sender's personnel assigned it a "high-risk" in the TAP-plan. However, as Sender only expected moderate profit margins and had to manage their resources with extra care, instead of assigning personnel to update the PT documentation prior to the training of the Receiver's personnel at their site, Sender decided to update it together with the Receiver's personnel. Consequently, part of Receiver's personnel had to travel to Norway frequently, and because of the relatively large distance between the sites, the travel expenses came to represent a significant portion of the total PT cost. Had the Sender carefully reviewed and prepared the transfer documentation ahead of Receiver's training, they could have incurred significantly lower expenses. These results provide support to Fredriksson *et al.* (2015) and Terwiesch *et al.* (2001) recommendations that the Sender should update the transfer documentation prior to training. Examples of documents that could be updated are drawings, product tolerances, manuals, spare parts

lists and training aids (McBeath and Ball, 2012; Fredriksson *et al.*, 2015; Terwiesch *et al.*, 2001).

6.4. A framework for the preparation of production transfers

Based on the findings from literature, the in-depth study and the survey during the international seminar, the authors developed the basic framework in Figure 5. Its aim is to foster a common understanding between the Sender and Receiver's personnel, the main types of preventive actions in the PT-preparation procedure (the literature-based procedure in Table AII) and the relation between them. It should provide a basic structure that can be easily used to introduce the PT preparation procedure in the early phase of a PT. Each preventive action category includes a few examples of keywords based on the PT preparation procedure.

As previously mentioned, the PT scholars have hitherto focussed on the physical transfer of equipment and inventory (the execution phase), on the knowledge transfer and on the transfer of sub-suppliers. The PT literature has only recently started to pay more attention to the transfer of administrative systems and to the organisation, project and quality management. According to Fredriksson *et al.* (2014), if the Senders and Receivers regard the administrative, supply chain, knowledge and physical transfers as four distinctive parts of any PT, they are likely to allocate more resources to ensure each and every of these transfers. Similarly, the authors argue that if the Senders and Receivers are aware of the role played by the organisation, project and quality management areas during PTs, it should be easier for them to invest in these areas.

In the in-depth case study, most of the organisation and project management preventive actions that initially were regarded as highly relevant were assigned a medium risk in the action plan, as the transfer parties did not consider them as indispensable for the ability to produce during the start-up phase (Table AII and Table AIII). However, at the end of the in-depth study, several of those actions turned out to be more important than earlier thought (e.g. holding regular cross-locational status meetings [A10] and collecting all the transfer documentation in an electronic directory that is easily accessible to the entire transfer organisation and is continuously updated [A11]). This suggests that when PT practitioners evaluate the organisation and project management actions, they should be aware that these

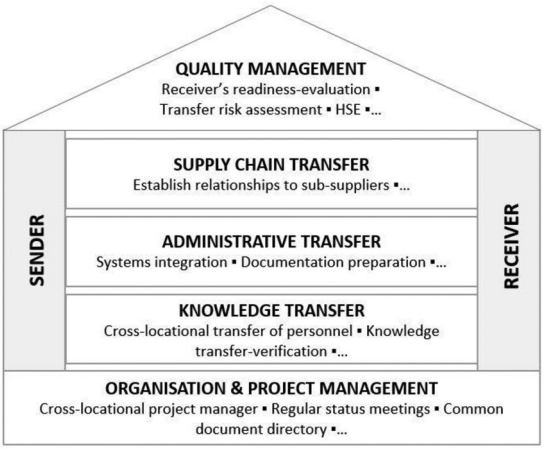


Figure 5.
Production transfer preparation framework

actions could facilitate the execution of those actions that are indispensable for the ability to produce during start-up. For instance, an electronic directory that contains all the necessary transfer documentation and is rigorously used by the transfer personnel should be a minimum requirement for a smooth transfer of administrative systems. Moreover, it can significantly mitigate the risk of schedule disruptions and of futile costs caused by, e.g. late or missing documentation. Finally, the findings also indicate that practitioners should revisit the PT preparations procedure several times as the relevance of the actions may change throughout PTs.

Similar to the organisation and project management preventive actions, the quality management and the transfer of administrative systems actions emerged as key areas of attention during the PT to Spain. The in-depth study showed that the quality management actions enable or facilitate the achievement of expected supply performance targets during the PTs. Based on his experience with the transfer to Spain and with another large offshoring to Asia, QA and risk manager (Sender) even recommended that prior to knowledge transfer actions such as training, the transfer parties should verify that an appropriate quality management system is in place the receiver. This should be done by conducting a Gap analysis in the very beginning of the PTs to identify risk sources connected to the readiness of the Receiver's facilities, equipment and support services (e.g. HSE management and purchasing and inventory control mechanisms), as well as by risk assessment and risk mitigation. Furthermore, the in-depth study showed that the integration of the Sender and Receiver's administrative systems (e.g. ERP and test systems) could be a complex endeavour; hence, it should be initiated as early as possible during the preparation phase. Moreover, by carefully reviewing and preparing the transfer documentation ahead of the Receiver's training, the Senders could streamline the knowledge transfer and significantly reduce expenses. In an era of increasing digitalisation, the integration of the Sender and Receiver's systems is expected to become more and more critical for the transfer parties' competitive edge.

The PT preparation framework in Figure 5 can be related to McBeath and Ball's (2012) knowledge transfer framework, which comprises five required key themes for successful knowledge transfer from the Senders to the Receivers. These are the willingness to share information, willingness to receive information, explicit knowledge transfer, tacit knowledge transfer and verification. The authors argue that McBeath and Ball's framework is one of the "detail views" of a PT, whereas the PT preparation framework is a "general view" of the PT preparation phase. It highlights the four additional key areas of the PTs and the relation between them.

7. Conclusion

This paper proposes a procedure for a thorough preparation of PTs based on risk management principles. The goal is to reduce the amount of supply chain disruptions during PTs and thereby facilitate the achievement of the targeted performance results during production-relocations.

Although several PT scholars have acknowledged the importance of a thorough preparation phase and recommended relevant preparatory activities (Madsen, 2009; Terwiesch *et al.*, 2001) to the authors' knowledge, none has yet reviewed, summarised and structured the existing PT literature and proposed a validated procedure.

The authors argue that this paper contributes to the PT literature by providing a detailed and systematic description of the preventive actions that Senders and Receivers can implement to prepare the PTs and reduce the amount of supply chain disruptions (Section 4.2 and Table AIII).

Moreover, the in-depth study showed that the outcome of a PT and thereby of a production relocation not just depends on the *physical transfer* (the transfer of equipment and inventory), on the *knowledge transfer* (e.g. training) and on the *supply-chain transfer*, as presented in earlier research. It also depends on the *administrative transfer* (the transfer of documentation and the integration of operations management systems e.g. ERP at the Receiver), as well as on the *organisation, project* and *quality management* during the PT. Thus, the transfer parties should make sure to allocate sufficient resources to these categories of preventive actions, too. This study argues that although the organisation and project management actions might not be regarded as indispensable for the ability to produce during the start-up phase, they facilitate the execution of those actions that are considered as indispensable. Similarly, the quality management actions are fundamental during PTs, and the PT practitioners should intend to implement them at the beginning of the PT preparation phase. These preventive actions facilitate the achievement of supply performance targets during the PTs and generally in the supply chain by, e.g. mitigating the risk of supply chain disruptions and futile expenses. Furthermore, in an era of increasing digitalisation, the integration of the Sender and Receiver's administrative systems is expected to become more and more critical for the success of the PTs and the supply chain collaboration in general. Thus, it should be also initiated in the early phase of PTs. Moreover, this paper argues that a careful preparation of the transfer documentation ahead of the Receiver's training is worthwhile and a minimum requirement for a smooth PT. Finally, the authors also attempt to enhance the PT literature by providing a clearer way of conceptualising risk management during PTs.

Furthermore, it is argued that the refined PT preparation procedure (Table AIII) represents this paper's primary contribution to practice. The proposed procedure was developed by implementing the literature-based procedure (Table AII) during an offshoring case and continuously refining it with the Sender and Receiver. Thus, the proposed procedure is based on both transfer parties' perspectives.

Practitioners can use the proposed procedure several times during the relocation process. First, they can use it during the relocation-decision and supplier selection phases of relocation processes (Figure 1) as an example of what a PT preparation process implies. Second, they can apply the procedure in detail to thoroughly prepare for the PT. Finally, the procedure can be also used during post-transfer evaluations to structure the Sender and Receiver's lessons learned.

In evaluating design science studies, criteria such as the validity (the artefact works and does what is meant to do) and utility (it has value outside the development environment) of the developed artefact are highlighted (Gregor and Hevner, 2013). Moreover, according to Holmström (2009), the success of a design science approach hinges on its ability to integrate itself with the theory-oriented mainstream research. At the end of the in-depth study, key informants from both transfer parties reported that the PT procedure and its implementation by help of the TAP action plan were appropriate and very useful. Receiver's key informants reported that although the PT to Spain was more complex than during another transfer they were undertaking, its tempo was considerably faster, and Sender's assistance was more substantial and timely. Sender's key informants reported that the PT procedure ensured that important preventive actions were implemented, and it reduced the amount of disruptions. Moreover, they informed that the start-up phase had been relatively shorter than during earlier PTs, and the on-time delivery precision better. Furthermore, the PT practitioners during the international seminar evaluated most of the actions in the refined PT preparation procedure as relevant, and the verification process indicated that the PT preparation procedure should be useful for different types of production relocations and production industries. Finally, as recommended by Holmström (2009), the research

findings were systematically compared with the earlier research on the topic of production relocation, and significant similarities and differences were highlighted. In addition, the authors payed attention to describing the research process and results in a detailed manner, to support actors that want to implement the PT preparation procedure [Holmström in Kaipia *et al.* (2017)].

In this paper, the proposed procedure was implemented during a PT in the electronics industry. However, each production relocation is different; therefore, the procedure should be adapted to different PT circumstances. Two factors that can have a significant influence on how the procedure is applied are the PT risk level and the strategic impact of the PT. The PT risk level depends on, e.g. the technological novelty of the transfer object (e.g. a product), the experience of the Receiver and on the cultural differences between the transfer parties. The strategic impact of a PT is contingent on the value of the transfer object and on how critical the transfer object is for the Sender and Receiver's profit. Further research should test the PT preparation procedure during PT cases with distinct characteristics and explore how the preventive actions in the procedure will be prioritised in different contexts. For instance, the researchers could explore if certain types of preventive actions are more relevant during PTs with high risk and/or high strategic impact than during PTs with low risk and/or low strategic impact. It would be also interesting to test the PT preparation framework from Figure 5 during distinct PTs and validate the action categories and the relation between them. Furthermore, the procedure-verification was carried out by only three PT practitioners. Hence, a large survey study is needed for a more extensive verification and for the development of a formal representation of the procedure (as recommended by Holmström *et al.*, 2009). Finally, the authors contend that the impact of digitalisation on the administrative transfer during PTs is an intriguing future avenue of research.

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Appendix 1

Table AI. research activities conducted to implement, evaluate and refine the PT risk mitigation procedure

Id	Data collection method	Date	Research activity purpose	Main events	Participants
1.	Video conference	Sept.'16	First evaluation of the procedure	The lead author presents the initial procedure to the participants, who evaluate it as useful. Then, the lead author is invited to present it in detail during a live meeting	Project manager (Receiver), Production and quality and risk manager (Receiver), Lean manager (Sender), Lead author
2.	NA	Sept.'16	First refined version based on feedback from previous research activity	The procedure activities are transferred to an Action plan prepared in Excel	Lead author
3.	2 meetings at Sender	Oct.'16	First tailoring of the procedure to the transfer case; 2nd evaluation	Participants evaluate each procedure action as having low, medium or high relevance. The procedure inspires the participants to create an Organization chart presenting the transfer team, the role of each team member, as well as main contact points for each member at the other transfer-party. Moreover, it also inspires the participants to schedule a Risk-assessment for the transfer. To facilitate the implementation of medium and highly relevant actions, the participants plan several sub-actions. Several new preventive-actions are also recommended (A10*, A17*, A5.1*, A6.2*, A14.1*, A22.1* in Appendix 5)	Product owner (Sender), Project owner (Sender), Division managing director (Sender), Lead author
4.	NA	Oct.'16	Second refined version based on feedback from previous research activity	The actions recommended by the participants are added to the Action plan. All the procedure activities (incl. the ones evaluated as having low relevance) and all the actions planned during the previous evaluation are kept in the Action plan for a new evaluation	Lead author

(*continued*)

Table AI.

Id	Data collection method	Date	Research activity purpose	Main events	Participants
5.	1 meeting at Sender, 1 video conference	Oct.'16	Second tailoring of the procedure to the transfer case; 3rd evaluation	The participant evaluates each procedure action as having low, medium or high relevance and plans an additional action (A20*, Appendix 5) and necessary sub-actions	Project manager (Receiver), Lead author
6.	NA	Oct.'16	Third refined version based on feedback from research activities 3 and 5	A Risk-assessment tool and a Communication plan are added to the Action plan, to conduct the Transfer risk-assessment	Lead author
7.	Kick-off at Sender	Oct.'16	Presenting the procedure	–	All of Sender's transfer organization, Lead author
8.	1 meeting at Sender	Oct.'16	Third tailoring of the procedure to the transfer case; fourth evaluation	The participants start conducting the Risk-assessment. First, they discuss the status of the previously identified sub-actions. Second, they break down each sub-action into sequences of steps. Third, they identify potential supply disruptions during Execution and Start-up and assess if the sub-actions they had planned are sufficient to mitigate the risk of disruptions. Moreover, the information necessary to implement the sub-actions is also identified by preparing the Communication plan. Action plan and sourcing responsible (Sender) provides a transfer template to the lead author. Where needed, several additional sub-actions are identified	Project owner (Sender), Quality assurance and risk manager (Sender), Action plan and sourcing responsible (Sender), Production manager and ERP production planning responsible (Sender), Documentation and test responsible (Sender), Planning and forecasting responsible (Sender), Order and delivery responsible (Sender), Lead author
9.	1 meeting at Sender, 2 video conferences	Nov.'16	Continue research activity 8	The participants evaluate the risk-assessment process as useful. Yet, the extra tools made the action plan cumbersome to use. Sender and Receiver decide to start	Quality assurance and risk manager (Sender), Project owner (Sender), Lead author

(*continued*)

Table AI.

Id	Data collection method	Date	Research activity purpose	Main events	Participants
				using again the previous Action plan and to assign the Action owners with the responsibility to conduct risk-assessments for their actions. Two more new actions are recommended (A18*and A19*, Appendix 5). The actions are assigned to a newly created category, *"Test"*	
10.	NA	Nov.'16	Fourth refined version based on feedback from research activities 8–9	The Risk-assessment tool and Communication plan are removed from the Action plan. Actions and sub-actions identified during the risk-assessment are kept in the plan	Lead author
11.	2 video conferences	Nov.'16	Fifth refined version based on feedback from research activity 8	The Action plan (containing the procedure actions) is compared with Sender's template for production transfer plans. It is found out that all but one of the actions in the template are already addressed by the procedure. The new action is added (A16*, Appendix 5). Moreover, the procedure included actions that although not found in template had been evaluated as relevant by Sender and Receiver. Nonetheless, the actions are regrouped following the structure of the template, i.e. according to the departments at the case company. It is easier to hold more frequent status meetings if only one department at a time is invited	Quality assurance and risk manager (Sender), Project owner (Sender), Lead author

(*continued*)

Table AI.

Id	Data collection method	Date	Research activity purpose	Main events	Participants
12.	2 meetings at Receiver, in Spain	Nov.'16	Fourth tailoring of the procedure to the transfer case; 5th evaluation	Actions evaluated as having a low relevance are removed from the Action plan (see Appendix 5). Additional actions (A9*, A12*, A13*, A13.1*, A22.2*, A27.1*, A31.1*, Appendix 5) and corresponding sub-actions are planned with Receiver's representatives	All Receiver's transfer organization; Project owner (Sender), Quality assurance and risk manager (Sender), Lead author
13.	NA	Dec.'16	Sixth refined version based on feedback from previous research activity	At the suggestion of the Project manager (Receiver), the data in the Action plan is transferred from Excel to an MS Project, which is more appropriate for complex action plans	Lead author
14.	1 meeting at Sender	Dec.'16	Fifth tailoring of the procedure to the transfer case; 6th evaluation	Not all employees have access to the MS Project. Sender's representatives transfer the data in the Action plan to a new, more user-friendly Excel template prepared by Sender. All the actions are assigned a risk level depending on how indispensable they are to produce during Start-up. Moreover, a Plan-Do-Check-Act tool is implemented in the new template. The Organization chart and an overview of all the transferred product versions are also included in the Excel file as two separate sheets	Quality assurance and risk manager (Sender), Action plan and sourcing responsible (Sender), project owner (Sender), Lead author
15.	E-mails, 1 video conference	Dec.'16 Jan.'17	Seventh refined version based on feedback from previous research activity	Missing data from the previous Action plan is added to the new version. User instructions and a Meeting log are added to the file as two separate sheets. One new action category is created, "*HSE*"	Lead author, Action plan and sourcing responsible (Sender)

(*continued*)

Table AI.

Id	Data collection method	Date	Research activity purpose	Main events	Participants
16.	2 meetings at Sender	Jan.'17	Sixth tailoring of the procedure to the transfer case; 7th evaluation	The participants verify that all the relevant data from the previous Action plan had been transferred to the new version. An overview of project milestones is added as a separate sheet	Action plan and sourcing responsible (Sender), Lead author
17.	2 meetings at Sender	Jan.'17	The procedure is used for the 1st time by Sender to update the transfer status during status meetings	Transfer action plan responsible (Sender) uses the Action plan to update the actions' status. The Action plan works as intended	Action plan and sourcing responsible (Sender), Project manager (Receiver), Production and quality and risk manager (Receiver), R&D, process control and chemical hazard responsible (Receiver), Moulding operator (Receiver), Assembly operator (Receiver), Project owner (Sender), Quality assurance and risk manager (Sender), Process technology manager (Sender), Product owner (Sender), Production manager and ERP production planning responsible (Sender), Moulding operator (Sender), Lead author

(*continued*)

Table AI.

Id	Data collection method	Date	Research activity purpose	Main events	Participants
18.	E-mails	Jan.-Feb.'17	Seventh tailoring of the procedure to the transfer case; 8th evaluation	The participants decide that the Action plan with the procedure actions manages to address potential supply disruptions in a satisfactory way. Thus, actions (A33* and A34*, Appendix 5) and sub-actions from a risk-assessment conducted by Receiver by using Sender's Risk-assessment tool are transferred to the Action plan. It is decided to continuously update the Action plan	Quality assurance and risk manager (Sender), Action plan and sourcing responsible (Sender), Lead author
19.	1 video conference, e-mails	Mar.'17 Apr.'18	Sender and Receiver's evaluation of the Action plan during the remainder of the in-depth study	Transfer action plan responsible (Sender) continues to use the Action plan to update the actions' status without notable incidents	The entire Transfer organization
20.	6 semi-structured interviews	Apr. '18	Sender and Receiver's evaluation of the Transfer-preparation procedure and its implementation at the end of the in-depth study	3 key informants from Sender and 3 from Receiver are interviewed about their experience with the Transfer-preparation procedure and its implementation. Prior to the interviews, the authors prepare and send a questionnaire to the informants and their answers are used as a starting point for the interviews. The informants are mainly asked to evaluate on a scale from 0 to 5 the utility of the procedure and its implementation (in the form of an action plan) as well as the Start-up time and delivery precision, compared with the two transfers to the Norwegian supplier (see Section 3) and to the previous transfer to Receiver (see Subsection 5.1). Moreover, they are asked to describe the main advantages and disadvantages of the procedure implementation	Action plan and sourcing responsible (Sender), Project owner (Sender), Quality assurance and risk manager (Sender), Project manager (Receiver), Production and quality and risk manager (Receiver), Documentation responsible (Receiver), Lead author

Appendix 2

Table AII. The literature-based transfer preparation procedure (H-high relevance, M-medium relevance, L-no or low relevance; PT-A, PT-B, PT-C are the examples of production transfers on which 3 transfer-experts applied the procedure to evaluate it)

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
	Organisation and Project Management	(WHO, 2011)					
A1	Establish a project team with project managers and representatives from all the disciplines affected by the transfer and from both the sender and receiver. Assign a general project coordinator. Clarify the role and responsibilities of each member	(Madsen, 2009; WHO, 2011)	H	*Closed action. Not included in the plan*	H	H	H
A2	Establish a Process Improvement team with representatives from all the relevant disciplines and from both the sender and receiver	(Fredriksson *et al.*, 2015; Madsen, 2009; Terwiesch *et al.*, 2001, Rudberg and West, 2008, WHO, 2011)	H	Medium risk	M	M	H
A3	Establish a Supplier Development team with representatives from all the relevant disciplines and from both the sender and receiver	(Modi and Mabert, 2007, Dyer *et al.*, 2000)	L	NA. *Removed. Not relevant during the transfer. Supplier Development actions will be mostly implemented after Start-up*	M	H	H
A4	Establish a Risk Management team with representatives from all the relevant disciplines and from both the sender and receiver	(WHO, 2011)	H	Medium risk	M	M	H
A5	Organise a project start-up meeting with the sender's and receiver's personnel involved in the transfer. Announce the object of the transfer, reasons for the transfer, the relationship between the sender and receiver, expected performance targets, etc.	(Dudley, 2006; McBeath and Ball, 2012)	H	*Closed action. Not included in the plan*	H	H	H

(*continued*)

Table AII.

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
A6	Evaluate regulatory requirements in the sender's and receiver's countries and in any countries to where the product is to be supplied	(WHO, 2011)	H	Medium risk	H	M	M
A7	The sender and receiver to agree on performance targets (e.g. KPIs) and their continuous monitoring	(Terwiesch *et al.*, 2001; Almgren, 1999)	H	Medium risk	H	M	M
A8	Sign a formal agreement. Include in the agreement specifications about expected performance targets and how to monitor targets, profit and risk sharing, the rights to access confidential information, product ownership, Request for Proposal, etc.	(Danilovic and Winroth, 2005; Franceschini *et al.*, 2003; Zhu *et al.*, 2001)	H	High risk	H	L	H
A9	Prepare a project management plan	(Terwiesch *et al.*, 2001; WHO, 2011)	H	NA. *Removed. For Sender and Receiver, this plan was the Transfer Action plan. Updated during status meetings*	H	H	H
A10	The sender and receiver to hold regular status meetings and send meeting notes to all the affected personnel	(Rehme *et al.*, 2013; Zhu *et al.*, 2001)	H	Medium risk	H	M	H
A11	Create a Transfer Protocol that includes all the transfer documentation and is easily accessible to all the sender and receiver's personnel involved in the transfer. The protocol should be continuously updated	(Terwiesch *et al.*, 2001; Ferdows, 2006; WHO, 2011)	H	Medium risk	H	H	H

(*continued*)

Table AII.

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
A12	The sender and receiver to prepare a Communication plan. To include a Crisis management procedure and to address the impact of confidentiality on the open communication of technical matters	(Danilovic and Winroth, 2005; Norrman and Jansson, 2004; WHO, 2011)	H	NA. *Replaced by A8*. Communication was addressed by the Organization chart document*	H	H	M
A13	Reduce the outputs at the sender only gradually, as the production stabilises at receiver (if possible)	(Fredriksson, 2011; Terwiesch *et al.*, 2001; Minshall *et al.*, 1999)	L	NA. *Removed. Replaced by A9**	H	M	H
A14	Plan the transfer during a low customer-demand period (if possible)	(Madsen, 2009)	L	NA. *Removed. Sender will produce the products until the material developed by Receiver is approved. Also addressed by A9**	H	H	L
	Quality management	(WHO, 2011)					
A15	Evaluate the receiver's readiness with regards to facilities, equipment and support services (e.g. by a Gap Analysis)	(Malm *et al.*, 2016, Modi and Mabert, 2007, WHO, 2011)	H	High risk	H	H	H
A16	Assess the transfer risk. Include customs clearance and material supply risks	(Minshall *et al.*, 1999; Fredriksson *et al.*, 2015; WHO, 2011)	H	Medium risk	H	H	H
A17	Identify and implement preventive actions to mitigate the risk of supply shortages (e.g. safety stock and safety capacity). Identify corrective actions to mitigate the risk of supply shortages (e.g. overtime and express transports)	(Fredriksson *et al.*, 2015)	H	High risk	H	H	H

(*continued*)

Table AII.

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
A18	Improve the transferability of the transfer object (upgrade or replace obsolete equipment, codify tacit knowledge, etc.)	(Grant and Gregory, 1997a, McBeath and Ball, 2012; Madsen, 2009; Minshall *et al.*, 1999)	NA	NA. *Removed. Sender does not want to change the transfer object, except for the material developed at Receiver. Tacit knowledge is codified during A26*	H	M	H
	Knowledge Transfer	(Fredriksson and Wänström, 2014)					
A19	The sender and receiver to jointly develop a training plan	(Madsen, 2009; WHO, 2011)	H	Medium risk. Part of 2nd milestone	M	H	H
A20	Train the receiver's personnel. Send personnel from the receiver to the sender for training and to improve the transferability of the production-system |	(McBeath and Ball, 2012; Grant and Gregory, 1997b, Terwiesch *et al.*, 2001; Madsen, 2009, Galbraith and Galbraith, 1990, Minshall *et al.*, 1999)	H	High risk	M	H	H
A21	Transfer photographs and a video-taped review of the production process to the receiver	(Galbraith and Galbraith, 1990, Minshall *et al.*, 1999)	M *(Because of IP in processes)*	NA	L	M	L
A22	Define and implement a Change Control process at the receiver	(Terwiesch *et al.*, 2001; WHO, 2011)	H	Medium risk	M	H	H
A23	Conduct activities to enhance the receiver's performance level (e.g., VSM, RCA, FMEA, Lean, Six sigma, APQP)	(Modi and Mabert, 2007)	H	Medium risk	L	M	M
A24	Verify Knowledge Transfer at the receiver (e.g. check documentation and test personnel)	(McBeath and Ball, 2012)	H	High risk. Part of 1st milestone	H	H	H
	Transfer of Administrative Systems	(Fredriksson and Wänström, 2014)					

(*continued*)

Table AII.

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
A25	Prepare a list of items and documentation to be transferred. Specify transfer means, if purchases are required, costs and lead-times to the receiver	(Minshall *et al.*, 1999; WHO, 2011)	H	High risk	H	H	H
A26	Review, update and create missing documentation. Translate documentation, if necessary	(McBeath and Ball, 2012; Fredriksson *et al.*, 2015; Terwiesch *et al.*, 2001; Minshall *et al.*, 1999)	H	High risk	H	H	H
A27	The sender to provide the receiver information on all HSE issues associated with the transfer object: material safety data sheets, inherent risks (e.g. exposure limits), exposure-mitigation actions, emergency planning (e.g. in case of fire), waste management, etc.	(WHO, 2011)	H	High risk	H	M	M
A28	The sender to transfer all the necessary information. The receiver to review the information from the sender, identify gaps (in facilities, systems, capabilities, testing methods, etc.) and notify the sender. Thereafter the receiver should develop documentation (e.g. operating procedures) based on this information	(WHO, 2011)	L *(This process will be carried out with Sender)*	Medium risk	H	H	H
A29	Make robust forecasts (of start-up time, new lead times, new quality levels, etc.)	(Fredriksson *et al.*, 2015; Minshall *et al.*, 1999)	H	Medium risk *Part of 1st milestone*	H	H	H

(*continued*)

Table AII.

Id	Preventive actions in the literature-based procedure	References	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transf. experts' evalu PT-A	PT-B	PT-C
A30	Update the planning and control systems (e.g. ERP) Supply-chain Transfer	(Fredriksson *et al.*, 2015; Minshall *et al.*, 1999) (Fredriksson and Wa«nstro«m, 2014)	H	Medium risk Part of 1st milestone	H	H	H
A31	Establish relationships to sub-suppliers of raw materials, components, parts, etc.	(Aaboen and Fredriksson, 2016)	L *(Transfer within the same company)*	Medium risk. Part of 2nd milestone	H	H	H

Appendix 3

New id.*	Preventive actions in the refined procedure	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transfer experts PT-A	PT-B	PT-C
	Organisation and Project Management					
A1*	Establish a project team with project managers and representatives from all the disciplines affected by the transfer and from both the sender and receiver. Assign a general project coordinator. Clarify the role and responsibilities of each member					
A2*	Establish a Process Improvement team with representatives from all the relevant disciplines and from both the sender and receiver					
A3*	Establish a Risk Management team with representatives from all the relevant disciplines and from both the sender and receiver					
A4*	Organise a project start-up meeting with the sender's and receiver's personnel involved in the transfer. Announce the object of the transfer, reasons for the transfer, the relationship between the sender and receiver, expected performance targets, etc.					
A5*	Sign a formal agreement. Include in the agreement specifications about expected performance targets and how to monitor targets, profit and cost sharing, the rights to access confidential information, product ownership, Request for Proposal, etc.					
A5.1*	The sender and receiver to agree on performance targets (e.g. KPIs) and their continuous monitoring					
*A5.2**	*The receiver's personnel with access to confidential information sign a Non-disclosure agreement*	*H*	*Medium risk*	*M*	*M*	*H*
A6*	The sender and receiver to hold regular status meetings and send meeting notes to all the affected personnel					
A7*	Create a common directory that includes all the transfer documentation and is easily accessible to all the sender and receiver's personnel involved in the transfer. The directory should be continuously updated					
A8*	The sender and receiver to prepare a Crisis management procedure and to address the impact of confidentiality on the open communication of technical matters					
A9*	*Plan for overproduction at the sender to cover the needs during the Execution and Start-up phases*	*NA*	*Medium risk. Part of 1st milestone*	*M*	*M*	*M*
	Sourcing					
A10*	Evaluate regulatory requirements in the sender's and receiver's countries and in any countries to where the product is to be supplied					

(*continued*)

Table AIII. The transfer preparation procedure after the procedure refinement process (H-high relevance, M-medium relevance, L-no or low relevance; PT-A, PT-B, PT-C are the examples of production transfers on which 3 transfer-experts applied the procedure to evaluate it; only the actions added by Sender and Receiver are evaluated)

Table AIII.

New id.*	Preventive actions in the refined procedure	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transfer experts PT-A	PT-B	PT-C
	exchange rates for equipment and inventory (e.g. parts and components) from the sender and the sub-suppliers, import duties, land codes and new origin on finished products					
*A10.1**	*Verify shipping requirements (e.g. customs requirements and trade agreements applicable when shipping from the receiver vs. the sender)*	*NA*	*Medium risk. Part of 1st milestone*	*H*	*L*	*H*
*A11**	Establish relationships to sub-suppliers of raw materials, components, parts, etc. Quality Management					
*A12**	*Involve the sender in the design and approval of the layout, if this is modified*	*H*	*Closed action. Not included in the plan*	*M*	*M*	*H*
A13*	Evaluate the receiver's readiness with regards to facilities, equipment and support services (e.g. by a Gap Analysis) *purchasing (the selection and development of the sub-suppliers through the Change Control procedure)* *storing (FIFO, serial and version control, ESD)* *receiving structure (routines and equipment for receiving control and tolerance control)* *non-conformance handling* *Total Preventive Maintenance for equipment*					
*A14**	*Validate the receiver's facilities (after the implementation of sub-actions for improving the receiver's "readiness" for transfer)*	*NA*	*High risk Part of 3rd milestone*	*H*	*H*	*H*
*A14.1**	*Validate the purchasing, warehousing and receiving structure*	*NA*	*High risk. Part of 3rd milestone*	*M*	*M*	*H*
A15*	Assess the transfer risk. Include customs clearance and material supply risks					
A16*	Identify and implement preventive actions to mitigate the risk of supply shortages (e.g. safety stock and safety capacity). Identify corrective actions to mitigate the risk of supply shortages (e.g. overtime and express transports)					
A17*	Define and implement a Change Control process at the receiver					
A18*	Conduct activities to enhance the receiver's performance level (e.g., VSM, RCA, FMEA, Lean, Six sigma and APQP)					
A19*	Prepare a list of items and documentation to be transferred. Specify transfer means, if purchases are required, costs and lead-times to the receiver					

(*continued*)

Table AIII.

New id.*	Preventive actions in the refined procedure	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transfer experts PT-A	PT-B	PT-C
A20*	Review, update and create missing documentation. Translate documentation, if necessary					
*A21**	*Ensure that the equipment to be transferred is registered and marked with the sender's property*	*NA*	*Medium risk*	*M*	*L*	*H*
*A22**	*Verify if the actions in the Preparations phase are closed prior to the Execution phase*	*NA*	*High risk*	*H*	*M*	*M*
	Process Technology					
*A23**	*Develop, test, implement and validate the new material*	*NA*	*High risk*	*H*	*M*	*H*
*A24**	*The sender and receiver to prepare the documentation for newly developed material*	*NA*	*High risk. Part of 2nd milestone*	*M*	*M*	*H*
	Test					
*A25**	*Verify the readiness of the test system for the transfer (software, equipment, documentation, access rights to the sender's systems, etc.)*	*NA*	*High risk. Part of 1st milestone*	*M*	*M*	*H*
*A26**	*Update/create documentation about tests*	*NA*	*Medium risk*	*H*	*M*	*H*
*A27**	*Send personnel from the sender to the receiver to perform training on testing methods*	*NA*	*High risk. Training activities are concurrent*	*H*	*H*	*H*
	Production					
A28*	The sender and receiver to jointly develop a training plan					
A29*	Train the receiver's personnel. Send personnel from the receiver to the sender for training and to improve the transferability of the production-system					
A30*	Verify Knowledge Transfer at the receiver (e.g. check documentation and test personnel)					
A31*	The sender to transfer all the necessary information. The sender and receiver to review the information from the sender, identify gaps (in facilities, systems, capabilities, testing methods, etc.) and notify the sender. Thereafter the receiver should develop documentation (e.g. operating procedures) based on this information					
A31.1*	Transfer photographs and a video-taped review of the production process to the receiver					

(*continued*)

Table AIII.

New id.*	Preventive actions in the refined procedure	Sender and receiver's evaluation	Transfer risk in sender and receiver's action plan	Transfer experts		
				PT-A	PT-B	PT-C
	Plan for ERP set-up					
A32*	*Implement ERP at the receiver. Train the receiver's personnel on ERP use*	*NA*	*Medium risk. Training activities are concurrent*	*H*	*H*	*H*
A32.1*	*Verify that ERP is functional at the receiver*	*NA*	*Medium risk*	*H*	*H*	*H*
A33*	Make robust forecasts (of start-up time, new lead times, new quality levels, etc.)					
A34*	Update the planning and control systems (ERP)					
A34.1*	*Sales order forecasting and planning*	*NA*	*Low risk*	*H*	*M*	*M*
	HSE					
*A35**	*Ensure documented procedures and routines for hazardous materials (e.g. for purchase, reception, storage, handling and disposal)*	*NA*	*High risk*	*H*	*M*	*H*
*A36**	*Ensure HSE visual management*	*NA*	*High risk*	*M*	*M*	*M*
A37*	The sender to provide the receiver information on all HSE issues associated with the transfer object: material safety data sheets, inherent risks (e.g. exposure limits), exposure-mitigation actions, emergency planning (e.g. in case of fire), waste management, etc.					