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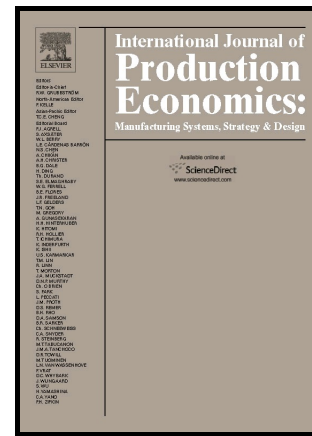
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Implementation of lean production in multinational corporations: A case study of the transfer process from headquarters to subsidiaries

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Abstract

Several multinational corporations are launching multi-plant lean programmes to increase the coordination of dispersed and heterogeneous plants and promote the growth of the organisation as a whole. Such programmes represent an emerging field of research that seeks to understand the most important mechanisms to transfer lean concepts and practices successfully, given the different contextual conditions of a multi-plant network over time. Here we present an in-depth explorative case study to investigate this issue. An analysis of the programme of an Italian-based company to transfer lean to its Chinese and US subsidiaries over approximately four years was used to develop propositions. Proposition 1 indicates that, throughout a programme, headquarters should use international teamwork to perform training, sensegiving and adaptation in foreign subsidiaries. It also underlines the relevance of pressure via teamwork if a subsidiary resists. Proposition 2 suggests to deploy close and lasting teamwork to transfer lean to plants that are autonomous and new to lean. Close but brief teamwork can be used for subsidiaries that are integrated with headquarters and not new to lean. Proposition 3 argues that the presence of a stable group of managers in subsidiaries facilitates interactions with headquarters and knowledge transfer. Proposition 4 underlines that training, sensegiving, adaptation and pressure via secondary mechanisms throughout a programme are necessary to sustain actions via teamwork. The propositions serve as a basis for future research

and empirical validation. They also serve as guidelines for managers in charge of multi-plant lean programmes.

1. Introduction

Over the past two decades, several companies have grown internationally by establishing production subsidiaries worldwide, giving rise to multinational corporations (MNCs). As a consequence, managers faced the new challenge of coordinating dispersed and heterogeneous units. A widespread way to deal with differences among plants and manage the MNC as a whole is launching multi-plant improvement programmes (Netland and Aspelund, 2014). Such programmes concern the transfer of operational knowledge among plants and can be defined as 'the systematic process of creating, formalising and diffusing better operational practices in the intra-firm production network' (Netland and Aspelund, 2014; p. 392).

This study focuses on multi-plant lean programmes (or programmes hereafter). Lean production is a method that levers on a complex system of socio-technical practices to enhance manufacturing performance through waste elimination and continuous improvement of production processes (Liker, 2004; Shah and Ward, 2007; Bortolotti et al., 2015). Driven by the success achieved by headquarters, several MNCs have transferred lean knowledge to foreign subsidiaries seeking similar benefits. Apart from Toyota, a few recent examples are Mercedes, Caterpillar, Bosch, Siemens and Volvo (Netland and Aspelund, 2013). This trend is not only confined to medium and large companies, but also small MNCs are transferring lean to their international subsidiaries nowadays (Camuffo, 2014).

However, several programmes encountered significant difficulties, and some even failed (Pay, 2008; Netland and Aspelund, 2014). Such difficulties can be generally attributed to the complexity

of lean implementation as well as to dealing with the different subsidiaries' contexts (Maritan and Brush, 2003; Lander and Liker, 2007). As mentioned in Netland and Aspelund's (2014) literature review, little research is available regarding multi-plant improvement programmes. For example, little support is provided for the selection of mechanisms for transferring lean knowledge (transfer mechanisms or mechanisms hereafter). According to previous studies (e.g., Ferdows, 2006), both social mechanisms (e.g., social interactions among lean experts of different plants) and standards (e.g., lean knowledge codified in manuals) are generally important for sharing and improving lean practices in MNCs. However, preliminary evidence showed that the effectiveness of such mechanisms can vary during a lean programme because of the absence or presence of specific contextual conditions (Ferdows, 2006; Inkpen, 2008). According to Inkpen (2008) and Dinur et al. (2009), further research should identify which mechanisms are most important according to different contextual conditions as programmes evolve over time. Our study addresses this call and empirically investigates the research question: In a MNC, which are the most important mechanisms to transfer lean knowledge according to the different contextual conditions of the network over time?

It is worth noting that the paper focuses on analysing two main contextual conditions that seem to be crucial: the maturity of lean implementation in a subsidiary and headquarters-subsidiary relations (e.g., Ferdows, 2006). For what concern mechanisms, we considered the differences in the type of mechanisms (Ferdows, 2006; Inkpen, 2008) and in actions performed via such mechanisms (Schein, 2010; Canato et al., 2013).

This paper makes an explorative study to investigate this issue. We use an in-depth case study methodology to examine initiatives implemented by an Italian-based company to transfer lean to its US and Chinese subsidiaries, which occurred over a period of four years.

The paper is structured as follows: Section 2 develops the theoretical foundation, Section 3 describes the research methodology, Section 4 provides a detailed narrative description of the case

study, Section 5 discusses insights and proposes research propositions and implications for practitioners. Section 6 discusses the limitations and future research.

2. Literature review

Section 2.1 identifies in the literature which mechanisms can be used to transfer lean knowledge in MNCs. Section 2.2 reviews previous studies to depict which contextual conditions are more relevant in influencing the transfer of lean knowledge. Finally, to understand how a MNC can get closer to the ideal contextual conditions, the actions for organisational change are discussed in Section 2.3.

2.1 Mechanisms for the transfer of lean knowledge

Literature describes many mechanisms to transfer knowledge in MNCs. Scholars agree that their effectiveness depends on whether the transferred knowledge is explicit or tacit, as explicit knowledge is easily codifiable and can be shared by means of documents, while tacit knowledge is difficult to codify and hard to convey without interaction between parties (Kogut and Zander, 1993; Mohr and Sengupta, 2002).

Lean production involves concepts and practices that are characterised by a different extent of explicit or tacit knowledge. While technical and analytical practices concern more codifiable knowledge, concepts and practices concerning people and relations are more tacit and difficult to transfer (Henriksen and Rolstadas, 2010; Liker and Rother, 2011). However, lean practices are strictly inter-related. The success of lean depends on the systemic implementation of all core bundles of practices – i.e., JIT, built-in-quality, continuous improvement and a foundation bundle that comprises lean concepts and philosophy, organisational structure and people and stable and standardised process (Liker, 2004; p. 32). For example, as explained by Shook (2010), a proper implementation of the technical andon (or stop-the-line) practice requires that other more tacit elements, such as leadership, are put in place.

Inkpen (2008) recommended social interactions as a mechanism suitable for simultaneously transferring explicit and tacit knowledge enclosed in lean. This mechanism is pivotal in communicating 'the meaning and value of the knowledge' when introducing it in a plant (Inkpen, 2008; p. 449). Similarly, several studies stress the importance of using social mechanisms, such as interactions among lean experts, rotation of personnel and knowledge brokers, to effectively share and improve lean knowledge in MNCs (e.g., Ferdows, 2006; Henriksen and Rolstadas, 2010).

However, a number of scholars also underlined the relevance of codifying and sharing lean concepts and practices through standards collected in manuals and/or ICT and internet-based solutions (e.g., Spear, 1999; Bruun and Mefford, 2004).

Interestingly, Dinur et al. (2009) suggest a relation between mechanisms and contextual conditions when transferring knowledge within MNCs. In addition, Inkpen (2008) found that mechanisms are affected by contextual conditions, and contextual conditions can change during the transfer process of lean knowledge. This evidence highlights the relevance of understanding which mechanisms are most important as programmes evolve over time.

2.2 Contextual conditions in multi-plant lean programmes

MNCs are heterogeneous since they are embedded in different nations (Kostova, 1999), therefore practices developed by one plant may not fit contextual conditions of foreign adopters. According to a *practice-context congruence perspective* (Lozeau et al., 2002; Ansari et al., 2010), incongruence between contextual conditions and knowledge transferred may generate resistance to change and, if not properly managed, the preclusion of knowledge transfer.

Among the various contextual conditions that may affect the success of lean, cultural values are particularly important (Rich and Bateman, 2003; Kull et al., 2014; Bortolotti and Boscari, 2015). Scholars stressed the relevance of having specific organisational culture values and behaviours, such as the use of face-to-face and open communication, cooperation between employees and long-term approach to management (Rother, 2009; Bortolotti et al., 2015). They referred to these as *lean*

cultural values, and found that such characteristics distinguish plants that successfully implement lean. However, cultural values characterising a particular nation may differ from lean ones, and the resulting incongruence is a leading explanation for unsuccessful lean implementations (Kull et al., 2014).

These studies highlight that adopters' contextual conditions can influence the success of lean, therefore should be considered when transferring lean knowledge in MNCs. In line with this, Ferdows (2006; p.8) argued that 'the ultimate aim (of multi-plant improvement programmes) is to create a powerful mindset in every production unit'. These ideal contextual conditions favour knowledge transfer in MNCs. In case of lean, such mindset is characterised by the existence of lean cultural values in the production network, but it also requires *strong relations* between plants.

Although underestimated by studies on multi-plant lean programmes, literature on knowledge transfer highlights the importance of relations between the parties among which the knowledge is transferred (e.g., Kostova, 1999; Van Wijk et al., 2008). Scholars agree that strong relations, interactions and communication lead to greater knowledge transfer (Easterby-Smith et al., 2008), while independence and differences between plants hinder knowledge, especially a complex one (Hansen, 1999).

Lee and Jo (2007) observed that multi-plant lean programmes can be understood only by analysing contextual conditions and the knowledge transfer according to a process perspective. Accordingly, Netland and Ferdows (2014) recommended to define actions for each plant in a MNC conforming to its maturity in lean implementation. Moreover, previous studies also suggested that actions performed via transfer mechanisms have an impact on contextual conditions.

2.3 Training, sensegiving, pressure and adaptation actions via transfer mechanisms

The existence of lean values and strong relations between parties characterises the ideal situation for transferring lean in MNCs, but it may not be present. Some actions can be performed via transfer mechanisms to get closer to ideal contextual conditions. Organisational change literature suggests

that training, sensegiving and pressure can be performed to adjust an organisation, thereby developing a certain maturity in practice implementation and, over the years, building specific organisational culture values (Shein, 2010). According to a practice-context congruence perspective, these actions can also contribute to reduce incongruences between an adopter's contextual conditions and the transferred knowledge. In addition, a better fit can be created by adapting practices (Ansari et al., 2010).

Training allows adopters to acquire knowledge held by others (Kostova, 1999). Social mechanisms can be used for training employees, thus creating lean cultural values (Shook, 2010). For example, teams can be created among lean experts of different plants to train employees (Ferdows, 2006; Netland et al., 2015a). Moreover, training can be performed via ICT, such as by creating a shared database where plants can upload standardised documents on lean implementation to facilitate mutual learning (Bruun and Mefford, 2004).

It is important to combine training with *sensegiving* when implementing lean to develop adopters' commitment (Inkpen, 2008; Yu and Zaheer, 2010). Due to differences in the social and cultural understanding among nations, some subsidiaries can consider new knowledge as non-value adding and resist practice adoption (Kostova and Roth, 2002). Social interactions are pivotal in communicating the meaning of lean knowledge and in persuading people of its importance (Inkpen, 2008).

Literature provides evidence on the relevance of *pressure*, i.e., forcing the adoption of new practices and control their implementation over time (e.g., Kotter, 1995). When there is incongruence between knowledge and adopters' contextual conditions, pressure helps avoiding regressions in a programme and triggers cultural change (Canato et al., 2013). Due to the hierarchical nature of headquarters-subsidiary relations, adopters tend to comply with parent representatives that move to subsidiaries to supervise programmes (Kostova and Roth, 2002). Formal audits are another way to perform pressure: teams involving headquarters' lean experts visit subsidiaries and assess their maturity of lean implementation (Netland and Ferdows, 2014).

Adaptation concerns modifications of transferred practices without destroying their aims (Lozeau et al., 2002). To accommodate foreign national culture peculiarities, adaptation is necessary to increase adopters' acceptance of new practices (Bhagat et al., 2002; Wallace, 2004). According to Dyer and Nobeoka (2000), managers can leverage on residences in adopters' plants to understand their perspectives and specific problems. Close interactions among experts of different plants can also help to improve lean knowledge over time (Ferdows, 2006). When expertise and collaboration are present, internet solutions can contribute to continuous improvement among plants, as they 'rapidly disseminate all types of data [...] that are essential to effective process improvement' (Bruun and Mefford, 2004; p. 251).

The above actions imply a certain interaction and communication between the parties. According to Easterby-Smith et al. (2008), strong relations between plants can be built by past joint experiences, interactions and communication. For example, training via social interactions builds inter-personal familiarity and personal affinity among representatives of different plants (Van Maanen and Schein, 1979; Gupta and Govindarajan, 2000). In other words, it seems that actions via mechanisms contribute in achieving strong relations.

Overall, the literature review indicates that mechanisms, through performing training, sensegiving, adaptation and pressure actions, may change contextual conditions. In turn, such conditions may affect mechanisms and actions. However, it is not clear which are the most important mechanisms to transfer lean knowledge in different contextual conditions as a programme evolves over time. It is also not clear how each mechanism can be used to combine training, sensegiving, adaptation and pressure actions.

3. Methodology

This research aims to identify the most important mechanisms to transfer lean knowledge in a MNC according to different contextual conditions of the network over time. Researchers suggested the case study as a valuable method to generate deeper and novel understanding of MNCs functioning

(Birkinshaw et al., 2011; Doz, 2011; Welch et al., 2011). Furthermore, scholars (e.g., Yin, 1989; Eisenhardt and Graebner, 2007) recommended it when inadequate prior research has been conducted. Research on multi-plant improvement programmes in MNCs is still in its infancy (Netland and Aspelund, 2014). Given the scarcity of prior research and the high complexity of the phenomenon under investigation (Gupta and Govindarajan, 2000; Birkinshaw et al., 2011), we limited our investigation to one in-depth case. Single case studies can be valuable for explorative theory-building research because they allow to develop an in-depth understanding of the phenomenon, along with the contextual conditions under which it occurs (Dyer and Wilkins, 1991; Voss et al., 2002), and it is particularly appropriate for theorising from process data (Langley, 1999; Barratt et al., 2011). Our study develops some propositions that can be subject to further testing in studies levering on other research designs (Meredith, 1998).

3.1 Research setting

In accordance with the theoretical sampling approach (Glaser and Strauss, 1967), we selected a sub-network of an Italian-based MNC that has been recently involved in a multi-plant lean programme and allows a transparent investigation. Due to confidentiality issues, we do not disclose the company's identity; instead, we will refer to it here as Heating, Ventilation, Air Conditioning/Refrigeration (HVACR), recalling products made by its plants. HVACR is a well-established and leading lean company in Italy. It has actively participated in developing several lean initiatives with local universities and renowned institutions of higher education. About a thousand employees work in its facilities located in five continents, classifying HVACR as a small MNC. The selection of this case is interesting as the transfer of lean knowledge in a small MNC is scarcely investigated, even though an increasing number of small MNCs have launched international lean programmes (Camuffo, 2014).

The sub-network under investigation comprises the Italian headquarters, the Chinese and US subsidiaries. General information regarding the three plants is provided in Table 1. HVACR

products can be grouped in: electronic control solutions (e.g., parametric controls for air-conditioning), humidifiers (e.g., adiabatic humidifiers) and valves (e.g., electronic expansion valves). While all plant produce the first two categories, valves are only made in the headquarters and the Chinese subsidiary. Within each category, headquarters produces the full range of products, while subsidiaries focus on a partial range, depending on local market needs, as the three units target mainly neighbouring markets. Table 1 also provides information on contextual conditions at the beginning of the programme.

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3.2 Data collection

A long collaborative relationship between company and researchers allowed transparency in the investigation, access to rich data and continuous availability of key informants. Our study investigates the period between March 2010 and July 2014, the time the programme was implemented. We mainly relied on retrospective data collection, but we tracked the last 17 months in real-time.

Our major source of data was interviews with key managers and employees involved in the programme (Table 2). We contacted all members of the so-called 'change teams' in charge of the transfer initiatives:

- Change agents in the corporate lean office – a staff unit in the headquarters dedicated to lean implementation

- Lean coordinators in subsidiaries – managers in charge of coordinating all lean initiatives in their plant

- Parent collaborators in headquarters and foreign collaborators in subsidiaries – managers or employees of the operations or office macro-area who took part in change teams.

<p align="center">10</p>

Interviews with the members of the change teams allowed detailed information on the programme to be obtained. In addition, further details (e.g., reasons that originally led to implement lean, details on lean practices and standards) were provided by managers and employees in headquarters.

Most of the interviews were done face-to-face, while we also had some telephone and video calls. We recorded all interviews and transcribed them after each interview. Plenty of valuable data emerged from the informal conversations. Most interviews were open-ended; however, we arranged a list of core questions for each interview to ensure that most relevant issues would be covered.

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TABLE 2 approximately here

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According to data-triangulation, we combined interviews with other sources (Eisenhardt, 1989). We analysed company documents developed during the programme (e.g., protocols for transferring lean, subsidiaries' progress reports, meeting reports, lean standards manuals, subsidiaries' comments and proposals for standard modifications). The use of information in the company's documents developed during the programme was particularly important to limit potential inaccuracies and biases derived from the use of historical data (Maritan and Brush, 2003). In accordance with Maritan and Brush's (2003) approach, another solution that we employed during interviews was to ask similar questions to different informants.

During the last 17 months of the programme, researchers maintained frequent contacts with the company and visited plants included in the study, verifying information collected through interviews and enriching the understanding of the context and the programme (Voss et al., 2002). A student performed his master's project (seven months of work) in HVACR, closely supervised by the authors.

To improve validity, key informants were asked to check our recorded accounts to ensure their correctness and verify possible omissions. Where data discrepancies or omissions were found, a thorough investigation was conducted.

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3.3 Data analysis

Data collection comprised of four main stages (Pandza et al., 2003). First, we interviewed members of the corporate lean office and other promoters of the company's lean transformation (originated in 2007), to understand the business context and provide a programme overview, and identify key informants. Second, we interviewed key informants of all plants and analysed company documents to define a chronological picture of significant initiatives in the programme, to describe contextual conditions and define main choices concerning mechanisms and actions performed via such mechanisms. We schematised main information by means of a visual graphical representation (Miles and Huberman, 1984). Then, we used this visual map in a group interview to guide discussions and collect additional and deeper information regarding initiatives, the influence of context on initiatives and choices, and the effects of choices and initiatives on the network (it is worth noting that the group involved headquarters change agents and lean coordinators from both subsidiaries). This data resulted in an improved map (Figure 1 shows a simplified schematisation), which constituted an important intermediary result in moving from raw data to a more general understanding of the studied process (Langley, 1999). Finally, additional interviews were conducted while starting to develop a general interpretation of the lean transfer process. As a result, data analysis relied on an iterative approach, which involved frequent steps back and forth among data.

We analysed contextual conditions considering the adopters and relations between the parties. As it generally takes years to fully change cultural values, in line with previous studies (e.g., Netland et al., 2015b), we coded for changes in terms of maturity of lean implementation and measured it using the HVACR assessment model. We observed that HVACR constantly monitors the implementation of every lean element constituting its production system (see Appendix). While foreign managers assess the status of lean implementation on a weekly basis, parent representatives validate main changes by frequently visiting subsidiaries and through formal audits. In every case, a standard set of metrics is used for the assessment. The level of implementation of an element is classified from '0' to '4' according to how widely a practice is diffused (e.g., pilot area, all areas)

and how deeply is implemented (e.g., instilled within the culture). A measure of the maturity of lean implementation in a macro-area of a plant (hereafter *macro-area maturity*) can be obtained by aggregating these elements. In addition, by combining macro-area maturity in operations and office, the maturity of lean practice implementation in a plant (hereafter *plant maturity*) is also obtained. We distinguish between these two different levels of maturity because during data collection and coding, we realised that mechanisms may be affected by macro-area and/or plant maturity.

Regarding relations, we coded for changes in the *strength of relations* between the parties (e.g., Hansen, 1999). We realised that relations were mainly developed between parent and foreign sub-units, or between groups of people within the sub-units composing the change teams. Overall, macro-area maturity, plant maturity and strength of relations influence the resistance/collaboration of foreign sub-units.

We coded for changes in *type of mechanisms* employed to transfer lean knowledge, considering both social mechanisms and standards (e.g., Inkpen, 2008). Finally, we analysed *actions via mechanisms* that contributed to the changes in the subsidiary's contextual conditions, coding our data for training, sensegiving, pressure and adaptation actions (e.g., Canato et al., 2013). We not only considered the type of actions, but also the effort made by the headquarters to perform such actions.

4. The case study

This section presents a detailed account of our observations. Following best practices for building theory from case studies (Eisenhardt and Graebner, 2007), we intermingled the narrative with key informants' quotations and provided evidence from company documentation. Section 4.1 presents the background and activities undertaken by headquarters to prepare the transfer of lean. Section 4.2 provides an overview of the programme. Sections 4.3, 4.4 and 4.5 describe the programme chronologically.

4.1 Background and preliminary activities

HVACR's international growth resulted in coordination issues. Senior management acknowledged heterogeneous performance between plants and feared potential negative impacts on customer satisfaction, recognising the need to change the manufacturing strategy. As reported in an archival document explaining the new manufacturing strategy, senior management conceived 'lean as a key means to transform the group of autonomous units into a coordinated high performance manufacturing network' (company documentation, April 2010).

Headquarters initially launched an experimental initiative. Between late 2007 and early 2010, the plant changed itself from being a 'traditional manufacturer' into a 'leading lean producer', with 'significant improvements in terms of performance' (HQ-CA_1). HQ-CGOO stated that, 'considering the benefits achieved by the Italian plant through lean and the coordination problem, in 2010, the board of directors decided to replicate our experience in foreign plants'.

In 2010, HVACR established a new staff unit, the corporate lean office, to support the programme by providing 'central coordination and control of all lean initiatives in the company' (HQ-CA_(US)). A number of parent managers with expertise in lean, the change agents, were moved in the corporate lean office. One change agent (HQ-CA_(RC)) was made responsible for the Chinese subsidiary, another (HQ-CA_(US)) for the US plant.

As a preliminary step, the corporate lean office defined a common protocol for transferring lean to 'ensure not only the consistency between the activities implemented within each subsidiary, but also the alignment between the initiatives among plants' (HQ-Collaborator_1). The protocol had been initially modelled on headquarters' experience, and then developed according to subsidiaries' peculiarities. It specified which lean elements to transfer and adaptations required to fit foreign peculiarities, the pilot area (i.e., the value stream in a macro-area) under transformation, a schedule of the initiative, the set of mechanisms to employ and changes expected by their implementation (company documentation, 2010). Since the implementation of these preliminary activities, change agents in the corporate lean office were supported by other parent managers (parent collaborators).

4.2 Overview of the multi-plant lean programme

Our informants observed that the transfer process of lean knowledge involved three main groups of initiatives characterised by different levels of maturity and strength of relations. Figure 1 provides a chronological picture of significant initiatives HVACR launched between March 2010 and July 2014. For each group, the corporate lean office employed various mechanisms to transfer and sustain the implementation of lean elements. The Appendix reports a description of all the lean elements transferred and examples of their adaptation. According to HVACR classification, basic elements are lean concepts and philosophy, visible planning, value stream mapping (VSM) and plan-do-check-act (PDCA) logic. Core elements include basic elements and elements in organisational structure and people, stable and standardised process, JIT (except for the inbound logistics and material replenishment elements), built-in-quality and continuous improvement (except for the policy deployment element) bundles. They embrace all lean bundles described in the literature (Shah and Ward, 2003; Liker, 2004).

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FIGURE 1 approximately here

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4.2.1 Early initiatives in operations macro-area

Initiatives

At the beginning of the programme, HVACR launched two dyadic initiatives (1_Op,2_Op) to introduce the core lean elements into the Chinese and US operations macro-area. HQ-CA_(RC) and HQ-CA_(US) acted quite independently but carried out initiatives in a similar way, following the protocol for transferring lean.

Visits to the headquarters and plant tours with main foreign representatives were planned to establish a first contact between plants. As an informant observed, 'the programme entailed significant novelty for subsidiaries because of the introduction of practices totally new to the plants,

and for new ties created between plants. Therefore, it needed to be appropriately explained to the subsidiaries' representatives, so they could understand the relevance of the change and the importance of lean adoption' (HQ-CA_(US)). Accordingly, in April 2010, HQ-CA_(RC) organised a three-day event with Chinese managers. Since the company's resources were not enough to launch a second initiative simultaneously, the visit with US representatives was postponed to September 2010.

Preliminary actions via plant visits and tours

Informants explained that the plant tour allowed to show 'how a lean unit works', and was intended to 'make more evident potential benefits of lean implementation' (HQ-CA_(RC)). During these events, change agents explained the 'change in manufacturing strategy' (HQ-CGOO). 'The headquarters' board of directors strongly manifested their personal commitment to the programme', such as 'repeatedly stating they considered the programme as the number-one initiative' (US-LC_1). 'They repeatedly stressed the key role of change agents and their collaborators in successfully implementing lean in the Italian plant and for the future replication of the headquarters' experience in subsidiaries' (RC-LC_2). Their intent was to 'give authority to parent representatives over the initiatives' and promote their role of sensei (teachers) (HQ-CGOO). These observations suggest the parent representatives' *training* and *sensegiving* efforts to support the following implementation of lean in both subsidiaries.

Change teams and initial contextual conditions

Shortly after the visits, HQ-CA_(RC), HQ-CA_(US) and some collaborators, moved to subsidiaries to coordinate foreign employees' training and lean implementation in everyday activities (*residence* mechanism). An inter-unit *change team* was established in both plants. Apart from the change agents in charge of initiatives in the plant, the parent sub-unit involved one to two collaborators from the headquarters operations (HQ-Collaborator_1,2,3). Foreign managers appointed as future lean coordinators (RC-LC_1,2, US-LC_1,2) and two to three collaborators in the macro-area (RC-

Collaborator_1,2,3, US-Collaborator_1,2) took part in the foreign sub-units. During the entire residence, the headquarters' effort was mainly directed towards people in the foreign sub-unit. Accordingly, training activities followed a 'cascade approach': headquarters focused on training members in the foreign sub-unit, while closely supervising in training other employees and implementing lean practices in the pilot area. Several rounds of training and implementation occurred to introduce all core elements.

Informants reported how significant difficulties characterised the transfer process. In both cases, parent managers faced foreign sub-units' *resistance* to lean. Since the beginning, US managers clearly opposed the introduction of lean, causing delays in the initiative. HQ-CA_(US) explained that 'the Americans valued concrete aspects and short-term goals, such as weekly sales', values in contrast with headquarters' emphasis on 'customer satisfaction' and 'long-term improvement' (company documentation, 2010). Informants in the foreign sub-unit recalled how they initially perceived lean principles as 'too abstract' (US-LC_2). When asked to consider relations with headquarters, US managers admitted they used to run their plant autonomously and didn't want to change their managing approach (US-Collaborator_2).

Regarding the Chinese subsidiary, parent managers reported that the Chinese people were not against lean, but they also pointed out how Chinese employees used to poorly participate in lean activities. RC-LC_1 explained that Chinese people used to 'wait for directives from superiors'. He acknowledged that at the beginning they 'struggled with providing opinions to the headquarters' managers' who 'continuously asked what should be done'. Other Chinese employees were also oriented toward hierarchy and authority rather than autonomy, and encountered similar difficulties. This was a problem as 'even the opening activity cards (to solve problems or improve processes) was very hard' (HQ-CA_(RC)). Informants also reported how lean implementation was compromised during a quick absence of the parent sub-unit in September 2010 (the residence was temporarily interrupted to allow the change agent and parent collaborators to support the initial event with US representatives). When asked to consider the relations with headquarters, Chinese

managers acknowledged they were afraid to give opinions and make decisions because they feared a negative impact on their jobs. In addition, first training sessions were hampered by the 'lack of intimacy' and 'high differences' between sub-units (HQ-CA_(RC)).

Actions via residences

Both parent sub-units made a significant and prolonged *training* effort to deeply explain lean elements to foreign representatives. Informants observed how several sessions over many months were necessary to train foreign sub-units on all core elements. HQ-CA_(RC) recalled how some sessions were even redone in China.

During training, parent members not only detailed 'how practices work' (i.e., information collected in lean standard manuals provided to foreign sub-units since the beginning of the initiatives). Their role was fundamental to clarify the 'purposes under each practice' (US-Collaborator_2). Considering the concept of 'standard', several practical examples and evidence from headquarters' experience were important to understand the relevance of precisely follows well-defined standards (RC-LC_2). Informants observed how the parent representatives closely supervised foreign sub-units by regularly visiting shop-floors when foreign sub-units trained other employees in the pilot area. This way, foreign managers learned 'how to diffuse lean' in subsidiaries (HQ-Collaborator_3). Regarding practice implementation, informants observed that the parent sub-unit's effort was crucial, especially at the beginning, for identifying problems and supervising their resolution.

Considerable *sensegiving* effort was made by both parent sub-units during residences to persuade foreign employees to adopt lean, thereby reducing resistance. Informants explained how parent representatives displayed headquarters' full commitment to the programme. They also observed how parent representatives highlighted advantages of lean and the importance of using the lean elements on a daily basis to achieve long-term success. Sensegiving helped US managers to acquiesce in launching of the initiative and to shift their focus toward 'long-term benefits of lean implementation' (US-LC_1). The presence of parent sub-units in the macro-area 'helped to create a

sense of urgency' and was perceived by all employees as a strong signal of headquarters' commitment (RC-LC_2).

Parent sub-units' constant *pressure* contributed to introduce lean into subsidiaries, while handling resistance. Hierarchical power was used to break resistance at the beginning of the US initiative. In that case, 'they left no choice on whether or not to adopt lean' (US-Collaborator_2). Informants observed how faithful lean implementation was forced by parent sub-units throughout their residence. RC-LC_1 described how 'the headquarters' members regularly went to the pilot area to assess actual progress'. An informant reported that 'they did not only used to control quantitative measures and performance, but also verify the understanding of how practices work, along with their aims' and 'conformity of the managers' and employees' actions' to lean values and behaviours (US-LC_2). They also closely supervised the foreign sub-units' members while inquiring other employees' understanding of lean – ad-hoc checklists were developed to support this activity (Appendix). As explained by HQ-CGOO, parent sub-units played a crucial role in guaranteeing that the initiative progressed, that 'lean was not adopted superficially and that no unnecessary or detrimental modifications to practices were made'. To this aim, they committed considerable efforts to *adapt* headquarters' elements and fit foreign subsidiaries' peculiarities.

Informants in the headquarters observed how some changes to lean elements were made when planning the initiatives to overcome some evident criticalities (e.g., because of high illiteracy rate, figures replaced descriptions in standardised work in China; company documentation, 2010). Parent sub-units encountered further criticalities during residences, and had to closely work with foreign managers for a long time to develop adaptations and make lean elements effective. Informants involved in the Chinese initiatives described how long they worked together to identify solutions to stimulate people participation (e.g., lean leader assistants, sharing of responsibility between team members, checklists, incentive system; Appendix). Similarly, informants in the US change team recalled how several meetings occurred before developing a shared conceptualisation of lean to reduce resistance. Finally, informants lamented how modifications led to repeatedly print *manuals*.

Several releases along the entire residence provide further evidence of considerable efforts in adapting lean elements (company documentation, 2010–2011). These observations suggest that a strong and prolonged effort of parent representatives via a long-term residence was necessary for developing the maturity of foreign macro-areas. According to informants, this reflected on the competence of foreign sub-units. In addition, as remarked by informants, close and prolonged teamwork strengthened the relations between sub-units.

Follow up actions via e-mail and telephone consultancies and manuals

A plan for diffusing lean beyond the operations pilot area was developed at the end of the residences (company documentation, 2011). Foreign sub-units had to implement the plan, while headquarters provided constant support by *e-mail and telephone consultancies* (*training*). Parent representatives helped subsidiaries in solving problems regarding lean implementation and providing further details on lean elements. According to parent informants, frequent contacts were also necessary to control the subsidiaries' lean implementation progress (*pressure*). One informant explained that the parent managers' effort was important to support the Chinese subsidiary, where 'high employee turnover hindered lean implementation both in and outside the pilot area' (RC-Collaborator_1). When asked to consider the usefulness of *manuals*, US-Collaborator_1 observed that they were a fundamental reference point, particularly when parent representatives were not there.

4.2.2 Late initiatives in the operations macro-area

Initiatives, change teams and initial contextual conditions

In May 2012, the corporate lean office organised a one-week event in headquarters (3_Op) to revise elements in lean concepts and philosophy, and introduce to both subsidiaries policy deployment practice. Then, one to two-week events occurred every four to six months to revise practices introduced in 1_Op and 2_Op on a network basis (6_Op,9_Op,11_Op,16_Op,19_Op). One to two-week events were also organised to revise and/or introduce new elements to a single subsidiary to

satisfy specific needs (10_Op, 18_Op in China, 14_Op in US). Initiatives focused on operations and occurred through *assignments* (i.e., practical training events in which representatives move to the plant that has better knowledge on specific element/s), or *study-teams* (i.e., theoretical events in which representatives work in teams to share knowledge on specific element/s).

In network events, *change teams* comprised of change agents in charge of transferring lean to the subsidiaries and the lean coordinators of both subsidiaries (RC-LC_1,2, US-LC_1,2). Dyadic events were led by teams involving the change agent in charge of initiatives in the subsidiary, one to two collaborators from the headquarters operations (HQ-Collaborator_1,2,3) and lean coordinators and two to three collaborators of the specific subsidiary (RC-LC_1,2, RC-Collaborator_1,2,3 or US-LC_1,2, US-Collaborator_1,2). HQ-CGOO observed that 'foreign sub-units were made responsible for diffusing practices to other employees in the pilot area and carrying on practice adaptation without our direct supervision'.

Informants consistently reported that *no resistance* was noted among members of foreign sub-units. 'Every member provided contributions for the enhancement of standards in all events' (RC-LC_2). For instance, referring to the introduction of policy deployment, there was 'significant interaction during classroom sessions. The subsidiaries' managers pointed out new relevant ideas for common improvement opportunities' (HQ-CA_(RC)). Similarly, HQ-CA_(US) observed that 'the subsidiaries' managers demonstrated the ability to formulate solutions that could also be effectively implemented outside their plant. They demonstrated competence on lean elements'.

Actions via assignments and study-teams

Higher macro-area maturity and strong relations influenced the parent sub-units' effort in transferring lean. *Training* sessions progressed 'quite smoothly' (HQ-CA_(RC)). For example, considering the revision in 3_Op, US managers acknowledged wider benefits obtainable through pursuing long-term customer satisfaction, therefore 'the headquarters managers made little effort in directing discussion towards common conceptualisations of lean and waste' (RC-LC_1) (little

training and adaptation effort). 'Chinese managers revealed high awareness of lean concepts, such as waste, although they had encountered several difficulties in understanding their meaning at the beginning of their lean journey' (HQ-CA_(RC)). Similarly, parent sub-units made little effort in introducing new elements. One informant recalled how 'the knowledge gleaned during the previous initiatives favoured the smooth introduction of complex standards, such as policy deployment' (US-LC_1). Regarding *adaptation*, informants consistently reported how in network events 'intimacy and constructive discussions between members (of different sub-units) helped to easily define common directions for modifications' (RC-LC_1). Foreign sub-units had to follow these guidelines, determining detailed implications to their specific context (company documentation, 2012). One informant exemplified this aspect, referring to 16_Op: 'We went to the Chinese plant to see their new solution for training operators, which basically used a training cell to quickly introduce operators to new practices. […] Both in the US and in Italy, the turnover is much lower than in China. For this reason, we agreed to prolong the permanence of (the US and Italian) operators in the training cell to go more in-depth into each element. […] Initially, we opted for different durations, then commonly set the best one' (US-LC_2). In case of dyadic events, 'shared awareness of foreign peculiarities and (foreign) managers' competence and motivation allowed to quickly and jointly define guidelines for adaptation, guaranteeing that they can autonomously deploy and implement them in their plant' (HQ-CA_(US)).

No evidence of *pressure* in these events was reported. 'We didn't need to force them, since they collaborated with providing suggestions during teamwork and were also proactive in suggesting some events' (HQ-CA_(US)). Instead, US-LC_1 observed that parent sub-units recalled the relevance of the lean programme (*sensegiving*). 'It was important to reinforce commitment to the lean programme to avoid them resting on their laurels' (HQ-CA_(RC)).

Actions via plant visits and tours

One-day *plant visits and tours* of the hosting plant occurred in correspondence with assignments and study-teams. Their main aim was to reinforce foreign sub-units' commitment (*sensegiving*). Informants recalled how gemba walks were also useful in observing how production and lean practices actually take place in a specific plant, and in exchanging information across plants (*training*).

Follow up actions via e-mail and telephone consultancies, the intranet and manuals

Headquarters used *e-mail and telephone consultancies* to support subsidiaries in problem resolution and occasionally provide details on lean elements (*training*). Until July 2013, such mechanism was also used to obtain headquarters' approval for modifications introduced after events (*adaptation*). Afterwards, a company-wide *intranet* was used. Informants observed how the intranet facilitated remote adaptations and standard improvements. Similarly, parent representatives levered on e-mail and telephone consultancies first and then on intranet to regularly control the subsidiaries' progress in lean implementation (*pressure*). 'Lean coordinators regularly upload standardised reports of plant status in a specific section of the intranet, allowing us to have real-time assessment' (HQ-CGOO). A virtual collection of lean standards, constantly updated by the corporate lean office, was also available in the intranet (*training*). Foreign managers were in charge of updating hardcopies of books on lean standards. In this regard, 'in 3_Op, we agreed in replacing manuals with *handbooks* (i.e., ring binders with removable sheets), which are simpler to update and more useful for supporting everyday activities' (RC-LC_1). Headquarters also performed *sensegiving* via the intranet. On its main page, a statement highlighted the relevance of the lean programme for HVACR. As observed by an informant 'similar statements are also present in other sections of the intranet, along with a detailed descriptions of the benefits of our lean system for single plants and the whole organisation' (US-LC collaborator 2).

4.2.3 Initiatives in the office macro-area

Initiatives, change teams and initial contextual conditions

Starting from July 2012, some dyadic initiatives were launched to introduce some lean elements in office macro-areas. HQ-CA_(US) and HQ-CA_(RC) carried out the initiatives quite independently, but following a common protocol. A first *residence* of two weeks introduced the basic elements (4_Of,12_Of). Short-term residences transferred other core elements (5_Of,7_Of,8_Of in US, 13_Of,15_Of,17_Of in China).

In both subsidiaries, a *change team* comprising the two lean coordinators (US-LC_1,2, RC-LC_1,2) and two foreign employees from the office macro-area (US-Collaborator_3,4, RC-Collaborator_4,5) was established. This group represented a constant interface for the parent sub-unit, involving the headquarters' change agents in charge of initiatives in subsidiaries and two collaborators (HQ-CA-Collaborator 4,5). Parent sub-units' residences focused on training foreign sub-units only on 'specific knowledge about how to implement lean in the office' (US-LC_2). This means that lean coordinators were in charge of providing a general background regarding lean, and coaching on how to train other employees. Foreign representatives were responsible of coordinating activities related to practice adaptation.

A *partial collaboration* characterised the foreign change teams. While lean coordinators were collaborative, foreign collaborators resisted initiatives. There was no to low macro-area maturity and relations with foreign collaborators lacked, as 'the office had never been involved in previous lean initiatives with the headquarters' (RC-LC_1). Interestingly, informants consistently observed how these conditions negatively affected other employees in the pilot area. US employees lamented that lean conceptualisation was abstract, while Chinese people poorly participated, especially in the first activities. However, initiatives in both plants benefited from the collaboration of lean coordinators. Their participation in previous initiatives in operations, creating a certain maturity and strong relations, contributed to determine such positive reaction.

Actions via residences

The collaboration of foreign lean coordinators contributed to reduce the effort of parent sub-units, whose role was nevertheless crucial. Informants reported how parent sub-units provided fundamental support in persuading new foreign members regarding the importance of lean (*sensegiving*), and in forcing lean element introduction (*pressure*). 'While the tour of the shop-floor and training sessions basically left our colleagues unconcerned about lean, we were able to launch lean in office only with the presence of the parent managers' (US-LC_1). 'Just having parent representatives in our office helped to overcome the initial resistance' (US-LC_2). Informants observed the relevance of the parent sub-units' support for subsequent actions made by foreign change teams. US-LC_1 recalled that 'because of their periodic presence in the office, employees tend to acquiesce to implement lean'.

The effort of the headquarters' sub-units in training and adaptation during the residences was little. Informants reported how quick *training* sessions sufficed in clarifying lean elements, as lean coordinators had already experienced their implementation and foreign collaborators received some training from lean coordinators. Foreign sub-units lacked specific knowledge on how lean elements could be applied in office. 'We could focus on explaining how to implement lean in the office, providing examples on how we did it in the headquarters and directly experimenting in their gemba' (HQ-CA_(RC)). This way, 'a common understanding and a basis for the future comparison of plants' was built (HQ-CA_(US)).

Regarding *adaptation*, change agents and lean coordinators were aware of a subsidiary's main criticalities. During previous initiatives, they had identified some countermeasures – which could be potentially effective in office – to deal with. However, HQ-CA_(RC) explained that 'only by going there and assessing the situation in the office we were able to guide them with the right direction for modifications'. Foreign sub-units were made responsible for specifying how to modify lean elements according to guidelines. RC-LC_1 described that 'similar to operations, we levered on checklists to stimulate employee participation in problem-solving and improvement activities, but had to change some parameters to make them effective in the office'.

Actions via plant visits and tours

Plant visits and tours of subsidiaries occurred in correspondence with residences. Their main aim was to verify the status of lean implementation (*pressure*). However, as for the late initiatives in operations, plant visits and tours were also useful for *sensegiving* and *training*.

Follow up actions via e-mail and telephone consultancies, the intranet and manuals

Informants in US initiatives recalled several *e-mail and telephone consultancies* for helping subsidiaries in solving problems, and few others for providing further details on standards (*training*). These mechanisms were also used to control the progress of lean implementation in office (*pressure*) and sustain *adaptation* (e.g., send weekly reports regarding the status and progress made in the macro area, or documents detailing proposal for standard modifications, respectively). After July 2013, part of such information was conveyed through the *intranet*. Informants involved in initiatives with the Chinese plant consistently observed that they mainly used the intranet for exchanging information since the first initiative in office (12_Of). RC-CA_1 explained that 'information is more easily accessible on the company's intranet' than using e-mails.

While the corporate lean office constantly reviewed the virtual database collecting standards for office (*training*), lean coordinators updated their printed copy of standards. *Handbooks* were used in both subsidiaries.

4.2.4 Formal audits

During the programme, the maturity of lean implementation in the subsidiaries was assessed by parent representatives through *formal audit*.

In April 2012, a unit of three managers from the corporate lean office (HQ-CA_(RC),HQ-CA_(US),HQ-CA_1) spent a week in both subsidiaries to audit the implementation of each core element in operations (*pressure*). As observed by an informant, 'both events concluded with a celebratory dinner in which the subsidiary's progress was awarded with particular magnets to be posted on the cell status boards' (HQ-CA_1) (*sensegiving*).

In July 2014, the corporate lean office conducted a second formal audit of both subsidiaries to validate and award the plants' progress in lean implementation (*pressure* and *sensegiving*). It was carried out as the first formal audit, except that, this time, the office macro-area was also included.

5 Analysis and discussion

Our study analysed the programme of an Italian-based company to transfer lean knowledge to its Chinese and US subsidiaries. Table 3 summarises our observations and classifies the programme initiatives based on the different contextual conditions emerging over time.

At the beginning of the programme, there was no maturity in lean implementation in both subsidiaries (i.e., no implementation of lean elements in both operations and office-macro areas). Moreover, foreign managers used to manage their plants autonomously (i.e., independence, no relations with headquarters). Our observations suggest that these contextual conditions may lead subsidiaries to *resist* the lean introduction.

Literature describes MNCs as heterogeneous because embedded in different nations (Kostova, 1999). According to a practice-context congruence perspective, incongruence between contextual peculiarities of a foreign plant and transferred knowledge is likely to generate resistance to change. Regarding the Chinese subsidiary, we observed that one of the main evidence of resistance was poor participation in activities (with ideas and suggestions) due to employees' orientation of hierarchy and the preference of orders instead of autonomous decision-making. Instead, US employees considered lean workless and time-consuming. Their opposition to lean can be explained by their emphasis on short-term goals and tangible objectives. These cultural values are consistent with Chinese and US national cultures (Hofstede et al., 2010), and hinder lean implementation (Hofer et al., 2011; Kull et al., 2014; Bortolotti et al., 2015).

Literature suggests that the strength of relations between the parties affect knowledge transfer (Kostova, 1999). Differences and independence between plants can reduce subsidiary's acceptance of new practices and hinder knowledge transfer (Easterby-Smith et al., 2008). We observed that

independence between plants contributed to generate resistance in both early initiatives. For instance, the US sub-unit opposed the programme and wanted to continue to manage the plant autonomously.

As a result of resistance, significant difficulties are likely to occur during the transfer process, even the failure of lean adoption (Lozeau et al., 2002; Netland and Aspelund, 2014). However, consistent with previous studies (e.g., Canato et al., 2013), we observed that some actions via transfer mechanisms can be taken to implement new practices, while reducing resistance. These actions can reduce the incongruence among practices and contextual conditions by adapting practices or adjusting the organisation through training, sensegiving and pressure. Moreover, consistent with studies suggesting that interactions and communication between the parties strengthen their relations and collaboration (Gupta and Govindarajan, 2000), we observed that actions performed during the early initiatives led to a certain maturity in lean implementation in both subsidiaries and stronger relations with the headquarters, favouring collaboration of subsidiaries in the introduction or revision of lean elements.

Although having similar plant maturity, in case of late initiatives in operations, a certain macro-area maturity and strong headquarters-subsidiary relations led to a *wide collaboration* of foreign sub-units. All foreign managers in the sub-units collaborated with parent representatives to introduce and/or revise lean elements. In case of initiatives in office, no or low levels of macro-area maturity and mixed headquarters-subsidiary relations led only to a *partial collaboration* of foreign sub-units. We observed that in all these initiatives, only the group of managers that took part in the early initiatives in operations collaborated with the headquarters. Conversely, all other members resisted the introduction of lean. Overall, the contextual conditions characterising the late initiatives in operations and those in office resemble and are consistent with the ideal conditions recommended by Ferdows (2006).

Our study contributes to the literature by suggesting which mechanisms can be employed to perform training, sensegiving, pressure and adaptation actions according to the different contextual

conditions of a programme over time (see Sections 5.1 and 5.2). For each group of initiatives, Table 3 shows the mechanisms used to transfer lean knowledge and actions performed via such mechanisms. In the remainder of the paper, a set of research propositions derived from the case data is presented to guide future research and practitioners.

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TABLE 3 approximately here

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5.1 International teamwork and actions via primary mechanisms

Scholars suggested several mechanisms for transferring knowledge in a MNC. Several studies highlighted the need of transferring lean through social mechanisms (e.g., Inkpen, 2008). Some recommended the use of lean standards, collected in manuals and/or through ICT (e.g., Bruun and Mefford, 2004). We observed that a set of mechanisms comprising social interactions and codification by standards were used throughout the programme. International teamwork (i.e., teamwork among representatives of headquarters and foreign plants through residences, assignments or study-teams) represented the main mechanism for *training*. For both early initiatives in operations and those in office, training essentially occurred through the residences of parent representatives in each subsidiary. Similarly, assignments and study-teams were used by headquarters as the main means for training in case of late initiatives in operations. This way, parent representatives could transfer different kinds of information. In early initiatives in operations they detailed how lean practices work, i.e., information collected in the manual, but also clarified lean practice purposes and taught how to diffuse lean. In initiatives in office, teamwork allowed to transfer specific knowledge and exemplify lean elements. In late initiatives in operations, teamwork promoted discussion among plants about possible common improvements.

To sustain actions via teamwork the headquarters levered on other mechanisms (i.e., manuals/handbooks, e-mail and telephone consultancies, the intranet, visits and plant tours) for training (see Section 5.2). Considering the difference between teamwork and the latter mechanisms in performing training, we propose to classify between primary and secondary mechanisms, respectively.

The literature agrees that training should be combined with sensegiving (Schein, 2010), pressure (Kotter, 1995) and adaptation (Wallace, 2004). Although Canato et al. (2013) recommended to lever on all these actions for successfully implementing new practices, studies failed to investigate all these actions and how they can be combined through different mechanisms. With reference to primary mechanisms, we observed that headquarters levered on teamwork not only for training, but also for *sensegiving*. In early initiatives in operations and those in office, the presence of parent representatives in the subsidiaries stressed headquarters' commitment to the programme and was fundamental in persuading foreign members regarding the importance of lean, therefore contributing in reducing resistance. For the late initiatives in operations, teamwork was important to reinforce collaboration at network level and maintain engagement of foreign representatives over time.

Adaptation was also performed through teamwork. In the early initiatives in operations and those in office, modifications to lean elements aimed to better fit foreign contextual peculiarities. Even if adaptation led to some differences in lean implementation among plants, it helped to avoid superficial adoption of lean practices. Teamwork and collaboration between plants was important to identify right directions for modifications and develop effective adaptations, as well as to avoid that unnecessary or detrimental modifications were made. For the late initiatives in operations, adaptation through teamwork supported discussion among plants and definition of common directions for modifications, therefore helping to reduce heterogeneity in the network.

We observed that headquarters levered on *pressure* via teamwork only when resistance was encountered. In early initiatives in operations and those in office, hierarchical power was useful to

overcome initial opposition to lean adoption, while the presence of parent representatives and their support in controlling actual progress contributed to handle resistance and guarantee lean implementation. Instead, for late initiatives in operations, pressure was not necessary due to collaboration of foreign representative.

Taken as a whole, this evidence contributes to the understanding of the relation between different action mechanisms and contextual conditions. It can be observed that even if some previous studies recommended to combine different actions (e.g., Wallace, 2004; Inkpen, 2008; Schein 2010; Canato et al., 2013), it is not clear how teamwork can be used to perform training, sensegiving, adaptation and pressure. Our observations indicate when and how parent representatives should lever on each action via international teamwork. Hence, we propose:

Proposition 1a. Throughout a multi-plant lean programme, headquarters should use international teamwork as a main mechanism to perform training in foreign subsidiaries.

Proposition 1b. Throughout a multi-plant lean programme, headquarters should use international teamwork as a mechanism to perform sensegiving in foreign subsidiaries.

Proposition 1c. Throughout a multi-plant lean programme, headquarters should use international teamwork as a mechanism to perform adaptation in foreign subsidiaries.

Proposition 1d. For foreign subsidiaries that resist a multi-plant lean programme, headquarters should use international teamwork as a mechanism to perform pressure in the subsidiary.

Although our evidence suggests that international teamwork is a primary mechanism to perform training, sensegiving, adaptation and pressure in foreign subsidiaries, such a mechanism may require headquarters to devote considerable resources, and therefore this may hinder its

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implementation. One might expect that international teamwork may be difficult for large MNCs, since headquarters may need to simultaneously coordinate initiatives in several subsidiaries. According to Netland et al. (2015b), international teamwork is still important for large MNCs to perform training in subsidiaries. However, they observed that lean experts from subsidiaries that are more advanced in lean implementation typically support parent representatives in transferring knowledge. Further research should clarify to what extent international teamwork may be used by medium and large MNCs.

When going into details, we observed that HVARC levered on different types of international teamwork, depending on the contextual conditions of foreign plants. Long-term residences of parent representatives occurred in both early initiatives in operations so that they could face the resistance of subsidiaries. Short-term residences took place in all initiatives in office, which were characterised by partial collaboration of foreign sub-units. Headquarters opted for short-term assignments/study-teams in late initiatives in operations, when it could rely on wide collaboration. This evidence is in line with previous studies on multi-plant lean programmes suggesting that choices of general actions, and of mechanisms in particular, should be done according to the different contextual conditions of plants, which can change over time (e.g., Netland and Ferdows, 2014).

To better understand the relation between contextual conditions and different types of international teamwork, we classified primary mechanisms according to how long the parties work in a team (i.e., duration).

5.1.1 Classification of primary mechanisms according to duration

At the beginning of the programme, both subsidiaries had no maturity in lean implementation and relations between the parties lacked. Parent representatives organised several training sessions over many months to deeply explain all core lean elements to both US and Chinese sub-units. They closely supervised training sessions delivered by foreign sub-units to other employees in the pilot

area. In that, parent sub-units taught foreign representatives how to diffuse lean knowledge (this is similar to what Rother (2009; p. 18) called 'coaching kata'). Lean implementation in everyday activities was also supervised by parent sub-units, which provided support to fix problems. Parent sub-units' effort in adapting practices was important to overcome some criticalities. Close and prolonged teamwork allowed finding solutions that made lean more effective in subsidiaries. At the same time, it avoided worthless or even detrimental modifications. These observations suggest that *close and lasting international teamwork* was necessary to introduce lean knowledge.

In contrast, in the late initiatives in operations and those in office, both subsidiaries had a certain plant maturity and there were stronger relations between the parties (i.e., partial or wide collaboration). In these cases, parent representatives had a relevant role in training foreign sub-units. However, unlike early initiatives in operations, these activities were quicker, and foreign sub-units were able to train other employees and coordinate activities quite autonomously. In other words, there was no need for lasting supervision of foreign representatives (anyway, parent sub-units provided constant remote support; see Section 5.2). We refer to this as a chance to delegate diffusion of lean knowledge within a pilot area, thereby deploy a *close but brief international teamwork*. Due to collaboration, delegation occurred also for the modification of lean elements. Short-term international teamwork occurred to jointly define guidelines for adaptation, while foreign sub-units detailed implications for their specific context and managed other activities related to this issue quite autonomously.

Moreover, we observed that during the early initiatives in operations, parent sub-units constantly pressured lean implementation, while continuously remembering the sense of the programme. Their strong and prolonged effort in pressure and sensegiving helped to handle resistance. On the other hand, in the late initiatives in operations and those in office, delegation limited the parent sub-units' effort in sensegiving and/or pressure.

Taken as a whole, this evidence contributes to understand the relationship between contextual conditions and different types of international teamwork.

Previous studies suggested distinguishing primary mechanisms by considering the duration of teamwork (e.g., Evans et al., 2002). For example, Harris (2002) and Harris et al. (2003) described various alternatives of residence, such as long-term expatriation vs. short-term international teamwork. In line with these studies, Dyer and Nobeoka (2000) distinguished between permanent or temporary residences used by Toyota to transfer lean. However, these studies say little about how to relate primary mechanisms to contextual conditions. Our observations suggest that different types of international teamwork in terms of duration should be used according to the plant maturity and strength of headquarters-subsidiary relations. Duration seems to not be affected by the macro-area maturity. Hence, we propose:

Proposition 2a. For foreign subsidiaries that are autonomous and new to lean, headquarters should deploy close and lasting international teamwork in order to implement lean in the subsidiary.

Proposition 2b. For foreign subsidiaries that are integrated with headquarters and not new to lean, headquarters can deploy close but brief international teamwork in order to implement lean in the subsidiary.

In addition, our observations provide insights into the composition of international teams. We observed that foreign sub-units involved a stable group of foreign representatives. In addition, other employees belonging to operations or office were involved, depending on which macro-area was targeted by an initiative. This configuration is similar to one observed by Kostova (1999; p. 317). She referred to foreign sub-units as 'transfer coalitions', and described them as composed of two groups of people: a stable group of 'key managers' responsible for the transfer within a plant and a 'flexible' group of employees who are experts in the functional area. Although the author gave a hint of different roles played by the two groups, it is not clear how this configuration can support

knowledge transfer. We observed that the presence of stable groups of foreign representatives facilitates lean transfer to subsidiaries, particularly in a new macro-area, but in a plant with a certain maturity. For example, in all initiatives in office, even if new members of foreign sub-units resisted knowledge transfer, competence acquired by and relations developed with stable groups resulted in a certain collaboration of foreign sub-units. According to proposition 2b, delegation and close but brief international teamwork can be used. This helps to explain why the macro-area maturity does not affect the duration of international teamwork. In fact, whatever macro-area maturity, when there is a certain plant maturity, a stable group guarantees collaboration. We propose:

Proposition 3.   Throughout a multi-plant lean programme, headquarters should collaborate with a stable group of managers in a foreign subsidiary in order to implement lean in the subsidiary.

Further research should investigate the composition of international teams. For example, it could be interesting to study the implications of lean knowledge transfer when different configurations of foreign sub-units are used (e.g., from one stable sub-unit for all macro-areas to completely different sub-units for each one).

5.2 Actions via secondary mechanisms

In all the initiatives, international teamwork represented the main mechanism for training, in combination with sensegiving, adaptation and/or pressure. However, our observations suggest that throughout the programme, secondary mechanisms were needed to sustain main actions via teamwork. In particular, we observed that headquarters used a set of secondary mechanisms to perform training, sensegiving, adaptation and pressure (Table 3).

Regarding *training*, foreign representatives used standards in hardcopy books and/or in the intranet to diffuse lean elements in their plants and guide every-day activities. In the early initiatives in

operations, subsidiaries were given translated version of the headquarters' manual. These books needed to be reprinted whenever modifications to lean elements were made. Afterwards, the intranet allowed an easy access to information about lean elements, while the handbooks were easier to update and use compared to manuals. Moreover, headquarters used e-mail and telephone consultancies to ensure constant support to foreign representatives. Finally, visits and plant tours were used to begin the programme and allow careful observations on how lean practices were employed.

Headquarters used secondary mechanisms also for *sensegiving*. At the beginning of the programme, visits and plant tours allowed to prepare subsidiaries for the lean transfer and establish a first contact between the parties. In the late initiatives in operations and those in office, such mechanisms enabled to display headquarters' high commitment to the programme and recall the importance of lean elements. In addition, headquarters used formal audits and the intranet to highlight the relevance of the lean programme.

Regarding *pressure*, e-mail and telephone consultancies were used all along the programme to control subsidiaries' progress. However, starting from July 2013, pressure was partially performed via the intranet by a real-time assessment of each subsidiary. For initiatives in office, visits and plant tours were used by headquarters to control the subsidiaries' implementation status. Finally, formal audits were used to assess the maturity of the foreign subsidiaries.

Secondary mechanisms were used in all initiatives to perform *adaptation*. During the early initiatives in operations parent sub-units worked intensively with foreign representatives to adapt lean elements and had to continuously update manuals. During late initiatives in operations and those in office, short-term teamwork focused on defining guidelines for adaptation, while foreign representatives were responsible for detailing implications to their specific context and managing other related activities. In this case, a particular emphasis was put by parent representatives to adaptation via secondary mechanisms because of delegation. Headquarters had to provide constant remote support to subsidiaries whenever needed, and control that adaptation process had been

carrying on as agreed. E-mail and telephone consultancies were used before July 2013. A specific section on the intranet was developed by the corporate lean office to facilitate the exchange of information and documents on adaptations among plants, and was primarily used afterwards.

In line with previous studies (e.g., Bruun and Mefford, 2004), these observations show that various secondary mechanisms can be useful to transfer lean knowledge among plants in MNCs. However, our research provides a better understanding on the actions headquarters can perform through such mechanisms. Our observations suggest that throughout a programme, training, sensegiving, adaptation and pressure via a set of secondary mechanisms are important to sustain main actions via international teamwork. Hence, we propose:

Proposition 4a.   Throughout a multi-plant lean programme, headquarters should use secondary mechanisms to perform training in foreign subsidiaries in order to sustain lean implementation in the subsidiary.

Proposition 4b.   Throughout a multi-plant lean programme, headquarters should use secondary mechanisms to perform sensegiving in foreign subsidiaries in order to sustain lean implementation in the subsidiary.

Proposition 4c.   Throughout a multi-plant lean programme, headquarters should use secondary mechanisms to perform adaptation in foreign subsidiaries in order to sustain lean implementation in the subsidiary.

Proposition 4d.   Throughout a multi-plant lean programme, headquarters should use secondary mechanisms to perform pressure in foreign subsidiaries in order to sustain lean implementation in the subsidiary.

Going further into details of single mechanisms, it seems that some of them need a certain collaboration of subsidiaries to be used. According to some scholars (e.g., Bruun and Mefford,

2004), we observed that the intranet fostered communication among plants only when subsidiaries had a certain maturity and stronger relations with headquarters was present. This is particularly evident when considering adaptation. To enhance this understanding, we suggest future research on comparing MNCs using the same secondary mechanisms, with subsidiaries at different stages of lean implementation and having different strength of relations with headquarters.

5.3 Implications for practitioners

An important implication for practitioners of this study is that companies should not identify mechanisms once and for all, but have to revise their choice over time. Headquarters should use different types of primary mechanisms to transfer lean to foreign plants depending on contextual conditions. We found that managers' choice is between close and lasting teamwork versus close but brief teamwork. Therefore, practitioners may find propositions 2a and 2b useful when selecting these types of primary mechanism according to different contextual conditions.

Propositions 1a, 1b, 1c and 1d advice headquarters to lever on international teamwork as the main mechanism to perform training, but also for sensegiving, adaptation and pressure, respectively. While training, sensegiving and adaptation via primary mechanisms are important throughout a programme, pressure via teamwork should be used when subsidiary resists the programme. Moreover, propositions 4a, 4b, 4c and 4d highlight the importance of sustaining international teamwork with training, sensegiving, adaptation and pressure via secondary mechanisms (e.g., hardcopy books of lean standards, e-mail/telephone consultancies, intranet, visits and plant tours and formal audits) during the whole programme.

Finally, it emerges that a certain effort of parent representatives is needed. Having a dedicated staff unit within the headquarters favours coordination at plant and network level. Proposition 3 suggests that a stable group of managers should be identified within each subsidiary to facilitate interactions with the headquarters and favour the transfer of knowledge over time.

6. Conclusions

A growing number of MNCs are implementing lean across dispersed and heterogeneous plants to manage their organisation as a whole. Although successfully implemented in headquarters, parent's managers often find significant difficulties when lean is implemented in foreign subsidiaries (Netland and Aspelund, 2014). Applying a process perspective, this paper analysed the relation between mechanisms and contextual conditions in a multi-plant lean programme launched by HVACR over a period of approximately four years. Basing on our empirical investigation, we developed a set of propositions for the transfer of lean knowledge, which relates contextual conditions with different types of mechanisms and actions. These propositions can serve as a basis for future research and as a guideline for practitioners.

Scholars generally ascribed failures of lean programmes to the complexity of lean implementation and of dealing with highly different subsidiaries' contexts (e.g., Maritan and Brush, 2003). Based on our observations, we suggest that headquarters' slight attention to change in subsidiaries' contextual conditions is likely to hamper the selection of right mechanisms and the success of a transfer initiative.

6.1 Limitations and future research

It is important to consider limitations of our study. Future research should address these limitations to increase understanding on the transfer process of lean knowledge in MNCs. The main limitation to the generalizability of our results is the single case study design. However, single case studies allow to develop in-depth insights into a phenomenon and its context. Moreover, they can be particularly valuable for studying relatively unexplored topics and for complex phenomenon. We had access to detailed information on a programme and the opportunity to interview key informants and observe lean implementation in international plants. When conducting empirical studies on multiple MNCs, it is difficult to find these conditions due to resources constraints and because the transparency of the process under investigation needs a strong collaboration between company and

researchers to access confidential information and have full availability of key informants. Further research can verify to what extent our findings can be generalised.

Another limitation is the analysis of a small MNC. Previous research investigated lean programmes of Toyota and other medium and large MNCs. Though less documented, a growing number of small MNCs are implementing lean in their international networks (Camuffo, 2014). Therefore, our study is relevant to researchers and practitioners as it explores a phenomenon scarcely investigated. Future studies could test our propositions in MNCs of different sizes. For example, we observed that international teamwork is important to perform training, sensegiving, adaptation and pressure in foreign subsidiaries, but it may require headquarters to devote considerable resources. While HVACR's programme involved only two foreign plants, large MNCs typically need to simultaneously coordinate initiatives in several subsidiaries. In medium and large MNCs, are resource constraints a limiting factor for the use of primary and secondary mechanisms proposed in this study? Along with clarifying to what extent such mechanisms are used by bigger MNCs, future studies can explore whether other mechanisms are more important for medium and large MNCs.

Future studies could also investigate whether mechanisms vary when different initial contextual conditions are found. When HVACR introduced lean to the subsidiaries, the latter had no maturity in lean implementation and were independent. However, it can happen that subsidiaries have strong relations with headquarters. Are such contextual conditions sufficient for the delegation of knowledge diffusion within the pilot area at the begging of a programme?

Another limitation is related to the analysis of a programme from headquarters' perspective. This can contribute to the literature, as few studies on multi-plant programmes took this perspective (Netland and Aspelund, 2014). However, it would be interesting to combine headquarters with subsidiary perspective, to analyse costs and benefits associated with different mechanisms.

Multi-plant programmes are important and worthy to be explored, as they are a widespread phenomenon among MNCs. However, corresponding research is scarce, and as concluded by Netland and Aspelund (2014; p. 404), 'the current scholarly literature largely fails to fulfil its role to

synthesise and guide practitioners who implement and manage such programmes'. Therefore, we believe that the above ideas for future studies, together with those suggested in Section 5, provides a valuable base for guiding future research in this area.

Acknowledgements

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E-mail and tel. consultancies: no no		yes	
Intranet:	no		yes
2010	2011	2012	2013
E-mail and tel. consultancies: no		yes	
Intranet:		no	yes

Legend: White rectangles concern dyadic initiatives with the Chinese (above the timeline) or the US (below the timeline) subsidiary, w
network initiatives. Rectangles are placed in the area of the figure corresponding to the plant where the initiative occurred. Initiatives a
(from *1* to *19*) according to when they occurred and are coded as *Op* or *Of* depending on where they took place (i.e., operations or offic
means that the mechanism is associated with various initiatives. *Tour* is an abbreviation for plant visit and tour. The white and grey are
figure show if e-mail and telephone consultancies and the intranet were used to exchange information on the programme between the h
US subsidiary, respectively.

FIGURE 1 – HVACR's programme

	Italian headquarters	*Chinese subsidiary*	*US subsidiary*
Plant history	1973	2005 (wholly owned subsidiary from the ground up)	2003 (wholly owned subsidiary from the ground up)
Plant size (Employees, March 2010–July 2014)	About 400	About 200	Less than 100
Products	Electronic control solutions, humidifiers and valves – full range of products	Electronic control solutions, humidifiers and valves – partial range of products	Electronic control solutions and humidifiers – partial range of products
Target market	Mainly Europe	Asia-Pacific region	North America
Maturity of lean practice implementation at the beginning of the programme	High plant maturity	No plant maturity	No plant maturity
Headquarters-subsidiary relations at the beginning of the programme	-	Independence	Independence

TABLE 1 – Information on plants involved in HVACR's programme

Headquarters	*Chinese subsidiary*	*US subsidiary*
32 interviews • Chief group organisation officer (HQ-CGOO) – i.e., member of the corporate lean office and supervisor of all lean initiatives in the company • The change agent in charge of lean initiatives with the Chinese subsidiary (HQ-CA_(RC)) • The change agent in charge of lean initiatives with the US plant (HQ-CA_(US)) • 5 parent collaborators (HQ-Collaborator_1, 2, 3, 4, 5) • The other change agent who took part in the unit that formally audited the maturity of lean practice implementation in both subsidiaries (HQ-CA_1) • Other managers and employees (e.g., operations managers, HR	20 interviews • 2 Chinese lean coordinators in charge of lean initiatives involving the Chinese plant (RC-LC_1, 2) • 5 foreign collaborators (RC-Collaborator_1, 2, 3, 4, 5)	16 interviews • 2 US lean coordinators in charge of lean initiatives involving the US plant (US-LC_1, 2) • 4 foreign collaborators (US-Collaborator_1, 2, 3, 4)

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managers, R&D manager, product manager, shop-floor employees)		

TABLE 2 – Details about the interviews

Initiatives	Contextual conditions*	Mechanism	Actions via a mechanism by the headquarters
Early initiatives in the operations macro area: • China: 1_Op • US: 2_Op	• No macro area maturity • No plant maturity • Independence, no relations • Resistance • No collaboration	Plant visit and tour (three days)	• *Training:* provide a general overview of the lean approach and the change linked to its implementation • *Sensegiving:* display the high organisational commitment to the programme, highlight the importance and advantages of lean implementation; give authority to the parent representatives Aim: establish a first contact with the foreign subsidiary and prepare it for the subsequent transfer of lean
		Long-term residence (from 10 to 16 months)	• *Training:* deeply explain all core lean elements, starting from the basic ones; teach how to diffuse lean knowledge; support problem identification and resolution • *Sensegiving:* display the high organisational commitment to the programme; continuously highlight the importance and advantages of lean elements • *Pressure:* force lean adoption and constantly control the implementation of lean elements • *Adaptation:* closely work with the foreign managers to deeply understand the subsidiary's peculiarities and to develop effective adaptations Aim: transfer all core lean elements to the subsidiary and develop headquarters-subsidiary relations
		Manual	• *Training:* translate the headquarters' hardcopy collection of lean elements (once) • *Adaptation:* update manuals whenever adaptations to lean elements are made Aim: support and sustain lean implementation
		E-mail or telephone consultancy	• *Training:* occasionally provide further details on lean elements; constant support in problem resolution • *Pressure:* frequently control the subsidiary' status and progress in lean implementation in the macro area Aim: sustain lean implementation and reinforce headquarters-subsidiary relations
		Formal audit (1 week)	• *Pressure:* audit the subsidiary's implementation of lean elements • *Sensegiving:* reward the subsidiary for its progress in lean implementation Aim: sustain lean implementation and reinforce headquarters-subsidiary relations
Late initiatives in the operations macro area: • Network: 3_Op, 6_Op, 9_Op, 11_Op, 16_Op, 19_Op • China: 10_Op, 18_Op • US: 14_Op	• A certain macro area maturity • A certain plant maturity • Strong relations • Wide collaboration	Short-term assignment, short-term study team (1 to 2 weeks)	• *Training:* explain lean practices other than core elements or guide discussion when revising core lean elements • *Sensegiving:* display the high organisational commitment to the programme; recall the importance of lean elements • *Adaptation:* collaborate for jointly define the guidelines for following adaptations Aim: introduce to or revise with the subsidiary/subsidiaries some lean elements and reinforce headquarters-subsidiary relations
		Plant visit and tour (during the assignment or the study team)	• *Training:* guide observations of the *gemba*; exchange different kind of information related to lean implementation • *Sensegiving:* display the high organisational commitment to the programme; recall importance of some lean elements Aim: support the introduction or the revision of some lean elements and reinforce headquarters-subsidiary relations
		Handbook	No actions

(continued)

Initiatives	Contextual conditions*	Mechanism	Actions via a mechanism by the headquarters
		E-mail or telephone consultancy and the intranet (from July	• *Training:* occasionally provide further details on lean elements; constant support in problem resolution; transcribe on the virtual support a detailed description of lean elements as implemented by

		2013)	the various plants (only intranet, once); introduce the new system to subsidiaries (only intranet, once) • *Pressure*: regularly control subsidiary' status and progress in lean implementation in the macro area • *Sensegiving*: put into writing the organisational commitment to the programme and the importance of lean elements (only intranet) • *Adaptation*: constant support and control of the adaptation of lean elements Aim: sustain lean implementation and reinforce headquarters-subsidiary relations
		Formal audit (1 week)	*As for the early initiatives in the operations macro area*
Initiatives in the office macro area: • US: 4_Of, 5_Of, 7_Of, 8_Of • China: 12_Of, 13_Of, 15_Of, 17_Of	• No macro area maturity • A certain plant maturity • Mixed relations • Resistance • Partial collaboration	Short-term residence (1 to 2 weeks)	• *Training*: deeply explain one/few core lean elements • *Sensegiving*: display the high organisational commitment to the programme; highlight the importance and advantages of lean elements • *Pressure*: force lean adoption and give authority to the foreign sub-unit • *Adaptation*: collaborate for jointly define guidelines for adaptations Aim: transfer one/few core lean elements to the subsidiary and develop/reinforce headquarters-subsidiary relations
		Plant visit and tour (during the residence)	• *Training:* guide observations of *gemba*; exchange different kind of information related to lean implementation • *Sensegiving*: display the high organisational commitment to the programme; recall the importance of lean elements • *Pressure:* control the subsidiary' status and progress in lean implementation in the macro area Aim: sustain lean implementation and reinforce headquarters-subsidiary relations
		Handbook	No actions
		E-mail or telephone consultancy and the intranet (from July 2013)	*As for the late initiatives in the operations macro area*
		Formal audit (1 week)	*It's the same event occurred for the late initiatives in the operations macro area*

* Contextual conditions at the beginning of an initiative

TABLE 3 – HVACR's programme: A summary

Appendix

For each bundle/sub-bundle, Table A1 lists the lean elements transferred in the HVACR's multi-plant lean programme (note, headquarters' lean practices that were not transferred, such as supplier development, are not included in Table A1) and provides some examples of their adaptations during the transfer initiatives.

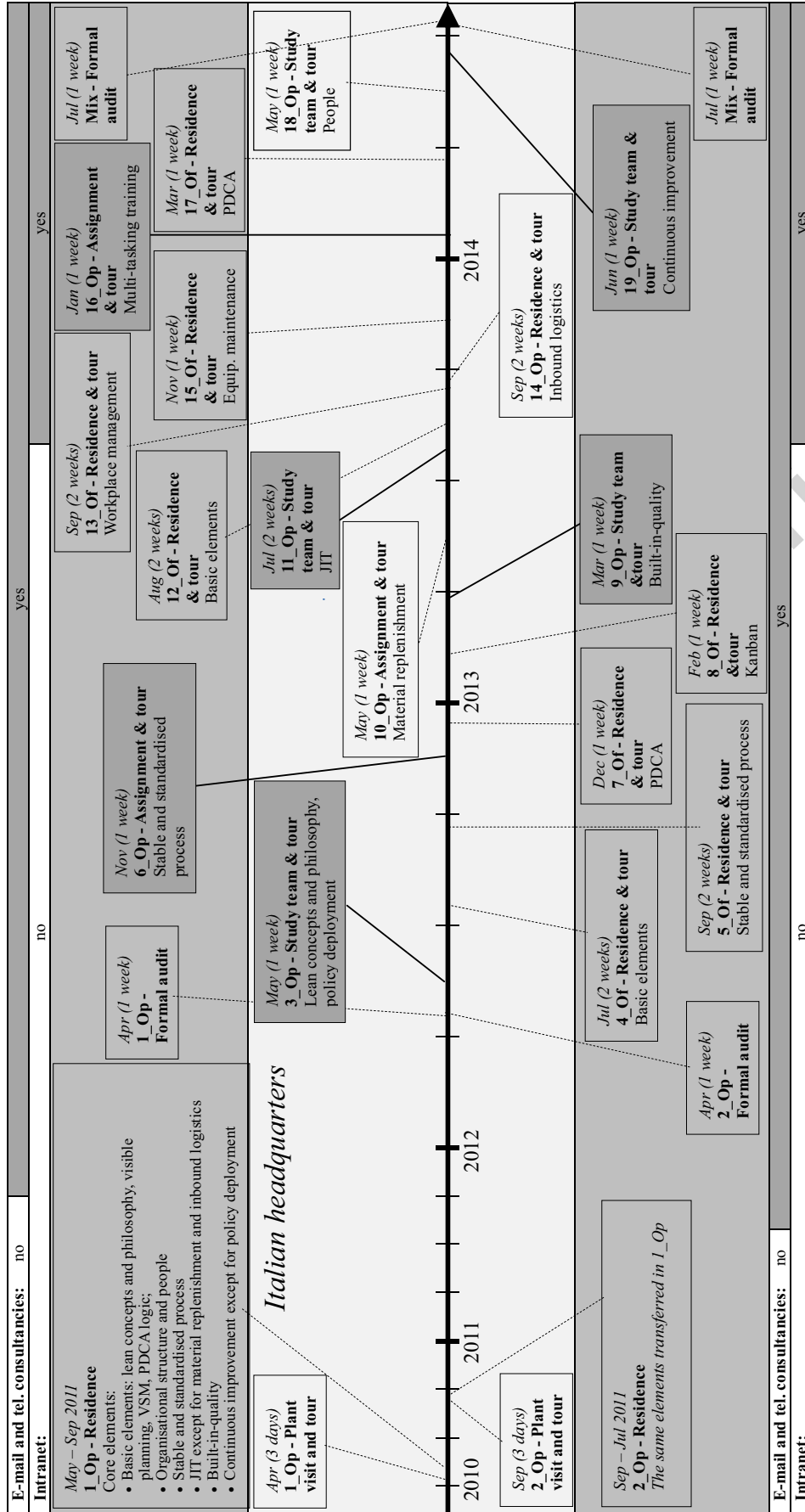| Bundles/sub-bundles	Main lean elements (original headquarters' template)*	Examples of adaptation**
Foundation bundle – Lean concepts and philosophy	• Lean and Womack and Jones' (1996) 5 principles *Note*: customer satisfaction and value should guide lean implementation; elimination of waste on a daily basis to achieve long-term success of the firm. • *Muda*, *muri*, *mura* (i.e., waste, no value added beyond capacity and unevenness, respectively)	• Lean philosophy *(2_Op; orientation towards short-term, concrete performance)*: lean not only as a powerful approach in sustaining long-term success, but also effective in improving short-term, concrete performance (e.g., sale targets can also benefit from improvements through lean) to overcome employees' opposition. • Lean philosophy *(3_Op)*: original headquarters' template.
Foundation bundle – Organisational structure and people	• Flat organisation and value streams • People in the firm should be trained to perform multiple tasks, empowered, encouraged to work in team and properly reward *Note*: training mainly as learning-by-doing in gemba. *Note*: team leaders are made responsible for the achievement of the team's goals.	• People – empowerment *(1_Op; high power-distance and low participation, illiteracy)*: development of ad-hoc checklists (**a**), which can be used by literate and participative operators – i.e., lean leader assistants – to question other operators (**b**). • People – empowerment *(2_Op; orientation towards short-term, concrete performance)*: development of ad-hoc checklists (**a**). • People – teamwork *(1_Op; high power-distance and low participation)*: responsibility for goals' achievement is shared between team members to stimulate everyone's participation (**c**). • People – teamwork *(18_Op)*: original headquarters' template. • People – multi-tasking employees *(16_Op)*: a training cell – i.e., an area in the shop-floor dedicated to train operators – is created in all the plants.
Foundation bundle – Stable and standardised process	• Workplace management (or 5S – *seiri*, *seiton*, *seiso*, *seiketsu* and *shitsuke*) *Note*: visual tools with text and symbols are used (e.g., tool shadow boards, colour coding, tags). • Planned and autonomous maintenance of the equipment • Standardised work • Floor marking • Levelled production (or *heijunka*)	• Workplace management *(1_Op; high power-distance and low participation, illiteracy)*: checklists for employees and lean leader assistants (**a,b**) for supporting 5S implementation; text in tags and other visual tools is replaced by symbols/photos. • Standardised work *(1_Op; high power-distance, illiteracy, high employee turnover)*: text in work instructions is replaced by symbols/photos; more detailed work instructions; the number of actions in some station is reduced.
		(continued)

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Bundles/sub-bundles	Main lean elements (original headquarters' template)*	Examples of adaptation**
Just-in-time (JIT)	• Value stream mapping (VSM) *Note*: (1) the VSM in a macro-area should start with the most critical value stream; (2) VSM activities are carried out by a team of people, while a person – i.e., the value stream leader – is appointed as the process owner. • Equipment layout for continuous flow • Pull system including *kanban* • Quick changeovers (or single-minute exchange of dies (SMED)) • Inbound logistics • Material replenishment (or water spider)	• *VSM (1_Op; high power-distance and low participation)*: all team members share responsibility for VSM (i.e., no one leader, [c]); stimulate participation through a checklist [a]. • *VSM (2_Op; orientation towards short-term, concrete performance)*: VSM starting from the value stream with the simplest and quickest potential improvements; stimulate long-term thinking and customer orientation through a checklist [a]. • *VSM (11_Op)*: original headquarters' template for responsibility and value stream selection; development of a common "VSM checklist".
Built-in-quality	• Daily control *Note*: (1) four main reason of deviation are classified in the daily control chart in the cell boards – i.e., men, machine, material, method; (2) every hour, operators quickly discuss deviations and one of them – on a rotating basis – fill the chart. • Andon (or stop-the-line)	• *Daily control (1_Op; high employee turnover, high power-distance and low participation, illiteracy)*: employee layoff is added as a fifth main reason for deviation; lean leader assistants are put in charge of questioning other operators by using a checklist [b] and fill the chart. • *Daily control (9_Op)*: development of a common "Daily control checklist"; lean leader assistants are put in charge of questioning other operators by using such a checklist and fill the chart in the all the plants.
Continuous improvement	• Improvement suggestions and problem-solving (or plan-do-check-act (PDCA)) *Note*: (1) operators themselves have to fill out activity-cards during their day shift and placed them in a specific area of the cell board; (2) weekly dedicated meetings for jointly discuss suggestions and activity-card status; (3) thermometer boards with green, yellow and red zones to show priority of ideas/problems. • Visible planning • Policy deployment (or *Hoshin Kanri*)	• *PDCA (1_Op; high employee turnover, high power-distance and low participation, illiteracy)*: lean leader assistants are put in charge of regularly questioning other operators by using a checklist [b] and fill out activity-cards with their suggestions; dedicated meetings every shift for jointly discussing suggestions, opening new activity-cards and tracking activity-card status. • *PDCA (19_Op)*: standardise weekly meetings organised around 3 points: opened activity-card status, discussion of single person's new ideas, teamwork for developing ideas/solutions to problems in the all the plants; impact-difficulty matrix to show priority of ideas/problems in the all the plants.

Legend: (*) A note can provide some details on a lean element relevant for understanding the modification/s on the side

(**) The initiative in which the lean element was adapted, along with the foreign peculiarities targeted (when applicable) are indicated in brackets

TABLE A1 – Lean elements transferred in the HVACR's multi-plant lean programme

E-mail and tel. consultancies: no / yes
Intranet: no / yes

May – Sep 2011
1_Op - Residence
Core elements:
- Basic elements: lean concepts and philosophy, visible planning, VSM, PDCA logic;
- Organisational structure and people
- Stable and standardised process
- JIT except for material replenishment and inbound logistics
- Built-in-quality
- Continuous improvement except for policy deployment

Apr (3 days)
1_Op - Plant visit and tour

Sep (3 days)
2_Op - Plant visit and tour

Apr (1 week)
1_Op - Formal audit

May (1 week)
3_Op - Study team & tour
Lean concepts and philosophy, policy deployment

Nov (1 week)
6_Op - Assignment & tour
Stable and standardised process

May (1 week)
10_Op - Assignment & tour
Material replenishment

Jul (2 weeks)
11_Op - Study team & tour
JIT

Aug (2 weeks)
12_Of - Residence & tour
Basic elements

Sep (2 weeks)
13_Of - Residence & tour
Workplace management

Nov (1 week)
15_Of - Residence & tour
Equip. maintenance

Jan (1 week)
16_Op - Assignment & tour
Multi-tasking training

Mar (1 week)
17_Of - Residence & tour
PDCA

Jul (1 week)
Mix - Formal audit

May (1 week)
18_Op - Study team & tour
People

Italian headquarters

2010 2011 2012 2013 2014

Apr (1 week)
2_Op - Formal audit

Sep – Jul 2011
2_Op - Residence
The same elements transferred in 1_Op

Jul (2 weeks)
4_Of - Residence & tour
Basic elements

Sep (2 weeks)
5_Of - Residence & tour
Stable and standardised process

Dec (1 week)
7_Of - Residence & tour
PDCA

Feb (1 week)
8_Of - Residence & tour
Kanban

Mar (1 week)
9_Op - Study team & tour
Built-in-quality

Sep (2 weeks)
14_Op - Residence & tour
Inbound logistics

Jan (1 week)
19_Op - Study team & tour
Continuous improvement

Jul (1 week)
Mix - Formal audit

E-mail and tel. consultancies: no / yes
Intranet: no / yes

Legend: White rectangles concern dyadic initiatives with the Chinese (above the timeline) or the US (below the timeline) subsidiary, while grey rectangles concern network initiatives. Rectangles are placed in the area of the figure corresponding to the plant where the initiative occurred. Initiatives are numbered in ascending order (from *1* to *19*) according to when they occurred and are coded as *Op* or *Of* depending on where they took place (i.e., operations or office macro area, respectively). *Mix* means that the mechanism is associated with various initiatives. *Tour* is an abbreviation for plant visit and tour. The white and grey areas at the top and the bottom of the figure show if e-mail and telephone consultancies and the intranet were used to exchange information on the programme between the headquarters and the Chinese and the US subsidiary, respectively.

FIGURE 1 – HVACR's programme