COUNTRY - SPECIFIC BARRIERS TO IMPLEMENTING LEAN PRODUCTION SYSTEMS IN CHINA

By

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LIST OF ABBREVIATIONS

ABS - Anti-lock brake system

CI – Continuous improvement

CIP – Continuous improvement process

CV – Curriculum Vitae

ECU – Electronic control unit

FIE - Foreign-Invested Enterprise

FIFO – First in first out

HR – Human resource

HRM – Human resource management

IP - Intellectual property

JIT – Just in time

Lean – Lean production

MIT - Massachusetts Institute of Technology

PCB - Printed Circuit Boards,

PDCA – Plan–do–check–act also known as the ‘Deming circle’

QC - Quality control

QCC - Quality control circles

SME – Small and medium-sized enterprises

SMWT - Self-managed work team

SOP – Start of production

STS – Socio-technical system

TPM - Total productive maintenance

TPS - Toyota production system

TQM - Total quality management

US – United States

FMEA - Failure mode and effect analysis

ABSTRACT

This thesis examines barriers to the implementation of Lean production systems in China. The aim is to evaluate how implementation barriers affect a Lean production system, and whether they can be explained by Chinese national context factors. The thesis also aims to investigate the mechanisms by which such context factors influence the barriers. A socio-technical systems (STS) perspective is taken to interpret the relative importance of, and the interplay between, the social and the technical barriers to Lean implementation in China.

To achieve the aims of the study, a multiple case study approach was chosen. I collected data at two Chinese plants of a globally-operating German automotive supplier in Suzhou and Changsha. As the main method of data collection, I conducted sixty qualitative interviews with Chinese and Western employees during a two month research trip to China. Using an iterative procedure of data collection and analysis, I developed a model that captures barriers to implementing Lean in China, the effects of these barriers on the production system, and influential context factors. Based on respondents' perceptions, I identify six main implementation barriers, namely: 'High employee turnover', 'Weak supplier performance', 'Market conditions', 'Lack of Lean knowledge', 'Intercultural communication', and 'Work styles'. The analysis highlights the effects of the barriers on specific elements of the Lean production system, and mechanisms by which the context factors influence the barriers. By exploring these mechanisms, I found strong evidence that Chinese context factors act as root causes or catalysts for the implementation barriers. The findings are corroborated through a comparison of the results obtained from the two locations in China, reports by Western and Chinese employees, and respondents at different hierarchical levels of the organisation.

Through the Lean implementation model, this research contributes to the literatures on international Lean manufacturing and socio-technical systems. The study is the first to provide detailed empirical evidence of six main barriers, and to describe thoroughly why each barrier was a burden for Lean. The thesis also contributes to the Lean literature by demonstrating how the national context of China can create barriers and therefore play a significant role when implementing Lean in China. The central claim of the study is therefore that implementation barriers do exist in China and that a greater focus on these barriers is required in order to gain a better understanding of Lean implementation in this context. With regard to STS theory, the study highlights that the main perceived barriers to Lean implementation were situated within the social sub-system of Lean, and that some aspects of the barriers were created through a lack of joint optimisation of the social and the technical sub-system. The study therefore shows that STS theory is applicable to the context of Lean systems, and that it facilitates our understanding of barriers to the socio-technical Lean system.

The study yields recommendations on managerial strategies for implementing Lean production in China, regarding people management as well as the adjustment of manufacturing facilities. A consideration of the national context can help practitioners to fully understand the causes of implementation barriers in China and, through this, to overcome these barriers. The thesis is concluded by reflecting on its limitations and suggestions for future research.

Key words: Lean, China, implementation, barriers, context factors, Lean production system, country context.

CHAPTER 1

1 Introduction

Intense competition in hotly contested markets, rising customer claims and high technology dynamics place high demands on industry. Further challenges are posed by the increasing differentiation of products and efforts of globalisation (VDA, 2005). Enterprises, therefore, have to ensure that their products are customer-oriented, of high-quality and at the same time, cost-effective. Global operating companies try to reach these objectives by using the established operational strategy of Lean production systems, aiming to reduce inventory, enhance process efficiencies, and eliminate waste. Moreover, many companies, multinationals as well as niche players, set up manufacturing facilities in the growing market of China. This opens up the opportunity for lower labour costs and higher profit margins. However, production and labour costs in China are increasing. This makes it important to implement Lean production systems in China successfully. To connect the manufacturing potential of China with the efficiency of the Lean philosophy is a major future challenge for the emerging global marketplace. How can Lean production systems, which have been refined for two decades in Western firms, be established successfully in China, where massive cultural, socio-political and economic differences to the Western world exist and are likely to create barriers to the implementation of Lean? An understanding of these Chinese context factors will help overcome such barriers and facilitate the successful implementation of lean production systems in China.

To develop our understanding of how Lean production systems can be successfully implemented in China, this thesis examines the main barriers to implementing those systems. Moreover, it establishes whether the barriers can be explained by country context factors, such as cultural, socio-political and economic factors. Evidence is drawn from a case study in a German, globally-operating, multinational automotive parts supplier. Findings are based on 60 qualitative interviews with Chinese employees and Western expatriates at two production plants of this firm in China, one in Changsha in the mainland and one in Suzhou, near the coastal belt. From the findings, a ‘Lean implementation model China’ is developed, which indicates the main implementation barriers and linked context factors, and states the effects of the barriers on the production system. A socio-technical systems perspective is taken to interpret the relative importance of, and the interplay between, the social and the technical barriers to Lean implementation in China. The model contributes to the literatures on international Lean manufacturing and socio-technical systems. It provides recommendations for managerial strategies to implement Lean production in China, regarding people management as well as the adjustment of manufacturing facilities.

After the current introduction (Chapter 1), Chapter 2 introduces socio-technical system theory and explains why this theory is useful for studying Lean implementation barriers and their national context factors. The review aims to make the reader aware of the core ideas of the socio-technical system approach, in particular the design precept of ‘joint optimisation’. This precept suggests that the implementation of a production system leads to the introduction of new technical processes alongside new working practices. The core ideas of socio-technical system theory will be used to distinguish whether barriers, or their root causes, are grounded in the social or the technical sub-system of Lean, and to investigate whether social and technical aspects work together and yield the desired outcomes when implementing Lean production systems in China.

A short comprehensive review of the principles embedded in Lean production will be the subject of Chapter 3. This chapter will present the main elements and the terminology of Lean. This consideration of the Lean fundamentals will give the reader an understanding of Lean production and outline which Lean elements are important in the implementation process. The basic concept of

Lean is also explained to prepare readers and allow them to comprehend why specific phenomena mentioned in the literature might act as barriers to Lean implementation.

Chapter 4 and 5 provide a review of the international Lean literature, and highlight the barriers to Lean implementation that other researchers have described in the contexts of emerging economies and China. This literature review underscores my argument that the national context of China is likely to create barriers and therefore play a significant role when implementing Lean in China.

Firstly, (Chapter 4), the study investigates Lean-related research conducted in the emerging economies of Brazil, India, and Mexico. The review provides an overview and appraisal of the main examined barriers in these countries. Based on the similar country context factors of China compared to other emerging economies, it is likely that there are parallels between barriers when implementing Lean in emerging economies and China. Accordingly, I also show that researchers have identified partly similar implementation barriers in Brazil, India and Mexico. A comparison of similarities and differences of the implementation barriers in emerging economies will help determine which barriers are country-specific and which are more generic. Secondly (Chapter 5), I take a more narrow focus and provide a comprehensive listing of the main barriers that are indicated by prior research on Lean in manufacturing plants in China. I will demonstrate that prior research only hints at such implementation barriers in a fragmented manner. However, the review will categorise the indications of barriers and group them into main implementation barriers. These barriers will later be discussed and compared to the data collected in the study. Chapter 5 concludes by presenting the research questions for this thesis. Chapter 6 describes the methodological approach that is adopted to address the research questions. To examine the implementation barriers and investigate the participants' perceptions on the role of the national context, it is important not to deploy the researcher's own preconceptions. The research questions are therefore fairly open, in order to allow for specific implementation barriers and influential factors to emerge from the participants' reports. At the same time, the study aims to transcend the participants' own accounts, by developing a theoretical model which captures the main implementation barriers and highlights the mechanisms by which context factors create barriers. For these purposes, qualitative methods of data collection are chosen as most appropriate. I justify the use of a case study approach, and discuss the methods of qualitative interviewing, document analysis and observations.

Chapter 7 presents the results of the study. A number of external and internal implementation barriers are identified and described, namely, 'High employee turnover', 'Weak supplier performance', 'Market conditions', 'Lack of Lean knowledge', 'Intercultural communication', and 'work styles'. The effects of these barriers on the Lean production system are explained. I have taken this perspective to highlight that the barriers are especially evident when applying Lean rather than traditional production systems. I further emphasise the mechanisms by which national context factors influence the barriers. These findings are summarised in a China-specific implementation model, which allows for a detailed and holistic understanding of the effects of barriers on the Lean elements. To illustrate these links for each barrier, sub-models are presented, which indicate the effects of each particular barrier on the Lean production system, and the links between the barrier and certain context factors. The models illustrate how China's national context influences the implementation barriers. This analysis leads to the observation that context factors are either root causes or catalysts for the barriers.

In Chapter 8 I discuss the study findings. Here, I first conduct an in-depth comparison of the findings obtained in different participant groups. I conduct comparisons between (a) the location and the maturity of the case study plants, (b) between the views of Western and Chinese participants, and (c) participants at different hierarchy levels. These comparisons serve to scrutinise whether the Lean implementation model generalises across the two sites and the different participant groups, or whether it depends on any specific context or group characteristics. Where relevant, I will refer to available research and highlight the contributions of the study to this research. Through this discussion, I demonstrate the relevance of the Lean implementation model and its value for our understanding of Lean implementation across the participating sites in China.

In the second part of the discussion chapter, I analyse each barrier with regard to (a) prior research, (b) links to Chinese context factors, and (c) the socio-technical systems perspective. I argue that through an in-depth analysis of the barriers in China, my study considers the implementation process in much more depth than other researchers have done before. Furthermore, I argue that this study is the first to demonstrate the mechanisms by which context factors influence Lean barriers, which further strengthens the evidence that the national context influences Lean implementation. I then consider the barrier from a socio-technical perspective. In particular, my research provides evidence that it is crucial to consider the social sub-system of Lean beside the technical sub-system in order to achieve successful Lean implementation.

In Chapter 9 I conclude the thesis by highlighting what research gaps my study fills and how the findings help to gain a better understanding of Lean implementation in different country contexts. By demonstrating previously neglected barriers and categorising other researchers' barriers in a more comprehensive manner, the study contributes to a more holistic understanding of Lean implementation in China. As one of its central contributions, the study provides empirical evidence for the main Lean implementation barriers in China, and it describes thoroughly why each barrier was a burden for Lean. These findings also contribute to our understanding of barriers in other emerging economies, given the overlap with the literature on Lean in emerging economies.

Another central finding is that a number of context factors, and mechanisms by which they create barriers, are specific to the Chinese country context. For example, the findings highlight that cultural factors within China, such as Guanxi connections, the “concept of face”, single child policy, and high power distance were seen as root causes of barriers. These Chinese-context factors seem to be particularly influential when implementing Lean compared to other production systems.

In the second part of Chapter 9 the practical implications of the study are drawn together. Here, I give recommendations for practitioners on how they can use the study findings to overcome the identified barriers. For each of implementation barrier, specific practical implications are suggested**.** Chapter 9 ends with a consideration of some of the study’s limitations, which are then linked, in turn, to suggestions for future research.

CHAPTER 2

2 Review of socio-technical system theory

2.1 Introduction

The present chapter introduces socio-technical system theory and explains why this theory is useful for studying Lean implementation barriers and their national context factors.

Existing studies which explore country-specific barriers within Lean in China pay only limited attention to significant human dimensions. By contrast, socio-technical system (STS) theory, and in particular its principle of 'joint optimisation', suggest that social and technical aspects of a system need to work together to allow the system to produce desired outcomes. With regard to production systems, this means that the implementation of a new system requires the introduction of new technical processes (technical aspects) alongside new working practices (social aspects).

STS theory is helpful for the current research because not only the technical but, even more so, the social sub-system of a production system is likely to be influenced by the national context. The need to consider both sub-systems stressed by STS theory therefore promises to help in understanding the emergence of implementation barriers within a production system. Human beings are part of the social sub-system, which is therefore likely to be influenced strongly by their cultural context regarding values, beliefs, and norms; and more so than the technical sub-system. The consideration of the STS theory should therefore provide a theoretical explanation for the importance of taking into account human factors and their country context, and their interaction with technical aspects.

The following review of socio-technical systems theory stresses the need within the implementation process to consider both technical and social dimensions of

Lean production system, and prepares the reader for the case study observation that a number of barriers emerged because the social and technical sub-system did not work together satisfyingly.

Instead of striving for completeness, the following provides a compressed overview of STS theory and its key principles. The chapter starts with a short summary of the theory's historical background. I then explain the main principles of socio-technical theory and highlight their significance for the thesis.

2.2 Historical background

The socio-technical concept arose in conjunction with several field projects undertaken by the Tavistock Institute in the British coal mining industry (Trist, 1981). Eric Twist and his fellow researchers invented the STS approach as a reaction to labour unrest and disappointing productivity in relation to mechanisation (Emery, 1959). In the 1950s, Eric Twist and his fellow researchers investigated coal mines where new production systems had been implemented. The management's intention to increase the mine's productivity by implementing a new and more advanced technology had failed. The Tavistock researchers explored the lack of productivity and helped to restructure the negative consequences of a recently implemented production method, which was called 'long-wall method'. The message was clear: a technological change that appears quite rational from a pure engineering perspective can disrupt the existing social system so as to reduce greatly the anticipated benefits of the new technology (Appelbaum, 1997). The findings of the Tavistock institute laid the foundation of the STS approach[1].

[1] More information about the Tavistock mining studies can be found in the book 'Organisational Choice: The Loss, Rediscovery and Transformation of a Work Tradition' by Trist et al. (1963).

2.3 Principles of socio-technical systems theory

Socio-technical systems theory is based on the idea that an organisation or a work unit is a combination of social and technical parts (Trist et al., 1963). In its core, the STS approach advocates a balance between the social and the technical sub-system of production systems (Dankbaar, 1997). The technical system includes the equipment and methods used to transform raw materials into products or services (Cummings, 1994). Within a production plant this can include, for example, not only machinery such as the assembly lines, but also Lean methods such as Kanban systems, the 5S housekeeping tool and TPM maintenance plans. The social system is experienced through the organisation's culture, norms, roles and communication patterns as well as through a network of social relationships and behaviour patterns that develop over time (Harvey and Brown, 1992). Within a production plant the social system includes for example, interactions and social relationships between workers and their supervisors, and the employees' job satisfaction and motivation.

Socio-technical system theory claims that within the system, social and technical elements have to work together to yield positive outcomes; this is called joint optimisation (Appelbaum, 1997). Joint optimisation requires that the technical and social systems are no longer to be maximised as independent bodies, but maximised simultaneously (Drenth et al., 1998). The design and performance of new systems can only work satisfactorily, if 'technical' and 'social' are brought together and treated as interdependent aspects of a work system (Clegg, 2000; Klein, 1994). In other words, joint optimisation intends to reach the 'best match' between technical and social aspects of a system.

The core ideas of the socio-technical systems approach is often seen as an attempt to avoid technology-led implementations in work design (Blacker and Brown, 1986). Those implementations which focus mainly on the implementation of technological aspects are likely not to meet the expectations of the system designers or managers, or even fail. Various social aspects of the socio-technical system have to be taken into account. For example, Emery and Trist (1965) revealed that improvements in the technical system do not always result in higher productivity or effectiveness, if the social system is not supportive and able to cope with any stresses it places on its members (Cummings, 1994). Clegg (2000) added that numerous studies have shown that the implementation of new technical innovations and modern management practices, which should lead to an increase in productivity, did not succeed.

Attempts to change the technical and/or social system must thus be mindful of the relationship between the two systems (Vecchio and Appelbaum, 1995). This method contrasts with traditional methods that first design the technical component and then fit people to it. The traditional methods often lead to mediocre performance at high social costs (Appelbaum, 1997). This is why detailed attention to the requirements of both the social and technical systems are required if the organisation's aim is to maximise the total output of the production system (Emery and Trist, 1965). For a more extensive introduction to socio-technical systems design and extensive bibliography, see Van Eijnatten (1993).

2.4 Significance of the socio-technical systems theory for the study

The implementation of a production system leads to the introduction of new technologies and technical procedures, and new management and working practices. Following the socio-technical perspective, system managers and users need to ensure that social and technical elements work together and yield positive outcomes. When western companies implement their own company internal Lean production system in China, this system had to be adjusted and therefore evolved to a new design.

Regardless of whether the ‘new’ production system is designed according to socio-technical design principles or not, the implementation of production systems in an organisation always includes social and technical aspects. Moreover, regardless of whether the system managers and users explicitly call the system ‘socio-technical’, it can be interpreted as such. Labelled as ‘socio-technical’ or not, changes and adjustments in socio-technology will happen when implementing Lean production in China. Therefore, especially when implementing an adjusted production system, practitioners need to consider the core ideas of the socio-technical systems approach to ensure joint optimisation.

In this study, the core ideas of STS theory are used to investigate whether social and technical aspects are equally applied when implementing a Lean production system in China. Because of the landmark papers by Cherns (1976, 1987) and Clegg (2000), which introduce a set of socio-technical principles to guide system design, the socio-technical approach might sometimes be mistaken as exclusively applicable to guiding system designers who invent new systems such as production systems or IT systems. Therefore, it could be argued that the STS approach is not applicable when investigating the transfer of a production system to a different cultural context. However, because of the versatile applicability of ‘joint optimisation’ within the STS approach, I argue that the STS approach can also be beneficial when implementing a production system in a different country context. With respect to these technical and social dimensions, the STS process seeks to help organisations (1) understand the implementation barriers in relation to country context factors, (2) to be aware of the importance of human aspects and (3) their interrelation with technical aspects, and (4) assess ways to overcome the barriers or implement counter measures. This is in line with Hackman and Oldham (1992) who explain the wide application of the STS approach due to its generality. It has the capacity to be adopted to almost any organisational situation and remains open to continual improvement and revision (Hackman and Oldham, 1992).

It is likely that when an organisation implements a Lean production system in China, social context factors play an important role. Arguably, only if systems managers and users consider both social and technical aspects, can the implementation lead to an increase in Lean productivity and employee wellbeing. In China, as in the early Tavistock studies in the UK, there might be the risk that a technological change (implementing Lean production) that appears quite rational from a pure engineering perspective can disrupt the existing social system so as to reduce greatly the anticipated benefits of Lean manufacturing. A disregard of the socio-technical approach, and especially joint optimisation, can thus lead to a technological driven implementation and fail to meet the expectations of systems managers and users within the host country. In the following, I will review the application of STS theory to Lean systems thinking within the operations management literature, demonstrating the need for further research using this lens.

2.5 Socio-technical system theory within operations management literature

With regard to the operations management, researchers use socio-technical system theory in two major ways. In some of the literature, production systems which were designed or adjusted according to socio-technical design principles are considered as an independent production paradigm (e.g.: Mumford, 2000). Other researchers regard the Lean production system as a socio-technical system and stress that applying STS theory to Lean contributes to our understanding of Lean implementation (Paez et al., 2004).

The paradigm view - consideration of Lean production and STS shaped production systems as a separate production paradigm: A large body of academic research explores various facets of different production systems, comparing, for example, Lean production, the Fordist mass production paradigm, and production systems shaped by socio-technical design principles (e.g.: Kuipers et al. 2004, Hummels and Leede, 2000; Dankbaar, 1997; Niepce and Molleman, 1998; Sandberg, 1995; and Medbo, 1994). Most of this research adopts a production paradigm focus, investigating which production paradigm might be best to be used in terms of effectiveness of the operations, product quality, and work quality etc.

In the socio-technical systems design, much attention is paid to the theoretical foundations of a new production paradigm. The socio technical approach contrasts with traditional methods that first design the technical components and then fit people to it (Appelbaum (1997). As a consequence, there are several studies within the STS literature which elaborate on whether or not the basic elements of certain production systems are in line with socio technical system design principles. These STS design principles introduced by Cherns (1978) are used by system designer as a body of theory that promotes joint optimisation of the social and technical sub-systems in the context of the organisation's business environment (Taylor and Felten, 1993; Pasmore, 1988). Much attention has been paid to the development of design principles for the use of semi-autonomous groups in production (Hummels and Leede, 2000). One famous example of a production system which considered socio-technical design principles was Volvo's auto plant in Uddevalla, Sweden, which emerged in the 1990s. Particularly within the automotive industry, discussions arose about the pros and cons of STS design compared to different forms of traditional lean production (Dreth et al., 1998). Within this debate, the "Uddevalla plant" is mentioned frequently. The Uddevalla plant was a Swedish Volvo factory in Uddevalla, where sociotechnical experiments were being carried out (cf. Sandberg, 2007; Dankbaar, 1997; Berggren, 1994). The major differences to other plants was the shift to a complete parallelisation of the final assembly process. However, even researchers who adopt the paradigm view, such as Hummels and Leede (2000), stress that the similarities of Lean production and socio-techncial system design are manifold. In both systems, great attention is paid to the primary process and adding values, which results in an organisation that is client-driven. Moreover, in both paradigms, integration of processes into product-oriented or market-oriented components is sought, rather than functional division of labour (Hummels and Leede, 2000). Both concepts also view the team as the building block of the organisation (Hummels and Leede, 2000).

Authors who take on the paradigm view stress that the team structure itself is different in Lean production compared to socio-technical system design (Hummels and Leede, 2000). These differences are related to the coordination mechanisms that are used. In Lean production, the work processes are carefully designed and standardised, aiming to achieve a perfectly balanced production system, in which everyone works at the same pace to develop exact standards for each process (Hummels and Leede, 2000). In STS on the other hand, employees have autonomy, although within certain limits, over their work pace, working procedures, and detailed scheduling (Hummels and Leede, 2000). Hummels and Leede (2000) conclude that there are some major differences, in that Lean focuses specifically – although not exclusively – on the contribution of the individual to the overall result, whilst STS design aims primarily at achieving the organizational objectives, by realising the full potential of the worker. It is by creating an environment where the team can decide more or less autonomously that STS design furthers the interests of the organization.

The auto plant in Uddevalla with its production system which was labelled as STS production system closed in 1993. No other car manufacturer followed up the same production system with its parallel-flow work principles as it was used in Sweden. When the management decided to close the plant, a new debate on the effectiveness of production systems which were designed according to STS design principles arose. In the following years, supporters of the system saw the reasons of the failure of the production system in the economic conditions and declining demand for automobiles that Volvo had to face. Supporters of the traditional Lean production paradigm regarded the failure of the production system as a proof that Lean production with its moving assembly line was superior to the STS paradigm, and would be the production paradigm of the future.

The strict separations within the paradigm view between Lean and socio-technical production systems neglects the fact that Lean manufacturing and STS design have very different origins. Lean production has its origins in best practise methods of the Japanese automotive industry, whereas the sociotechnical principles developed by Cherns (1976, 1987) and Clegg (2000) are broad and theoretical design principles. Lean emerged from the context of Toyota. Therefore, the principles used by Lean are not unique and exclusively applied within Lean. The ‘grown’ and non-theoretical background of Lean may explain overlaps of Lean production and production systems which are designed according to STS design principles. As mentioned earlier, I will not open this debate again and question whether lean production systems or other production systems based on Taylorist models are in line with the theoretical sociotechnical design principles. It would go beyond the scope and the intention of the study to raise the question of whether there is a superior production system which allows a more human and more effective way of industrial production. Hence, the current study does not follow a paradigm view and does not address the question whether there are ways to create a superior production system which allows a more human and more effective way of industrial production.

The STS framework will instead be used to demonstrate that Lean can be regarded as a socio-technical system and that the application of STS theory to Lean contributes to our understanding of Lean implementation. The focus of STS theory on a successful interplay between social and technical sub-systems, i.e. joint optimisation, will be used to demonstrate the applicability of STS to Lean. Taking a socio-technical perspective helps us to gain a better understanding of the implementation barriers, and therefore contributes to the understanding of the implementation of Lean in China.

The Lean literature stresses the importance of humans (employees) for a successful implementation of Lean (e.g. Liker, 2004; Womak et al., 1990; Ohno, 1988). It seems apparent that Lean production and their embedded central role of humans can be considered as a socio-technical system. Surprisingly, Lean production systems have rarely been viewed as socio technical systems. When looking at the operations management literature, most of this research can be characterised as technically focused, looking at production paradigms which were designed by considering the STS design principles, but giving only limited attention to the benefits a STS theory would have when transferring to the Lean implementation (rather than just applying it on the design level).

Some of the few reasearchers taking a socio-technical perspective when analysing Lean production are Paez et al. (2004) and Genaidy and Kartowski (2003). In their paper, Paez et al. (2004) define Lean as a socio-technical construct since it is based on the combination of human and technological sub-systems. Paez et al. (2004) consider Lean production as an evolutionary sociotechnical design, since it relies on the active interaction of individuals with the work design. At the same time, they categorise specific Lean elements into the technical and the social sub-system. They observe that the technical sub-system moves around three sets of practices: the Kanban system, production smoothening, and Autonomation (Paez et al., 2004). The social sub-system consist of work force capabilities demanded by Lean: creative thinking, problem-solving focus, and teamwork (Paez et al., 2004). Similarly, Genaidy and Kartowski (2003) stressed that Lean has been emerging as an important socio-technical system that can be used by manufacturing firms to achieve and sustain high productivity and high quality. Such application of STS principles to Lean is in line with Niepce and Molleman (1998), who claim that Lean production has universal value and that STS principles are generally applicable, in the same vein they suggest that elements of one system can easily be adopted by the other.

When considering publications which have taken a socio-technical perspective on Lean, it needs to be mentioned that these studies do not go far enough in assessing the relative importance of the social sub-system of Lean, and in showing barriers created by a mismatch of social and technical elements with the implementation of Lean. We know very little about causes of implementation barriers. However, prior evidence seems to suggest that human issues are often at their root (Humber and Brown, 1991). The question that must be answered is to what extent STS theory can contribute to the understanding of implementation barriers and how to overcome them.

To conclude, some operations management researchers consider production systems, like the Uddevalla plant, as socio-technical production paradigms, whereas other researchers consider Lean production as a sociotechnical system (Paez et al. (2004) and Genaidy and Kartowski (2003). The present study takes the latter view and applies socio-technical principles to Lean production. By adopting the STS perspective on Lean, we can expand our understanding of the applicability of the STS approach to Lean production, especially with regard to 'joint optimization'. It is important to fill this gap, because of the central role of humans in Lean. It is likely that implementation barriers are based on the social sub-system, or that barriers result of an inharmonious interplay between technical and social sub-system. Especially when implementing a production system in China (in a country context very different than to the western headquarters from where it was transferred), it may be important to consider the human aspects (social sub-system) within the implementation process. To be aware of these potential mechanisms behind the barriers may be crucial in order to fully understand them and introduce countermeasures.

By taking on a socio-technical system perspective on Lean, I will provide an integrated view on the interactions of human and technological elements within Lean.

2.6 Definitions of social and technical sub-systems with regard to implementation barriers

When examining implementation barriers, it is likely that some barriers are grounded in a mismatch of the technical and social sub-system. Therefore it is important to define what is meant when mentioning technical and social sub-system. Several definitions are available, but most of them follow similar themes. Pasmore, Francis, Haldeman, and Shani (1982) have integrated definitions from several sources to develop the following descriptions of the technical and social subsystems. Huber and Brown (1991) also adopted and further adjusted the definitions by Pasmore, Francis, Haldeman, and Shani (1982) which are presented below:

The technical System: "The technical sub-system of an organization consists of the tools, techniques, procedures, skills, knowledge, and devices used by members of the social system to accomplish the tasks of the organization . . . the technological configuration chosen by organization designers constrains the operation of the social system by shaping the behaviours required to operate it. The level of variety, challenge, feedback, control, decision making and integration provided for social system members is largely a function of the way in which the technology is arranged." (p. 1184) (Emphasis added by Huber and Brown, 1991).

Within Lean production, the technical sub-system includes technical facilities (operator work places and work processes), the work place lay out (cell design), working standards, and tools such as 5S, Poka Yoke, Andon system, or other technical quality control mechanisms.

The social system: "The social sub-system of an organization is composed of the people who work in the organization and the relationships among them. More broadly, the social system includes the reasons that organizational members choose to work in the organization, their attitudes toward it, their expectations of it, patterns of supervisory-subordinate relationships, skill levels of employees, and the nature of the subgroups within the population."(p. 1183).

Within Lean production the social sub-system includes the employees' attitudes, beliefs, motivations, work styles, interactions among employees. Given the importance of the operators' contributions to Lean elements such as continuous improvement, important attitudes of the operators includes; the motivation and ability to suggest improvements within the production process, actively contribute to problem solving, strictly following standardised working processes and procedures to ensure a stable production process.

According to the principle joint optimisation, these two definitions indicate that if you change the technical 'arrangement' or facilities of a system, you also change the nature of the social interactions among employees and the reactions to the technical change. These social changes will require careful attention because of their potential to influence employee attitudes and motivation. For example, within Lean production, time and motion studies are often used by engineers to reduce 'waste' through unnecessary operator movement within the assembly process. When engineers now restructure the operators handling process to a new and potential less 'wasteful' process there is a risk that the technical change will affect the employees' attitude and motivation. When after the change the operator feels uncomfortable with the new handling requirements set by the new standard, it's likely that his motivation and consequently his production output drops. Therefore engineers need to be aware of the consequences a change (potential improvement) of the technical sub-system has on the social sub-system and overall an improvement of the entire system is ensured. The interplay between the technical and social sub-system need to be considered and both sub-system need to be adjusted in coherence to ensure joint optimisation.

In this thesis, implementation barriers found in the case studies will be presented. To see to what extent technical or social aspects within a barrier play a role this study will categorise certain barriers in more social and technical barriers. It is very likely that in a production system where humans work on technical facilities every barrier consists to some extent of technical and social aspects and that interlinkages do exist. However, some barriers may be influenced more strongly by social aspects and others more strongly by technical aspects. For example barriers which are mainly grounded in the operators' behaviour, motivation, or other work style aspects may be categorised into barriers within the social sub-system of Lean. The present study will therefore categorise the findings into barrier within the social sub-system and barriers within the technical sub-system. Such a separation is artificial, because every barrier has social and technical aspects and these aspects are always interlinked. However, this approach is useful in order to stress the importance of social and technical aspects for certain barriers and consequently for the success of Lean.

2.7 Alternative theoretical frameworks

This section should give the reader a short overview of other theoretical frameworks which were taken into account to underline the case study results. Because of the interdisciplinary nature of the study, a number of culture and China related theories, but also theories present within operations management where taken into account. The aim of this section is to give the reader some indication of what other perspectives/theories were considered and why these were rejected. The main alternatives to socio-technical system theory which were taken into account were contingency theory within operations management and Hofstede's cultural dimension theory.

Contingency theory was considered as an alternative perspective because the study contributes to the understanding of contextual conditions influencing Lean production and therefore contributes to some extent to contingency research within operations management.

When considering contingencies within OM, Sousa and Voss' (2008) research paper can be seen as the landmark publication about contingencies within OM. They argue that in the last years, research on operations management has become more mature and operations research has begun to shift its interest from the justification of the value of certain operations practices to the understanding of the contextual conditions under which they are effective (Sousa and Voss, 2008). Sousa and Voss (2008) conduct an extensive literature survey to examine the current state of contingency research in operations management. They provide a listing of academic studies which directly address contingency factors affecting OM best practice operations. The listing distinguishes between three contingency factors named 'National context and culture', 'Firm size', and 'Other organizational context variables' (For a detailed listing including references see Sousa and Voss (2008) Table 1 p. 699-702).

The listing shows that there are just a few dozen studies which can be classified as OM contingency studies. Matyusz and Demeter (2011) also noted in their recent publication that contingencies studies are still rarely in the focus of OM publications and the handful of studies that exist usually do not give a very detailed analysis of the topic. The studies form these researchers do provide an indication that there is a gap in research and a need to conduct studies to close this gap and increase our understanding of the application of Lean under different contextual conditions. The present study examines the national context and culture as contingencies and strengthens the importance of these contingency factors for successful Lean implementation. By using case study research and qualitative interviewing, the study gives a detailed picture of the national context and its effects on the performance of Lean. This is in line with the request by Sousa and Voss (2008) to provide contextual richness. The authors stress that within operational management, studies are typically survey-based studies and therefore miss out the contextual richness and the eventual effects the context may have on the performance of the company.

The current study does, however, only contribute to some extent to contingency research, by examining national culture as a contingency and delivering the contextual richness which may allow observing how the national culture influences Lean. However, national culture is only one contingency amongst those named by Sousa and Voss (2008). The study does not contribute to any other contingencies. For example, the study does not aim to examine the influences of contingencies such as the organisational structure or organisational culture on the performance of Lean.

The present study thus delivers insights into the national context, but leaves questions about other contingencies unanswered. Therefore, the study cannot develop more solid conceptual foundations with regard to contingency research. Given the different focus of the study and the limitations regarding a solid contribution to contingency theory as suggested by the OM literature, contingency theory was rejected as theoretical framework for the study.

As another prominent theoretical framework, I considered the five socio-cultural dimensions indentified by Hofstede (1984, 1997). Hofstede's cultural dimensions seemed to provide a useful theoretical framework to underline the importance of national culture within the implementation process of Lean. Hofstede's cultural dimensions could be seen as an explanation for some of the barriers found in the present research. For example, the higher power distance of Chinese employees in comparison to German employees influenced some of the implementation barriers such as lack of problem solving, when operators feared to indicate managers the root cause of the problem. However, culture theory explains only a small part of the context factors and barriers.

The data analysis showed that besides cultural context factors, several societal and economical context factors were influential. For example, the data showed that the economic growth within the Chinese industry was seen as an influential factor within the implementation process, and Hofstede’s cultural dimensions are not applicable to societal and economical factors of China which were seen as important. Therefore, Hofstede’s cultural dimension theory was used by the study to get a better understanding of the emergence of some barriers, in particular when comparing Chinese and German views on the barrier, but not as the principal theoretical framework for the study. Socio technical system theory was finally chosen as the most useful perspective when looking at the implementation process of Lean in China, as it is sufficiently broad, and at the same time sufficient, to explain generic principles underlying the complete model of barriers and context factors that emerged from the study.

CHAPTER 3

3 General consideration of Lean manufacturing

3.1 Introduction

In order to provide the reader with a basic understanding of Lean manufacturing, the present chapter considers the origins of Lean and its underlying principles, and provides an overview of the Lean concept. After considering these Lean basics, the chapter will describe some tools and techniques used within Lean production, in order to give the reader a broad understanding of how they are used and what potential barriers might occur when these tools and techniques are implemented in a different country context.

3.2 The origin of Lean

In order to give the reader an understanding of the origins of Lean manufacturing, the following sub-chapter will classify Lean manufacturing in a wider industrial context.

3.2.1 Beginning of mass production

In the industrial revolution, huge numbers of people moved to cities to operate machines in large factories. The times of traditional craft work were over. The industry was looking for ways of how best to make goods. One solution brought Adam Smith's 'horizontal division of labour'. The idea was to break down complex jobs into simpler and narrower tasks. The workers would become more practised and consequently that would make tasks more efficient (Warr, 1996). Smith's approach enabled the factories to produce goods cheaper by using a less-skilled workforce. Frederick Taylor establish the 'vertical division of labour' also called 'scientific management', where engineers indentified the most efficient way of carrying out a particular task and then designed the job accordingly. This workflow optimisation divided the engineers to the people who determinate how to do the work and the workers to the ones who have to focus on doing, with little or no autonomy over decisions (Warr, 1996). The idea of job simplification laid the milestone for something that is often associated with the birth of modern manufacturing - Henry Ford's moving assembly line.

3.2.2 Ford's moving assembly line

In 1914 Henry Ford opened his conveyor belt driven car factory. Ford followed Tailor's principles by using a standard method for performing a task and using selected workers with appropriate abilities for each job. Through interchangeable parts, standard operations and conveyor belts he invented flow production. Ford's new techniques reduced costs while increasing product quality. Ford called his innovative system 'mass production'. Ford was producing a basic car called the Model T. It was a car that was designed to effectively manufacture. standardised parts and assembly processes that allowed manufacturers to set up huge, special-purpose machinery. With this machinery, it was possible to efficiently produce parts and deliver them directly to the assembly line. With larger and faster machinery, Ford could lower the costs per production process. Combined with the constant production flow, Ford was able to produce low-priced cars in high quantities. However, Ford's system was not flexible. The Model T was just available in very few specifications. Over the years, the customer needs changed, and cars in different body shapes and specifications were needed. The market required a higher product variety. Ford's mass production, with its large specific inventory, was not able to produce in a flexible manner to meet the market requirements.

3.2.3 Toyota

The massive quantities of Ford's production caught the attention of the Japanese industry (Oeltjenbruns, 2000). The Japanese studied North American production methods in the 1930s, and more intensely after the Second World War, with particular attention to Ford’s practices. The founder of Toyota, Kiichiro Toyoda, and the engineer Taichii Ohno investigated the system of Ford, but they did not copy it (Fujimoto, 1999). Toyota began to incorporate some of Ford’s ideas into their production. But to implement it into in the different country context of Japan, they needed to modify Ford’s production system. Liker (2004) and Oeltjenbruns (2000) summarised the economic differences of Japan in comparison to North America as:

- Low demands of automobiles as a result of the Second World War. High investment in machinery as in Ford’s factory was not affordable.
- Heterogeneous structure of the customer market. Diverse customer demand e.g. luxury cars for government members, small passenger cars for citizens and pick-up trucks for the rural population.
- Damaged Japanese economy as a result of the Second World War. Japan’s economy had low capital and foreign currency to invest in new western production equipment.
- High entry barriers to western markets based on strong domestic competition.
- Different labour conditions in comparison to North America and Europe. Japanese employees rejected working in exchangeable parts and working under exhausting conditions. In comparison to the west, where similar revolts took place, Japan lacked a willing immigrant workforce. Japanese companies were therefore forced to adjust their labour conditions.
- Lack of raw materials and capital assets after the Second World War.

By reason of Toyota's financial situation and small market demand for different cars, Toyota was not able to set up different production lines for every model. To use the production lines at full capacity, Toyota needed to produce several kinds of models together. With help of small multi-purpose machinery, Toyota was able to make its production more flexible and adaptable to produce small amounts of different parts. Through further improvements of, for example, the change-over procedures, Toyota was able to change its products more quickly. The resulting flexibility enabled Toyota to respond promptly to Japan's diverse market.

Ford's constant flow in the assembly line made the production process less time-consuming, and the workers were working at full capacity. However, high stock levels were needed to create buffers between the independent work steps. That made the actual process very efficient, but high levels of non-value added inventory reduced the flexibility and dropped the overall efficiency. After studying Ford's production, the Japanese engineers found a way to produce with a constant flow but at the same time with greater flexibility. The engineers at the Toyota factory called their production system Toyota Production System (TPS).

3.2.4 The MIT study

The rapid achievement of Toyota and other Japanese plants that adopted Toyota's principles after the Second World War again caught the attention of western industries. In the late nineteen eighties, the International Motor Vehicle Program at the Massachusetts Institute of Technology (MIT) conducted a study of the performance of the world's automotive industry. The research coordinators Womack, Jones, and Roos concluded the findings of the study in their book 'The machine that changed the World'. They called the Japanese approach of producing things 'Lean Production'. The study indicated that Japanese plants which followed Toyota's production principles achieved high productivity and high quality. Until this point, the general assumption was that production plants generally tend to have either high quality or high productivity. They stated that Lean production is ‘Lean’ because it uses less of everything compared with mass production - half the human effort in the plant, half of the manufacturing space, half the investment in tools, and half the engineering hours to develop a new product in half the time (Womack, Jones and Roos, 1990). This form of production is today known as ‘Lean production’ and will be explained in more detail in the following sections.

3.3 Underlying principles of Lean

To produce high quality products efficiently, Toyota follows five core principles. Womack and Jones (2003) summarised these five principles of Lean in their book *Lean Thinking*: specify value by specific product, identify the value stream for each product, make value-flow without interruptions, let the customer pull value from the producer, and pursue perfection (Womack and Jones, 2003). The authors stated that a clear understanding and application of these principles are essential to implement Lean successfully. In order to give the reader a general understanding of the philosophy behind Lean thinking, a short explanation of the five principles of Lean is presented here:

1. **Specify value for the customer**

   The first principle of Lean thinking is to specify value from the perspective of the end customer. According to Womack and Jones (2003), Lean thinking must start with a precise value definition in terms of specific products with specific capabilities, offered at a specific price, through a dialogue with specific customers. Firms in general tend to produce products which require explanations of why the customer needs them. This is not according to Lean thinking. Every feature of a product or service not required by the customer is 'waste' according to Lean thinking. For most businesses that requires a radical rethinking of what value is from the perspective of their customer. An awareness of the end customer's needs and an accurate value specification is the first step in Lean thinking.

2. **Identify all steps in the value stream**

   The second principle of Lean thinking is to identify all steps in the value stream of a product or service and if possible eliminate all those steps which do not create value for the good. Womack and Jones (2003) classified the steps within the values stream into three groups: (1) steps which clearly create value; (2) steps which do not create value but are not avoidable (Termed by the authors Type 1 waste); (3) steps which do not create value and are immediately avoidable (Termed by the authors Type 2 waste). The identification of all steps in the value stream is important because it enables the firm to detect all types of waste within the value stream. The firm is now are able to eliminate Type 2 waste and can try to eliminate Type 1 waste, for example by restructuring the value stream.

3. Create flow

After specification of the value stream and elimination of wasteful steps, the third principle of Lean thinking aims to make the value-creating steps flow in tight order to the end customer. According to Lean thinking, all forms of batch production mean long waits and consequently waste. Womack and Jones (2003) argue that based on departmental structures, firms tend to produce in batches. That makes it easier for firms to design their processes within the departments more efficiently. The authors argue that things work better if the product is focussed, rather than the organisation or the equipment. Lean thinking requires a conversion from departments and batches to product teams and flow.

4. Let customers pull value

Womack and Jones' (2003) idea behind the fourth principle of Lean thinking is that the firm designs, schedules, and makes precisely what the end customer wants just when the customer wants it. The customer should be able to 'pull' the product from the firm rather than the firms 'pushing' products into the market.

5. Pursuit to perfection

After value specification, value stream analysis, elimination of waste, and creation of flow, the fifth principle of Lean thinking aims to start this process again. This means firms should continuously try to discover better ways of creating value. For the authors, perfection means to continue all principles until a state of perfection is reached in which ideal value is created without waste (Womack and Jones, 2003).

3.4 The concept of Lean

Lean manufacturing frequently leads to misunderstanding through the association with a collection of Japanese tools and techniques intended to drive cost down (Ruffa and Perozziello, 2000). However, Lean production systems such as Toyota's are a sophisticated system of production in which all the tools and elements contribute to a whole (Liker, 2004).

However, to understand the position and contribution of elements such as just-in-time, Kanban, or Jidoka in a broader prospective might be confusing and the readers might get lost. In order to provide an overview of the different elements, Liker's (2004) model of the Toyota Production System (TPS) is presented.

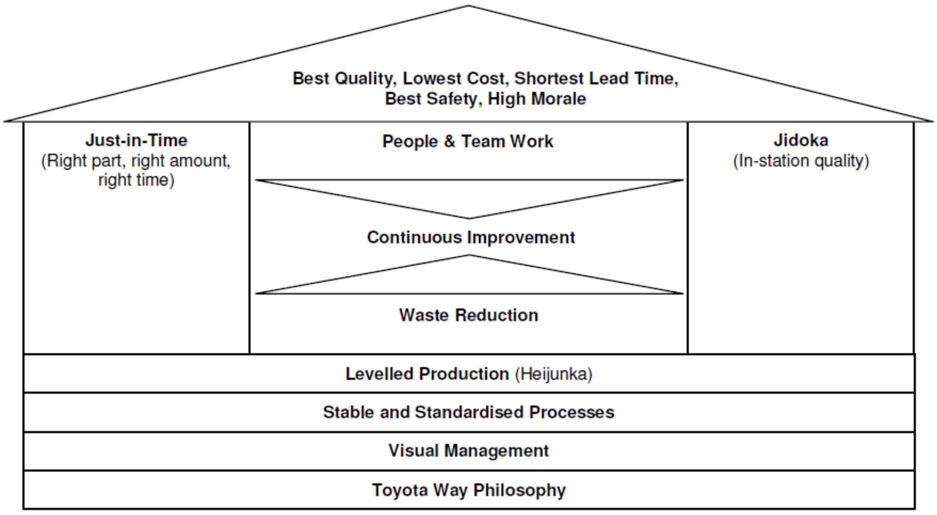

Figure 3.1: Elements of the Toyota production system

(Source: Liker, 2004)

As shown in Figure 3.2, the TPS-House aims to achieve best quality, lowest cost, and shortest lead time. Due to just-in-time and Jidoka, the workers are advised to focus on eliminating waste. This leads to continuously improving the system. Standardised, stable and reliable processes represent the foundation to make the system work.

To implement the different elements, Lean manufacturing created a number of tools and techniques. In the following, some of the tools and techniques will be considered in more detail.

3.5 Tools and techniques

In the last decades, it was shown that Lean manufacturing techniques and tools when used appropriately can help plants to eliminate waste, have better inventory control, better product quality and better overall financial and operational procedures (Womack et al., 1990). However, there is no single source for Lean tools and techniques which leads a company to a successful implementation (Hobbs, 2003). Over the past several years, an array of Lean guidelines and tool books have been published which contain numerous techniques and tools (Ruffa and Perozziello, 2000).

The tools and techniques within Lean are not discrete elements. Some elements overlap and support each other. For example, to follow the guiding principle ‘eliminate waste’, continuous improvement (Kaizen) is the methodology to make it happen (Nicholas and Soni, 2006). Moreover, cleanliness and orderliness programmes like 5S also promote ‘waste elimination’ alongside ‘quality improvement’. A tidy and clean environment contributes to quality conscious production. Moreover, such an organised workplace contributes also to more efficient work procedures and is consequently less wasteful. These examples demonstrate that most Lean tools and techniques are connected and therefore difficult to consider separately.

Therefore, the present chapter can give just a condensed overview of particular Lean tools and techniques. Only those elements that are particularly related to barriers within the implementation process which help the reader to better understand the barriers will be considered in more detail. In order to structure the chapter, tools and techniques have been grouped in the five main categories: Lean supply, waste and waste reduction, quality, improvement, and participation and job role. In the following, tools and techniques from these categories are presented.

3.5.1 Lean supply

3.5.1.1 Just in time production

The terminology in case of the relationship of Just-in-Time (JIT) production to Lean production is sometimes confusing and has changed over time. Some authors used the terms JIT production and Lean production interchangeably (Slack, Chambers, and Johnston, 2004); others consider JIT as separate principles within the manufacturing context (Liker, 2004). In order to develop the reader's understanding of what barriers can occur during JIT production, the present thesis will consider JIT separately as a Lean principle (see Figure 3.1).

According to Askin and Goldberg (2002), Kanban and the 'pull-approach' represent the key aspects of JIT production. The best way to explain Kanban is by comparing it with a supermarket stocking system as utilised by Nicholars and Soni (2006). In a supermarket, small batches of products are placed in the shelves. Before the products get sold out, the products will replaced by the supermarket staff. Depending on the customer's demand, staff will replace the goods several times a day. The Kanban system of a Lean production system works similarly. Parts are supplied in small standard boxes to the different workplaces in an assembly line. Through a Kanban system, mostly indicated by simple Kanban cards, the internal part delivery knows which parts are needed. Before the operator runs out of parts, new parts will be delivered to the workstation. The parts need to be 'pulled' through the production process.

In a Kanban managed assembly line, all production steps are initiated by orders from the downstream workplace. The upstream working place is just fulfilling its task when the workplace downstream has fulfilled its work step. The downstream is 'pulling' the orders from the upstream. This is a significant difference to the mass production where the material which arrives from upstream dictates the work of the downstream workplace. In Lean production, each workstation produces only enough to meet the demand of workstations immediately downstream (Nicholars and Soni, 2006). Any produced product or work step which is not requested and used as a buffer (or any form of internal inventory) represents 'waste' in Lean.

To follow the third Lean principle of creating a constant material flow, a similar workload on every work step is required. A reliable levelling system needs to be in place because of the missing buffers; late or wrongly-delivered parts leads to a sudden stop in the whole production line. This causes high requirements to the workers in a pull system. When parts arrive from the suppliers in most modern production plants the parts in the Kanban boxes will be packed on a small vehicle. The delivery vehicle, called the milk run, distributes the boxes to the different work stations JIT. The milk run driver is the link between parts delivery and distribution to the assembly line. This workplace is one example of high job responsibility within Lean. The driver is responsible for the right parts in the right amount being delivered to his vehicle in time. Process knowledge and experience are required to deliver JIT under the changing conditions of the assembly lines.

Through the reduction of process inventories to zero, any interruptions can easily lead to a stop in the production line. The idea of JIT to avoid disruption through direct failure detection may turn into an additional disruption risk. Therefore, Lean demands an advanced logistics system and a highly reliable supply chain to ensure the delivery of the needed parts just in time.

3.5.1.2 Supplier relations

Just-in-time production requires a frequent delivery which is reliable, of high quality, and flexible. Lean operating companies try to achieve JIT delivery by a reduction of the numbers of suppliers and build up close relations with local suppliers (Krajewski and Ritzman, 1996). Building up the relations with the suppliers aims at building up a long-term relationship which is profitable for both sides. Reducing the number of suppliers gives the remaining core suppliers more sales and securities. Moreover, more efficient communication and synchronised work procedures are the result. The manufacturer is now able to involve its core suppliers in product development processes, which helps both sides to tailor their products to their needs.

The use of local suppliers enables the manufacturer to develop a reliable distribution system which does not need buffers. The short distance to the manufacturer reduces the risk of unexpected incidents and long delivery times (lead times). Moreover a locally based supply chain enables more efficient scheduling, inventory planning and consequently higher profits for supplier and assembler based on lower component prices.

However, a small number of core suppliers require that the suppliers are able to meet the demand of the assembler. The need to produce the required components in high quality at the right time puts a lot pressure on the suppliers. Based on missing buffer levels, late deliveries or defective components might have significant effects on production flow at the assembler.

3.5.2 Waste and Waste reduction

3.5.2.1 Elimination of waste (Muda)

Arguably the most significant part of the Lean philosophy is its focus on the elimination of all forms of waste (Slack et al., 2004). Most of today's literature classifies the seven types of waste, which were introduced originally at Toyota by Taiichi Ohno. Ohno (1988) defined waste in the form of overproduction, waiting time, transportation, processing itself, inventory, movement and production of defective parts. Elimination of all types of waste aims to use the full capacity of the plant as 100% work.

However, labour unions have criticised that the elimination of waste within Lean is sometimes misemployed by the management to legitimate mass layoffs and increasing of operator workload (Liker, 2004). Therefore management responsibility is required to man power surplus and develop its efficiency.

3.5.2.2 Standardisation

An important concept to support waste elimination is standardisation. Setting standards of worker actions ensures that each task is organised and carried out in the most effective manner. No matter which worker is doing a task, standardisation of tasks ensures that the same level of quality is achieved. Through standardised work, line balancing is achieved, consequently inventory within production steps can be avoided, and non-value activities are minimised. However, these aims can only be fulfilled if the workforce is following the standards in great detail. A lack of work discipline might cause quality problems or interruptions of the production flow. Nevertheless, it is certainly not helpful to set standards for every minor task, because the system is run by humans and therefore variation and deviations up to a certain degree should be allowed, as long it does not cause problems.

Beside the maintenance of existing standards, standardisation plays an important role in any improvement activities. The standard sets the base for any continuous improvement activities. However, further improvements of the standards are required from the employees, beside high skill demand, high levels of participation and initiative. A workforce not willing to improve the standards might cause problems to follow the idea of ‘bottom up improvement’.

3.5.2.3 5S

5S describes a workplace organisation tool that ensures quality and contributes to the elimination of waste. The name is based on the Japanese words: Seiri (Reorganise), Seiton (Tidy), Seiso (Clean), Seiketsu (Sustain the change) and Shitsuke (Discipline). The concept aims at the workplace everything having in its place, being returned to its place every time, and no unnecessary things lying around. Good housekeeping is the starting point for all quality programs because quality can only be nurtured in a sound and orderly environment (Chen and Lu, 1998). Moreover, 5S contributes to reducing waste, for example through less movement when operators need to use tools from their workplaces. It also contributes to workplace safety, for example through a clean floor it is less likely that workers slip or fall over. 5S also contributes to quality and error detection. Moreover, a clean floor at the production line helps the operators to spot parts which are fallen off or broken off within the assembly process. Grinding chips which might indicate defective parts or a wrong setting of production facilities are visually more obvious. In a sound and orderly environment, it will be easier to cultivate healthy attitudes towards quality improvements throughout the entire company (Chen and Lu, 1998).

However, to make 5S work, the line operators need to be able to spot the slightest deviations and identify them as errors. Missing experience with modern production facilities or a lack of quality awareness and quality consciousness within the workforce might significantly influence the contribution of 5S.

3.5.3 Quality

3.5.3.1 Jidoka (Autonomation)

Jidoka contributes to the quality within Lean production. Jidoka, also called autonomation, describes a technique for detecting and correcting production defects which always includes a mechanism to detect abnormalities or defects, and a mechanism to stop the production when abnormalities or defects occur (Monden, 1998). Common practices associated in Jidoka against defects and wasteful production is Poka Yoke, Andon, and the line stop by workers (Nicholars and Soni, 2006). In the following these elements are considered separately.

3.5.3.2 Poka Yoke

Poka Yoke in Japanese stands for mistake proofing and prevention. Mistake proofing aims at making it impossible for errors to pass to the next step in the production process. Mistake prevention aims at stopping mistakes before they occur. Poka Yoke aims at making it very difficult or even impossible for machine operators to produce or pass a defective part to the next production step. For example through installation of devices which avoid assembling parts in the wrong way, operator mistakes can be prevented. Installation of mechanisms which check each item to determinate whether it is defective help to not pass errors to the next production step.

However, depending on the production step, it is not always possible or affordable to design a 100% fail-proof system for each production step. The operators still need be skilled to work according to the standardised procedures and work instructions and at the same time need to be able to identify errors or deviation.

3.5.3.3 Line stop and Andon

The ability of operators to stop the production line autonomously is a distinctive feature of Jidoka. If, during production, defects or abnormal situations arise, line workers are able to stop the entire production line. This is why Taiichi Ohno (1988) called Jidoka also ‘automation with a human touch’. When the line stops, a call light in what is called an Andon board will light and indicate the incident (in many cases Andon has different coloured lights to indicate several conditions of the line). The Andon light on the board indicates which process is responsible for the stoppage. Based on the stoppage of the entire line, the other operators cannot continue their work and are instructed to investigate the problem and take necessary corrective actions. Forcing immediate attention to the problem, an investigation into its root cause and initiation of corrective action prevent similar defects from occurring again. These actions make the production process more reliable and therefore more productive in the long term.

However, this approach demands operators who are empowered and skilled to identify, investigate and correct defects. However, detecting minimal quality defects, root cause investigation of incidents, and installation of a countermeasure require a well trained workforce with multiple skills, especially in high technology production facilities. Moreover, problem solving within a group of operators requires consensual teamwork abilities to conduct team-agreed solutions. The importance of the 'human touch' within Jidoka bears the risk that a lack of skills or empowerment of the workforce causes problems when implementing the Jidoka principles within Lean.

3.5.4 Improvement

3.5.4.1 Kaizen

The Japanese word Kaizen means 'continuous improvement'. In comparison to the traditional production where improvement activities take place infrequently in response to a major change, Kaizen aims to improve processes of the system continuously with incremental improvements (Bicheno and Holweg, 2009). Improvements should be actively initiated by all employees, including the shop floor (Ohno, 1990). Conducting continuous improvement requires active participation and responsibility of the workforce. Moreover, to make improvements on modern production facilities, high levels of process knowledge and skills are needed.

3.5.4.2 Root cause detection (5 Why)

Originally introduced at Toyota, the 5 Why technique aims to separate the root cause of a problem by its symptoms (Nicholars and Sony, 2006). By asking at least five times 'Why?' the nature of the problem as well as the solution should become clear (Ohno, 1990). Through detecting and removing the root cause of the problem, the 5 Why approach contributes to the improving process. Taichii Ohno highlighted that the elimination of a problem source will not remove the problem in the long run unless the root cause of the problem is eliminated. By using 5 Why techniques, the differences between the source of the problem and root cause becomes clear, which leads to a new reality of the problem and a different solution (Nicholars and Sony, 2006).

However, the sometimes very different countermeasures to the initial problem source demands high skill levels of the workforce. To diagnose a problem via several stages requires analytical skills and association capabilities of the employees within the shop floor.

3.5.4.3 Low inventory levels

The consideration of the 'pull-approach' earlier on already showed that inventory which acts as a buffer represents waste within Lean. However, the reduction of inventory also contributes significantly to problem solving and avoiding interruptions (Because missing buffers put a lot of pressure on the employees to prevent interruptions by solving problems from the root cause).

One significant difference between traditional mass production and Lean production is the use of inventory levels. Mass production uses inventory as buffers between each production step. This allows at each stage to produce in an uninterrupted and consequently efficient way. Lean, and more precisely JIT, avoids isolation of stages. The production in the upstream workplace is initiated by orders from the downstream workplace. Based on the missing buffers between up- and downstream workplaces, the two workplaces are interdependent. When problems at a single workplace occur, all other workplaces are affected. This moves the responsibility for solving the problem from the single workplace to all workers of the production line.

Lean uses these interdependencies to release the problem solving potential of all line workers and avoids problems spreading to the downstream production. The contribution of low inventory levels to problem solving is in the literature often expressed by the image: 'Lowering the water (inventory) to expose the rocks (problems)' (Mann, 2005). This metaphor highlights the fact that low inventory is essential for encouraging efficiency by noticing problems straight away and forcing employees to solve problems immediately. That is why, different from within mass production, within Lean inventory levels are considered as waste and employees try to avoid storing inventory.

3.5.5 Participation and Job role

3.5.5.1 Team agreed improvements

As mentioned before, Lean production improvements should be conducted in a consensus style. When there is an improvement activity, ideally all employees who are engaged with the improvement should be involved in the process. The idea behind these improvement teams is that working with first-hand information is a benefit in opposition to information compiled by a third party. Ideally, planned improvements from upper management should be conducted in accordance with the shop floor, to make sure that the changes lead to a real improvement in the daily production. Case studies have shown that decisions made in consensus style are extremely effective, because first-line team members are the most knowledgeable about the work (Ray and Bronstein, 1995). This prevents decisions which are made far away from the reality of the shop floor.

However, a consensus style within improvement teams requires empowered employees with equal rights, who are willing and able to contribute to improvements as a team.

3.5.5.2 Self-managed work teams and job rotation

Teamwork is one main characteristic of Lean production, as stated by Womack et al. (1990), and Adler and Cole (1993), who refer to teams or work groups as an important feature of Lean production. Self-managed work team (SMWT) describes a group of employees that is responsible for managing and performing most aspects of their work (Yeatts and Hyten, 1998). In addition, the team members of a SMWT are trained to perform each task of every workstation, which allows Job rotation within the production line periodically (Yeatts and Hyten, 1998). Such cross-training enables the team to rotate between workplaces and enhances the flexibility and motivation of the team (Wellins, Byham, and Wilson, 1991). To be able to work at all workstations gives the operators a wider picture of the product they produce and this helps maintain their responsibility for the finished product. Job rotation also prevents monotony of work tasks, gives the team autonomy to distribute the task within the team, gives a new impulse for improvement, maintains enthusiasm, and strengthens team membership through communication about work steps which are familiar to each team member. Case studies have shown that SMWTs are able to produce more work than employees organised in more hierarchical, traditional structures, because they use not only technical skills but also management skills (Hackman, 1990).

However, Yeatts and Hyten (1998) state that ‘the ability of those teams to achieve higher performance at less cost depends on several factors, including the interpersonal and work processes, numerous environmental factors, such as management support and employee training, the team’s design, and characteristics of the employees themselves”.

When such context factors are not considered in the implementation of SMWT, little or no performance improvement is the result (Yeatts and Hyten, 1998; Varney, 1989). These findings are supported by Nicholars and Soni (2006). In their investigation, they discovered that after implementing Kanban, the management and supervisors tended to take back responsibility from their subordinates. In this example, missing management support caused the drift back to a centralised management control system, not considering those factors might decrease the performance benefit of SMWT and act as a barrier for the implementation of Lean.

3.5.5.3 Management

In order to facilitate an effective implementation of quality programs, top management must play a crucial role of motivating employees and guiding them (Chen and Lu, 1998). Middle managers are expected to be fully aware of the significance of each and every quality program and to work out a detailed implementation procedure in accordance with the company's quality strategies (Chen and Lu, 1998). A lack of Lean support from the management may bear the risk that operators are less motivated to follow the instruction and quality control checks.

3.6 The importance of a thorough Lean implementation

This section should clarify why it is so important for companies implementing Lean in their plants to a high standard. Given the number of implementation barriers in China you could question whether a less strict implementation of Lean may reduce the number or the scale of the barriers and therefore would lead to the same production output. The question is whether an adapted version of Lean which allows 'slack' would have benefits for the company.

To allow 'slack' in certain areas within the production system may overcome some of the barriers. For example allowing more inventories would decrease the risk of not being able to deliver customers when requesting additional products in the last minute because of wrong production forecasts. However, this would not be in line with Lean principles, because waste is created by storing unused inventories and will lead to bigger barriers in the long run. To allow higher inventory levels within the firm and spending fewer efforts to reduce inventories and reducing the risk of running out parts when customers request parts last minute would be fatal for the entire Lean implementation. Why allowing 'slack' in China, such as less strict policies to prevent excessive inventories, is fundamentally against the Lean philosophy is best illustrated by using the analogy of a ship floating on an ocean of inventory.

This metaphor is often used to illustrate to practitioners the need to reduce the inventory levels. In this example, the ship represents the production plant and the water represents inventories (waste). Beneath the water there are lying rocks. The rocks represent problems and inefficiencies such as unreliable suppliers, unbalanced flow, unreliable machines etc. Conventional production systems follow 'The ship must sail' strategy. The idea is that there should always be enough water (inventories) to keep the boat flowing (production line running) without having the rocks disrupt flow (barriers). The idea of Lean thinking is that pumping in more water will cost more than hitting the rocks and stopping the ship for a short time. Within Lean theory the water level (inventory levels) need to be lowered until the first rock (e.g. unreliable machines) are exposed, making is easier to identify and solve the problem, then drop the water level again until another rock (e.g. poorly trained workforce) is exposed. This is the idea of continuous improvement to lower the 'water' is essential to make problems visible and solve it.

Instead of piling up inventories in China - increasing the cost by storage and risk of over production - to make the impact of barriers later invisible, also the plants in China should have been pursuing the Lean continuous improvement approach. Lower the inventories until a problem occurs - then eliminate the root course of the problem - fix the process - make that rock go away in the long run - then reduce the inventory levels until the ship need to stop at the next rock.

When allowing the subsidiaries which face implementation barrier to pump more 'water' in the 'ocean' (inventories) the rocks (barriers) will still be covered and therefore not be removed. The entire principle of continuous improvement would risk not being applied and, consequently, the core principles of Lean effectiveness would not work. The metaphor illustrates why the host company is so eager to implement Lean and its principles to a high standard. Only when the Lean principles do work satisfactorily, the benefits of the Lean production system in terms of quality and effectiveness will pay off. Allowing ‘slack’ in China or in any other production system may reduce certain barriers in the short run, but may increase the barriers in the long run.

3.7 Conclusion

This chapter has outlined key tools and techniques which are well known and applied within Lean manufacturing. By introducing the tools and principles of Lean, the chapter also gives an indication of how and where barriers may occur. For example, the consideration of the Lean supply chain suggests that a production according to JIT production is very dependent on suppliers, and the manufacturer’s production will be disrupted by unreliable part deliveries from suppliers. The chapter also gives some indications that a successful implementation of certain elements (e.g., low inventory levels to avoid buffering, to make problems within the production more visible) is more important for Lean than for traditional production systems. Finally, the chapter highlights why it is so important for companies to implement Lean thoroughly and why a cursory implementation will lead to problems in the long run.

Here, it needs to be said that the Lean literature includes many more elements and tools which are used when implementing Lean. However, the purpose of this chapter was just to impart a basic understanding of Lean and prepare the reader for the following consideration of implementation barriers.

CHAPTER 4

4 Transfer of Lean manufacturing to emerging economies

For investigating the implementation of Lean production systems in China, it is important to consider Lean implementation in other emerging economies, in particular Mexico, Brazil and India. Like the People's Republic of China, these emerging economies are also trying to benefit from the flexible and high productive Lean production system. Given the similar country context factors of China compared to these other emerging economies, it is likely they bear parallels with regard to the barriers to implementing Lean manufacturing. Based on a review of prior research, I shall provide an overview and appraisal of the main examined barriers to applying Lean manufacturing in manufacturing plants in Mexico, Brazil and India.

Although countries like Brazil, India, Mexico or China look very different at first view, all share similarities. These emerging countries need to cope with the opening of previously protected domestic markets and competition from international companies. This sudden move from a regulated environment to a competitive buyers' market made companies in emerging countries aware of the urgency to focus on quality and efficient production. Similar to China, other emerging countries aim to raise export rates by improving productivity, quality and delivery times of their own products.

Difficult and turbulent macro environments, low education levels and poor labour relations are all characteristics emerging countries have to cope with. A comparison of similarities or differences of implementation barriers in emerging countries might help to determine barriers which are country-specific. Then, it may be possible to explain China's specific barriers by certain national context factors. Possibly, China-specific interaction styles, such as the concept of face or Guanxi play a role when applying Lean in China. In the following, it may be possible to categorise barriers which are universally significant for emerging economies and barriers which are China-specific.

Before considering the reported barriers, it is necessary to say that there are emerging economies other than Brazil, India, and Mexico, which might share similar country context factors. For example, some 'Asian Tiger'[2] and 'ASEAN'[3] countries face similar economic conditions, and Russia shares its communist background. However, based on the very limited Lean-related literature regarding those countries, only the emerging economies of Brazil, India and Mexico were part of this literature review.

The literature review showed that the number of studies which focus mainly on the implementation of Lean with regard to Brazil, India and Mexico was limited. However, the review indicated that the authors used a number of different terms to describe specific barriers, disruptions, and difficulties which they found in their studies. The studies were not mainly investigating barriers within the implementation process. Therefore, the authors did not evaluate most of the mentioned barriers in much detail. Only a few authors explained the cause or the wider background and consequences of these barriers, without providing strong evidence. Detailed explanations of the mechanisms behind the barrier were not evaluated.

To evaluate the most prominent barriers within emerging economies, the first step of the review was to categorise the different barriers into two main groups.

[2] Also called 'Asian Dragons'. Both terms refer to the highly developed economies of Hong Kong, Singapore, South Korea and Taiwan.

[3] The Association of Southeast Asian Nations, including Indonesia, Malaysia, the Philippines, Singapore, Thailand Brunei, Myanmar, Cambodia, Laos, and Vietnam.

The barriers were divided into barriers within the technical sub-system and barriers within the social sub-system. As stated in Chapter 1, socio-technical systems theory argues that the technical and social systems must be developed in cooperation for a production system to be appropriate to its environment (Mefford and Bruun, 1998; Shani et al., 1992). Therefore this distinction is important to examine parts: the social and the technical systems. Both are likely to be influenced by the economic context (e.g. order situation of the company), and the socio-political context, (e.g. education of workers) but in different ways. However, the social system is likely to be more strongly influenced by the cultural context, regarding values, beliefs, norms than the technical system.

After categorising the literature in this manner, similar barriers were grouped together and overall headings groups were given. In the following sections, the barriers within the technical and social sub-system found in the literature will be detailed.

4.1 Barriers within the technical sub-system

4.1.1 Weak supplier performance

One of the key findings of the literature review on Lean implementation in emerging economies was a barrier which I called weak supplier performance. The term weak supplier performance describes, in this thesis, the lack of supplier performance in form of predictable quality and predictable delivery. Especially in Lean manufacturing, a close relationship with a very few suppliers is important for producing JIT (Krajewski and Ritzman, 1996). To follow the concept of JIT manufacturing, the assembler depends on suppliers who are able to deliver top-quality parts at the right time. Based on missing buffers in Lean production, defective parts or delayed part deliveries might immediately cause a breakdown of the entire assembly line.

Several authors identified a weak supplier performance as a barrier to apply Lean manufacturing in emerging countries. These authors explained that weak supplier performance was initiated by the lack of qualified local suppliers and the related dependency of assemblers on overseas imports. Kenney and Florida (1994) investigated the organisation of production of Japanese companies in Mexico (called Maquilas). Kenney and Florida (1994) reported that based on a weak supply chain, implementing JIT in Mexico has been difficult. The end-user and supplier in their study were unable to develop a JIT supply relationship on a daily basis despite suppliers and assemblers being located less than two kilometres away. More examples were reported where suppliers within the Maquilas were not able to operate according to JIT principles. As a consequence, the assemblers still depended on overseas imports of foreign suppliers in Asia or the US. That led to long lead times of the supplier parts and made JIT production impossible.

A lack of qualified local suppliers within Mexico was also mentioned by Mefford and Bruun (1998). They reported that as a consequence of the lack of qualified local suppliers, most materials needed to be imported. Besides Mexico, poor supply processes were also found in Brazil. Wallace (2004) reported in their case study that through restructuring of the supply process, significant areas of space were released. Such high improvement potential in the supply process shows evidence of a weak supplier performance also in Brazil.

4.1.2 Lack of quality control

One of the key indications of the literature review was the lack of quality control within emerging economies. The term lack of quality control is used to describe the inability to produce consistently products within quality requirements of a production plant. This includes issues like the lack of quality awareness, lack of maintaining quality standards, lack of monitoring and ensuring product quality during the production process. Lean-related studies conducted in Mexico and

India addressed the missing ability to control quality procedures as a barrier to applying Lean manufacturing in emerging countries.

Kenney and Florida (1994) found little evidence of quality control (QC) activities within Mexican firms under Japanese management. Through interviewing 17 plant managers and ten plant visits the authors found that some plant managers indicated that quality control circles (QCC) were too difficult to implement in Mexico. Other plants who took part in their investigation had some small group quality circle activities. However, the Japanese management stated that these were not comparable to Japan. An executive vice president commented the status of QCC activities as follows:" …*we are still in the application process (…) it's difficult to start and it's difficult to maintain*." Kenney and Florida (1994) concluded that the production in Maquilas was dependent on an extensive inspection of the produced goods to ensure quality. These findings are in contrast with research by Shaiken and Browne (1991) who showed evidence of organised quality control activities in the Japanese-Mexican plants, but gave not much detail how the Japanese-Mexican joint venture achieved that.

Seth and Tripathi (2005) investigated the relationship between total quality management (TQM) and total production maintenance (TPM) implementation factors and business performance of the manufacturing industry in the Indian context. In their empirical survey study, they indicated amongst other barriers inadequate quality control through poor equipment management. Seth and Tripathi (2005) stated that maintenance is still considered in India as expenditure and not as an investment. The authors' finding might indicate poor quality awareness within Indian's Lean production.

Still, the evidence found for low quality standards within emerging countries is not very strong. To maintain 'first-time' quality in the production process is even challenging for world-class organisations. It is surprising that there is not more evidence for a lack of quality control in the literature on emerging economies. In emerging countries, most workers are poorly educated with origins from rural, agricultural villages with little exposure to basic manufacturing techniques. It is a common but flawed assumption that such a workforce is able to effectively identify the slightest quality deficits or independently conduct quality checks. The low evidence found for low quality may be explained by the fact that most studies focus only on a particular aspect of implementing Lean in an emerging country. It is likely that quality problems are present in firms of emerging countries, but the authors did not consider quality issues in further detail.

4.1.3 Poor inventory management

The literature on Lean manufacturing in emerging economies indicates poor inventory management of manufacturing plants as a further barrier to implementing Lean. In this thesis, the term inventory management described how resources are managed and organised. Chapter 2 already stated that single-piece flow and low levels of inventory are fundamental for implementing Lean successfully.

High levels of inventory were reported in a study within Brazil and Mexico. Wallace (2004) investigated in their case study the introduction of Lean production at Volvo de Brazil. A lack of inventory management was observed when the company began trying to reduce unused inventories. After the waste reduction interventions when implementing Lean, the entire inventory which was used on the production line as an intermediate buffer had more or less disappeared. The Lean production project leader stated that they had liberated 'so much air' and they began to think '*Jesus – if you can do that with one area – you can just roll that out in the whole plant*". The acquisition of so much space indicates a lack of inventory management including a misunderstanding of the benefits of waste reduction practices. Workers' poor understanding of the importance of releasing productive space to eliminate waste was addressed by further examples within the study.

In Mexico, Kenney and Florida (1994) also examined poor inventory management. One Japanese Maquila manager stated that the inventory levels were five times greater than in Japan. Another manager reported that the inventory storage times in Mexico would be approximately one month, in comparison to just a couple of days in Japan. However, it needs to be said that besides a poor inventory management, high inventory levels can be grounded in several issues. For example, difficulties to create a constant production flow may require buffers. Unreliable suppliers may force the manufacturers to increase their inventory levels to overcome component shortages.

4.2 *Barriers within the social sub-system*

4.2.1 High employee turnover

Several authors who conducted studies in Latin America report high employee turnover as a barrier. Wallace (2004) and Humphrey (1995) mentioned the hire-and-fire practices within Brazilian firms, but did not closely investigate the consequences of high employee turnover for the company. In Mexico, Kenney and Florida (1994) and Mefford and Bruun (1998) also indicated high employee turnover as a barrier. Kenney and Florida (1994) reported that the monthly employee turnover rates in Mexico ranged from four to fifteen per cent. One company in their case study had such high employee turnover rates that the operators did not even receive a work uniform until they completed a trial period.

That high employee turnover does create problems when implementing Lean is supported by findings from Kenney and Florida (1994). They stated a knowhow loss within Mexican companies. Based on the high employee turnover, the plants' management had difficulties in accumulating IP and applying long term continuous improvement actions because their operators frequently changed jobs (Kenney and Florida, 1994).

As factors influencing the high employee turnover, Kenney and Florida (1994) named the large numbers of Mexican migrants workers who are attempting to cross into the US or returning home. These people mostly do not want to build up careers and want to work in the company temporarily, looking for monetary rewards to finance their journey. Kenney and Florida (1994) also identified poor public transport as a contributing context factor because the poor public transport system restrains the labour pool to the operators who are able to live next to the production plants.

4.2.2 Knowledge gap

A major social barrier addressed by several authors was the knowledge gap of the workforce in emerging economies. Nearly all authors of the studies in Brazil, Mexico or India mentioned the knowledge gap of the local workforce as a major implementation barrier.

In Brazil, the poor education level among shop floor workers was identified as a major limiting factor for industrial production. In their case study, Wallace (2004) stated that workers in Curitiba had little knowledge and experience of industrial production due to their origin from service or agricultural employment. These findings accord with the findings of Humphrey (1995). In his case study, he investigated the adoption of Japanese management techniques in the Brazilian industry. He stated that there is an enormous gap between the educational background of the workers and skills required within modern production and the Brazilian education and training system. According to Humphrey (1995), a complete first-grade education of eight years might be seen as the minimum required for production workers. His findings showed that the knowledge gap was considered as a main barrier to implementing Lean manufacturing. Fourteen of seventeen plant managers named improving basic education as their top three concerns when asked for problems the government needed to tackle (Humphrey, 1995).

Lack of knowledge was also mentioned in Mexican studies. Mefford and Bruun (1998) describe the workforce as poorly educated with low levels of industrial experience. These findings are supported by Kenney and Florida (1994). Managers were complaining that in Mexico there is no shortage of operators; however there would be a shortage of skilled technical workers and managers (Kenney and Florida, 1994). Kenney and Florida (1994) classified Mexican workers' educational skills at the sixth grade level and with most rudimentary training. The gap of skill demand of workers in modern production was also supported by a case study of Galperin and Lituchy (1999). Through interviewing shop floor workers they could get inside information from the operator side rather from a management prospective. One interviewee stated that he felt that he did not have a sufficient amount of knowledge to make crucial decisions within the production environment. Also, workers within the shop floor stated in their case study that they felt not knowledgeable enough to handle their responsibilities. These findings indicate that a knowledge gap created a barrier within Lean production.

Besides Brazil and Mexico, an education gap within the workforce was also indicated in India. Seth and Tripathi (2005) pointed out that without education and training of the workforce, Indian companies will not meet the requirements of continuous improvement.

The literature indicated that a knowledge gap represents another major barrier addressed when implementing Lean in emerging countries. It is likely that the indicated knowledge gap is restricting a number of employee tasks and processes within the production system. However, the evidence shown by Lean-specific literature that a knowledge gap is directly influencing Lean elements is weak. The reviewed studies did not indicate how the knowledge gap among the work force influences certain Lean elements. Further research is needed to indentify the effects of this barrier on specific Lean elements.

4.2.3 Work styles

Employees' work styles were also mentioned as an implementation barrier in the Lean literature on emerging economies. In the Mexican case studies conducted by Kenney and Florida (1994) and Mefford and Bruun (1998), the authors reported high absenteeism within the Mexican workers. In a Lean production system, ideally most workers are multi-skilled, and job rotation practices enable the operators to work in different workplaces. However, because of the high workload of the individual and the small team size, an absent operator may cause problems in the single piece flow-production. Therefore high levels of absenteeism may interrupt the production flow.

As a further barrier related to the employees' work styles, Kenney and Florida (1994) identified the lack of responsibility and activity of the workforce as a barrier. In their study, Japanese mangers complained that the JIT production in the Maquilas would not work as in Japan. As an explanation for the implementation failure, the managers named a lack of responsibility-taking and active participation of the Mexican workforce. Also, in Brazil, a lack of worker discipline required for industrial production was identified as a major barrier by Wallace (2004).

Surprisingly, there was not more evidence found where particular work styles act as barriers. It is likely that the rural origin and consequently missing industrial experience within the shop floor workers in emerging counties cause also problems. For example, it is feasible that limited experience and no daily routine to maintain manufacturing facilities might cause problems regarding workplace organisation, e.g. applying 5S.

Kenney and Florida (1994) also indicated inadequate time-planning capabilities among employees within the case study conducted in Mexico. They found that problems implementing JIT in Mexico were explained by the management through difficulties to train Mexican workers of the necessity of supplying on-time. This was attributed to a tendency among Mexican employees to treat deadlines and targets as goals rather than commitments.

Other authors of Lean-related studies within emerging countries did not explicitly comment on inadequate time planning. Given that these factors are present it is likely that inadequate time planning acts as a barrier when implementing Lean.

4.2.4 Management style

Several authors suggest that management styles in emerging countries act as a barrier to applying Lean manufacturing. This includes deficits of the management in terms of relations of managers to operators and lack of operator empowerment, which is related to a hierarchical organisational structure. The consideration of management styles overlaps partly with the chapter on work styles. There is a clear link, in that the behaviour of the supervisors influences the operators' behaviour. A balanced relationship between supervisor or team leader and line workers is important. Within Lean high status differences or an autocratic relationship between manager and workers may hold back participation and restrain 'improvement from the bottom up". Regarding Brazil, Humphrey (1995) named poor labour relations, such as hire-and-fire policies and an authoritarian management in Brazil, as major barriers. He related the poor labour relations to the management style of Brazilian companies. Humphrey (1995) stated that through a despotic management style, it is difficult for companies to get active worker participation or responsibility.

Interviews enabled the researcher to get inside of the first-line supervisor practices before a change of management style of one company which took part in the case study. One female line worker described the former management practices as follows: *"They (supervisors) used to shout at us, and we cried. Today they are listening to us (…)".* These statements reflect a supervision style which is not consistent with the idea of self-managing work teams.

Regarding Mexico, Kenney and Florida (1994) found in their case study that there is still a large status difference between workers and management. This is illustrated by a statement from the president of a Japanese supplier in Mexico: *"From a certain level (of employees) we listen…Below that, we consider the turnover zone. So, we do not even listen to them…Listen to (those in) the turnover zone just confuses the operation".* Such a worker-management relationship demonstrated by Kenney and Florida (1994) makes it hard for the company to perceive active participation and responsibility from the workers. Limited evidence of shop floor promotion based on status differences within Mexico is also supported by Galperin and Lituchy (1999). They also reported that the management resistance to worker participation in decision making can be intense. Galperin and Lituchy (1999) explain that factors within Mexico's national context, such as social class, education, race or family relations, might reinforce the large status differences between workers and management.

A lack of shop floor involvement of management was also found in India. Seth and Tripathi (2005) reported that family-owned as well as professionally-managed businesses in India still epitomise a top down and bureaucratic management process. Their research showed the status-conscious and hierarchy-bound middle management executives lacking initiative. Seth and Tripathi (2005) stated that lack of management support acts as a bottleneck to the improvement process.

4.2.5 Poor employee training

Several authors address a lack of employee training as a barrier to applying Lean manufacturing in emerging economies.

Several authors who conducted studies in Latin America and India reported poor employee training practices. Regarding Brazil and Mexico, Humphrey (1995), Kenney and Florida (1994) and Mefford and Bruun (1998) reported that the companies provided little training for those in production jobs. In a study by Kenney and Florida (1994) the management defended the lack of training with the unskilled nature of work and the high employee turnover. That is in contrast to Lean, where 'improvement from the bottom up' is an important feature. In their case study only a few firms gave newly-hired workers a proper training session before starting work. Similar HR practices are found in India. Dhandapani, et al. (2004) reported that in India, training is still treated as a luxury. According to them, top management views the training expenses as a symbol of modernity while employees treat the training programmes as the next best thing to paid vacation.

4.3 Summary of the barriers to Lean implementation in emerging economies

Chapter 4 investigated Lean related research conducted in the emerging economies of Brazil, India and Mexico. The review provides an overview and appraisal of the main examined barriers when applying Lean manufacturing in emerging countries. Table 4.1 again illustrates the findings.

Barriers within technical sub-system	**Barriers within social sub-system**
• Weak supplier performance • Lack of quality control • Poor inventory management	• High employee turnover • Knowledge gap • Work styles • Management style • Poor employee training

Table 4.1: Barriers within emerging economies based on the literature review

As main barriers within the technical sub-system, the review identified weak supplier performance, lack of quality control and poor inventory management. As barriers of the social sub-system, the review identified high employee turnover, knowledge gap, work styles, management style and poor employee training. The findings will be used for a comparison with implementation barriers within China. The aim is to categorise barriers which are universally significant for emerging economies and barriers which are China-specific.

The literature review on Lean in emerging economies showed that there is very little literature on studies that investigate the implementation of Lean in emerging economies. In the reviewed publications, most researchers looked at particular issues within organisations who applied Lean production, rather than investigating barriers which hindered the implementation process of Lean in more depth. Seth and Tripathi (2005), for example, investigated the relationship between TQM and TPM implementation factors and business performance of manufacturing industries in the Indian context. The review of their study, which is based on an empirical survey, gave valuable insights regarding barriers within the Indian context, such as the low literacy level of the workforce or the top-down management style applied within many family owned companies. However, the authors' attention did not lay in particular in investigating the implementation barriers in the particular context, which were therefore not investigated in more detail.

The literature review showed that even when authors mentioned implementation barriers, the studies did not investigate the mechanisms behind the barriers in any depth. Questions about the role of the national context or the root causes of the barriers remain mostly unanswered. Kenney and Florida (1994) conducted one of the studies which explained some of the barriers in more detail. For example, they provide explanations of the high employee turnover rates and focus on monetary rewards among Mexican migrant workers. They explain that most workers did not want to build up long-term careers; their initial aim was to work in the company temporarily, as they were looking for monetary rewards to finance their journey into the US or are returning to their homes.

However, explorations of the root causes and the role of the national context were widely missing. Based on the small number of publications and missing focus on barriers within the implementation process of Lean, the review showed that there is not much evidence in the literature from which a solid framework of implementation barriers could be grounded. Nevertheless, the literature review on Lean in emerging economies and the identified barriers provide valuable insights that underscore the further investigation.

CHAPTER 5

5 Transfer of Lean manufacturing to China

This chapter reviews publications that address the implementation of Lean in China. This literature review provides an overview and appraisal of the main barriers for manufacturing plants to apply Lean manufacturing in China, and explores the challenges that lead to a lack of performance of Chinese manufacturing plants with regard to international standards of quality and productivity. Based on similar country context factors of China compared to other emerging economies, the review enables me to demonstrate that there are parallels between barriers to implementing Lean manufacturing in China and in other emerging economies.

Similar to the literature review on Lean in emerging economies, the review of publications showed that there were only a limited number of studies on the implementation of Lean in the Chinese country context. Similar to the previous chapter, a high number of different barriers were found, and the authors also did not evaluate most of the mentioned barriers in detail. Only a few authors explained the cause or the wider background and consequences of Lean implementation barriers, without providing strong evidence. I grouped the different barriers mentioned by the authors together and categorised them into barriers within the technical sub-system and barriers within the social sub-system of Lean. In the following, I will present the barriers that I identified by reviewing the Lean literature on China.

5.1 Barriers within technical sub-system

5.1.1 Weak supplier performance

One of the key findings of the literature review was the weak supplier performance within the Chinese production. As in the previous chapter, the term weak supplier performance describes the lack of supplier performance in the form of predictable quality and predictable delivery.

Several authors addressed a weak supplier performance as a barrier when applying Lean in Chinese plants (Comm and Mathaisel, 2005; Taj, 2005; Oliver et al., 1998; Paolini et al., 2005; Lee, 2004a). These authors name a lack of supplier reliability and the dependency of Chinese assemblers on overseas imports as major explanations for the weak supplier performance.

The Chinese manufacturing industry has grown rapidly in the last decade. In contrast to already established industries, such as the textile industry, certain manufacturing industries, including automotive and electronics, are relatively new. The suppliers of automotive and electronics components are fragmented and widespread all over the country. These mostly family-owned small- and medium-sized manufacturing companies struggle to reach the international standards of quality and delivery of the assemblers (Oliver et al., 1998).

The weak base of suppliers among China was addressed by several authors. Taj (2005) addressed the bad supplier performance and relationship between assembler and supplier, but gives no more detailed explanations. Paolini et al. (2005) mentioned a lack of supplier reliability in the form of predictable quality and delivery in the Chinese manufacturing sector. The author explains that China’s partly poor infrastructure contributes to bad performance.

To produce JIT and keep inventory levels low, the manufacturer depends on JIT delivery of parts. A poor infrastructure combined with widespread nature of the industry might influence the delivery and quality of the products. Poor road conditions, for instance, might cause traffic jams or breakdowns of delivery vehicles which negatively influence predictable delivery. Poor road conditions might cause extensive vibrations during transport and lead to damage which might contribute to the lack of predictable quality.

China’s poor infrastructure and the lack of reliability in terms of buyers and suppliers lacking coordination and integration are also supported by Oliver et al.

(1998). In their case study, Oliver et al. (1998) illustrated weak supplier performance using the experience of a foreign brake manufacturer. The foreign manufacturer started to work with its Chinese local castings supplier one year before installation of their main production line. Despite technical support from the manufacturer, the Chinese supplier was still struggling to reach quality requirements just before the start of production. As a consequence of weak supplier performance, the brake manufacturer had to work with a second supplier as a backup to ensure supplier reliability.

Beside the lack of supplier reliability, Comm and Mathaisel (2005), Lee (2004), Oliver et al. (1998) and Paolini et al. (2005) address dependency on overseas imports as an aspect of a weak supplier performance. According to the authors' findings, the dependency of assemblers in China on overseas imports acts as a barrier to apply Lean manufacturing in China. Many Chinese manufacturers and joint ventures still depend on key parts or machinery from overseas companies or from their parent company. In these companies the import of key parts from suppliers outside China is essential to run the production. The overseas import requires long distance shipping and causes long delivery times. Orders need to be placed far in advance and long-term planning is required.

A study by Comm and Mathaisel (2005) demonstrated the case of a Chinese manufacturer who still depended on specialised materials from a Taiwanese supplier. The material orders needed to be placed several weeks in advance, therefore the company was not able to produce JIT without warehousing these materials.

In the same vein, Lee (2004) reported that the use of overseas resources can act as a barrier to apply Lean manufacturing. Lee stated that a lack of domestic key suppliers within China and consequently long delivery times and delays make adopting JIT production very difficult. In addition, Paolini et al. (2005) argued that besides the long distance, the reason for delays resides in the complex customs clearance procedures in China.

5.1.2 Lack of quality control

Another finding of the literature review was the lack of quality control within the Chinese production. The term lack of quality control is used to describe the inability to produce products within quality requirements of a production plant. This includes issues like the lack of quality awareness, lack of maintaining quality standards, lack of monitoring and ensuring product quality during the production process. Several authors addressed the missing ability to control quality procedures as a barrier to apply Lean manufacturing in Chinese plants (Aminpour and Woetzel, 2006; Aoki, 2008; Comm and Mathaisel, 2005; Oliver et al., 1998; Paolini et al., 2005; Lee, 2004; Cin and Pun, 2002).

Aoki (2008) investigated the transfer of Kaizen activities to overseas plants in China within the automotive industry. The findings of the case studies of nine medium- and large-sized Japanese auto-parts overseas plants in China showed evidence of poor quality control. High defect rates, repair rates up to 50% and poor maintenance were found in the companies. High defects rates and poor maintenance are also reported by Aminpour and Woetzel (2006).

At first sight, findings of a benchmark study by Oliver et al. (1998) draw a different picture. The study shows that the internal defect rates of Chinese plants were less than in manufacturing plants in the US and Europe. Oliver et al. explain the low defect rates by the relatively 'relaxed' internal quality standards in Chinese plants. Through a lack of quality awareness, some minor quality parts, which would be classified in western countries as defect parts, might not be classified as defect parts by the Chinese manufacturer. Consequently, the internal defect rate figures appear to be low. Nevertheless, the parts classified as free from defects cause quality problems at the assembler. This explains their findings on customer-reported defect rates. The study showed that the Chinese component plant delivered 18 times the number of defects to the assembler compared to the average Japanese plant, and 13 times more the American plants. The focus on output rather than quality, transcribed as ‘output-first mentality’ by Oliver et al. is also reported in the consultancy report by Paolini et al. (2005). Both studies conclude that the Chinese plants did not reach international standards of quality and production control.

Beside the lack of quality awareness, the literature addresses the lack of quality control procedures. Several authors support Oliver et al.’s (1998) statement concerning the lack of monitoring product quality within the production process in many Chinese manufacturing firms. They named inadequate quality control processes as a barrier for applying Lean manufacturing, the term includes issues such as the lack of calculating production time and little documentation (Comm and Mathaisel, 2005), underdeveloped control and operations management (Oliver et al. 1998; Lee, 2004), lack of corrective actions and revising quality targets (Cin and Pun, 2002).

5.1.3 Poor inventory management

The literature on Lean manufacturing in China indicates poor inventory management within Chinese manufacturing plants as a further barrier to implementing Lean. The term inventory management describes how resources are managed and organised. As mentioned in (See 3.5.1.1) within Lean, single piece flow and low levels of inventory are fundamental for following Lean principles such as pull approach and elimination of waste. Several authors addressed poor inventory management as a barrier to apply Lean manufacturing in Chinese plants (Aminpour and Woetzel, 2006; Comm and Mathaisel, 2005; Taj, 2005; Oliver et al., 1998; Lee, 2004).

High levels of inventory are drastically described in the consultancy report by Aminpour and Woetzel, (2006). They state that waste is ‘endemic’ in local and multinational Chinese factories. This observation is supported by findings from Oliver et al. (1998). Their benchmark study of four car assembler and 14 automotive component plants showed that the Chinese component makers hold five times more inventory of incoming parts as the Japanese plants. Oliver et al.

(1998) explained the prevalent high inventory levels with the lack of JIT delivery-based on long shipping times of overseas imports which has been discussed before. Taj (2005) and Lee (2004) explain the high inventory levels in Chinese plants by the companies' lack of inventory control and inventory management. But little evidence is given. Lee's (2004) quantitative survey study of more than one hundred firms indicated that the most significant benefit of TQM implementation was the reduction of inventory levels. This large improvement potential might indicate poor inventory management within the Chinese manufacturing industry. Comm and Mathaisel (2005) also reported barriers when using JIT production. They indicated high inventory levels within the textile company in their case study. However, they explained the high inventory levels by the use of batch flow production rather than single flow production.

The review indicated different reasons for the high inventory levels found in the Chinese production. However, studies did not investigate what the root causes of the high levels of inventory were. A detailed investigation of barrier and the role of context factors may explain the high inventory levels and poor inventory management found in the literature review.

5.1.4 Missing long term strategy

Missing long term strategy comprises all barriers related to timing and is a central issue in the literature on Lean manufacturing in China. Several authors address inadequate time planning in Chinese manufacturing plants (Comm and Mathaisel, 2005; Chen and Bo, 2008; Aminpour and Woetzel, 2006; Oliver et al., 1998; Paolini et al., 2005; Chin and Pun, 2002).

A general short term orientation within the Chinese plants was reported in the literature as a barrier, because a central underlying principle of the Lean manufacturing philosophy is that all decisions are made on a long term basis even when it results in short term pain (Berengueres, 2007). The literature reported a lack of long term planning within Chinese manufacturers.

Management's short term success expectations and focus on short term benefit was indicated as a barrier for a successful implementation of Lean principles (Chen and Bo, 2008; Aminpour and Woetzel, 2006). Chen and Bo reported the plant perception to be 'too busy' with the normal production to successful apply Lean. Aminpour and Woetzel (2006) also indicated the plant focus on 'fighting fires' rather than the long term implementation of Lean. These findings indicate a general short term orientation within the Chinese manufacturing plants which is not supporting the long term philosophy of Lean manufacturing.

Missing long term strategy, also sometimes described as short term orientation within Chinese plants, leads also to the rushed implementation of Lean processes and Lean tools. The consultancy reports by Aminpour and Woetzel (2006) and Paolini et al. (2005) reported too short ramp-up periods when launching production lines in Chinese plants. They criticised that the lack of time to refine production processes that leads to quality problems. Also Oliver et al.'s (1998) study indicates a rushed Lean implementation. They refer to a quote from a Japanese expatriate manager who was interviewed in their study: *"Usually in Japan, (…) we prepare materials perhaps half a year in advance. But here (in China), the car makers do not give us this time'* (Oliver et al., 1998).

Time to refine production processes when launching a production line is essential for conducting, for example, employee training or making modifications to the machinery settings to ensure the error-free run in normal production. Especially in Lean production, this time to refine processes is needed for applying continuous improvement and elimination of waste from the beginning.

Chin and Pun (2002) explained the barrier by the underestimation of time needed to implement Lean techniques or processes. This explanation might be related to the poor understanding of Lean manufacturing which will be discussed later in a separate chapter.

5.2 Barriers within the social sub-system

5.2.1 High employee turnover

Several authors report high employee turnover as a barrier (Brown and O'Rourke, 2007; Taj, 2005; Aoki, 2008; Aminpour and Woetzel, 2006; Paolini et al., 2005). High employee turnover, as a function of the job market, may act as barrier especially for companies which apply Lean production, because time-consuming and expensive employee training are essential before companies which applied Lean can benefit from their employee. Paolini et al. (2005) reported a general drift of experienced workforce to companies that offer higher salaries. They explain the frequent job jump of the employees within the Chinese manufacturing industry with multiple employment options of the Chinese industry. Taj (2005) also reported high employee turnover rates; they indicate that ten percent of the companies who took part in the survey study reported an annual employee turnover of more than 30%.

The high layoff rates might be the result of the employment policies of the former communist system where the Communist Party was dictating the numbers of employees within a company. Oliver et al. (1998) for example examines in their case study high staffing levels within Chinese companies. They discovered that 'iron rice bowl' job security practices can still be found in Chinese firms. However, little evidence is found that these practises from communist times are still applied these days. In the same vein, Oliver et al. (1998) states that generally there is a move away from these practices and that there is a trend towards modern market-based human resource policies.

5.2.2 Knowledge gap

Another main barrier addressed by several authors was the knowledge gap of the Chinese workforce. The education background is closely related to work styles of the workforce. The education of the workers influences the degree of initiative, participation or team-working abilities. Moreover, there might be more overlaps but, by reason of the frequent consideration of the education background as an implementation barrier this chapter considers education gap and work styles separately.

Brown and O'Rourke (2007), Aminpour and Woetzel (2006), Oliver et al. (1998), Paolini et al. (2005), Chin and Pun (2002) and Lee (2004) named a low level of education and experience of the workers, lack of skills in the local management ranks and deficits in internal trainings as major barriers to Lean manufacturing within Chinese plants.

The Chinese manufacturing industry has grown rapidly in the last decade. To run the production, manufacturing companies recruit an increasing numbers of workers. Well-educated workers with Lean manufacturing experience are becoming rare in the job market. Moreover, driven by cost-saving strategies, many factories intentionally attract poorly educated workers from rural areas, from agricultural villages with little exposure to basic manufacturing techniques (Brown and O'Rourke, 2007; Paolini et al., 2005). As previously mentioned (Sub-chapter 3.5.5), employees play a central role in a Lean production system. The employees within a Lean production system provide individual improvements within the system (Ohno, 1988). A highly-skilled workforce is therefore essential for achieving continuous improvement (Liker and Hoseus, 2008).

Several authors reported that an under-educated workforce may act as a barrier for applying Lean manufacturing. Brown and O'Rourke (2007) described the workforce in their case study as mostly young people from rural areas with limited education and experience in either urban living or industrial work. These findings are similar to case study findings by Oliver et al. (1998). They also reported missing specific expertise with respect to modern manufacturing methods such as TQM and JIT within Chinese workers. Low levels of Chinese expertise are also reported in the consultancy reports of Aminpour and Woetzel (2006) and Paolini et al. (2005). Both observe a lack of basic manufacturing skills of Chinese workers and a lack of technical knowhow. However, the skill deficits are not just restricted to the shop floor level.

Several authors also mention skill deficits within the management ranks. Skilled and educated managers are crucial to provide employee trainings which enable the workers to identify inefficiencies and provide individual improvements in a Lean production system.

Aminpour and Woetzel (2006) addressed a deficit of manager's problem solving skills. Paolini et al. (2005) also reported a lack of skills of local managers which do not enable them to conduct skills development trainings. Lee (2004) supports these claims by addressing a lack of direct teaching by local professionals and academic institutions as a barrier to developing TQM in Chinese firms. Accordingly, Chin and Pun (2002) reported in their case study that missing internal education and training are the explanation for the lack of TQM implementation knowledge.

As mentioned before, the education background is closely related to work styles of the workforce. There is a clear link that the education of the workforce influences the work style. However, based on frequent consideration of authors, the thesis considers both issues separately. Hence, there might be overlaps in the following consideration of the work styles.

5.2.3 Work styles

The work styles of Chinese workers, as part of the workforce characteristics, play a key role in applying Lean manufacturing in China. The main work styles mentioned as barriers are: lack of initiative, little participation, lack of teamworking, tolerance of untidiness. Several authors addressed the lack of self-initiative and little participation of the workers as a barrier (Taj, 2005; Aoki, 2008; Chen and Bo, 2008; Paolini et al., 2005; Lee, 2004; Chin and Pun, 2002). An investigation of transferring Japanese Kaizen activities to overseas plants in China by Aoki (2008) illustrates the lack of self-initiative of the Chinese shop floor workers. The author reported that the Japanese management found it difficult to encourage Chinese workers to show self-initiative. Aoki's (2008) case study showed that employees above team leader level made suggestions to improve work processes. Chin and Pun (2002) also reported a lack of participation. In their study operators and supervisors were unwilling or unaware how to contribute to improvement. Similar findings are found by Chen and Bo (2008). They also reported a lack of worker involvement when implementing the 5S in Chinese manufacturing plants. In their study, line workers considered 5S as extra burden and resist it (Chen and Bo, 2008).

A very few explanations for the lack of self-initiative and little participation is found in the literature. Paolini et al. (2005) explain the non-attentiveness to process and product quality by the top down approach over empowerment. They argue that a non-empowered workforce is not able to bring up their own ideas effectively and take initiative. That a poor empowered workforce and poor delegation of authority hinders Lean is also mentioned by Lee (2004). The role of delegation of authority will be evaluated in a separate chapter called 'management style'.

The reasons for the missing participation and involvement are barely discussed. It might be grounded in a poor understanding of bottom-up improvement philosophy, which might let line workers think that they are not involved in the improvement process. At the same time, a high power distance of Chinese workers from their supervisors is highly likely to constrain them against making own suggestions.

As further work style of Chinese workers which might act as a barrier is a lack of team working skills. Teamwork constitutes an important element of Lean manufacturing and is common in companies using a Lean production system. Paolini et al. (2005) reported a lack of team-working ability within the Chinese workforce. In their investigation Paolini et al. (2005) explain the deficits in of team-working abilities within the workforce with China's one-child policy and resulting ‘spoiled-child-syndrome’. Taj’s (2005) investigation also showed a low score in team participation.

In contrast, the case study by Oliver et al. (1998) draws a different picture. They report that the Chinese plants showed a range of work group structures and one plant used teamwork approaches for a long time.

As further work style that acts as a barrier, several authors addressed a tolerance of untidiness within the Chinese workers. Paolini et al. (2005) reported that Chinese workers tolerance for an untidy or disorganised workplace countered with housekeeping tools such as 5S. Similar observations are made in a case study by Wong (2007). The author reported an ignorance of accuracy within the Chinese workers. Aoki (2008) illustrated the tolerance of untidiness of the shop floor with an example from his case study. The management of one plant installed signs in the manufacturing areas which banned several offences. Aoki (2008) stressed within his case study a higher need for company rules to adjust to the lack of shop floor-based discipline.

5.2.4 Management style

Several authors identified that management styles in Chinese plants act as barriers to applying Lean manufacturing in China. This chapter includes deficits of the management in terms of a lack of operator empowerment, which is related to a hierarchical organisational structure. The consideration of management styles partly overlaps with the chapter on work styles. There is a clear link that the behaviour of the supervisors influences the operators’ behaviour. For example, a despotic management style may make it difficult to get active worker participation or responsibility from the operators. There might be overlaps but, by reason of the frequent consideration of the management styles as a source of implementation problems, management style is considered separately.

Several authors named examples in their studies showing that the company's management style was hindering the application of Lean manufacturing (Brown and O'Rourke, 2007; Taj, 2005; Aoki, 2008; Aminpour and Woetzel, 2006; Wong, 2007; Oliver et al., 1998; Paolini et al., 2005; Cin and Pun, 2002; Lee, 2004). According to the Lean philosophy, shop floor workers need to be empowered to suggest and conduct improvement from the bottom (Liker, 2004). Bottom-up improvement and problem solving are relatively new to Chinese managers (Oliver et al., 1998). Empowered shop floor workers are still not common in Chinese plants; this is indicated in the case study by Aoki (2008). The plants in the case study investigation were mainly managed by Japanese managers, only Chinese employees on team leader level felt empowered to made suggestions to improve work processes. Lee (2004) reports similarly that little authority has been delegated to line managers and workers; consequently on-line improvement was not possible. The author stresses the hierarchical structure of Chinese organisations as an explanation. In the same vein, Aminpour and Woetzel (2006) report that the hierarchical nature of Chinese organisations hinders the cooperation and joint decision-making needed for problem solving. Paolini et al.'s (2005) consultancy report states a general top-down approach over empowerment, with middle managers being afraid of losing authority when implementing Lean manufacturing.

5.2.5 Poor employee training

A lack or poor employee training practices were addressed by several authors. A non-trained workforce is inconsistent with the Lean requirements of a workforce which is able to contribute problem solving and continuous improvement (see Sub-chapter 3.5.5). Without solid training, employees within modern industries may not be able to make critical decisions and fulfil wider tasks such as maintenance or quality control.

Chin and Pun (2002) studied the implementation of TQM in their qualitative case study of six Hong Kong-based companies with plants in mainland China.

Their case study showed a poorly-empowered and poorly-trained workforce in some of the six Chinese plants. Moreover, several authors state that the importance of training was not recognised by human resource management departments in Chinese firms. Consequently, findings showed a general lack of training or inadequate training methods. For instance, Lee's (2004a) questionnaires findings showed a lack of employee training within small manufacturers in the computer and food industry. Brown and O'Rourke's (2007) case study indicated a need for training within the workforce after implementing Lean production at a textile producer who took part in the study. This might indicate that workers did not received additional training after implementing Lean.

It needs to be mentioned that there is not much evidence found in the literature that indicates that the poor employee training was affecting specific Lean elements. However, the evidence shown by the authors might indicate that inappropriate employee training is likely to negatively influence the implementation process.

5.3 Summary of the barriers to Lean implementation in China

Chapter 5 reviewed the literature on Lean implementation barriers within China. The review provides an overview and appraisal of the main examined barriers, which I categorised in a similar manner to the barriers within emerging economies. An overview of the implementation barriers found in literature is given in Table 5.1.

Barriers within technical sub-system	**Barriers within social sub-system**
• Weak supplier performance • Lack of quality control • Poor inventory management • Missing long term strategy	• High employee turnover • Knowledge gap • Work styles • Management style • Poor employee training

Table 5.1: Barriers within China based on the literature review

As main barriers within the technical sub-system are: the reviewed highlighted weak supplier performance, lack of quality control, poor inventory management and missing long term strategy. As barriers of the social sub-system, the review identified high employee turnover, knowledge gap, work styles, management style, and poor employee training.

Regarding the consideration of the technical sub-system, the review indicated that, besides the weak supplier performance, lack of quality control, poor inventory management, and missing long term strategy act as a barrier in China. The barrier ‘missing long term strategy’ was a barrier which was in particular evident in the literature review on Lean in China. Several studies mentioned a tendency towards general short term orientation within Chinese plants, and the management’s short term success expectations and focus on short term benefit. Authors stressed that a rushed implementation of Lean does not leave enough time to refine production processes, which lead to quality problems. Barriers related to a rushed implementation of Lean were prominently found in the literature on Lean in China.

Regarding the social sub-system of Lean, the review showed that high employee turnover, knowledge gap, work styles and management style, and poor employee training were indicated as a barrier in China.

5.4 Conclusion of the literature review

In Chapter 2, I introduced socio-technical system theory and stressed the importance of this theory for studying Lean implementation barriers and their national context factors. The consideration of STS highlights that for successful Lean implementation in China, social and technical aspects need to work together to yield the desired outcomes.

In Chapter 3, I outlined key tools and principles of Lean, and also give an indication of how and where barriers may occur. The main purpose of this chapter was to impart a basic understanding of Lean and prepare the reader for the consideration of implementation barriers.

In Chapter 4 and Chapter 5, I reviewed the Lean literature and identified the main barriers to implementing Lean production systems in China and other emerging economies named in the extant literature.

In the following sub-chapters I will give an overview of the main barriers found in the literature review. Then I will give a compelling critique of the current gaps and justify why it is important to fill them. The literature conclusion ends with an overview of the research questions of my thesis.

5.4.1 Overview of the main barriers found in the literature review

The main barriers found in the literature review are shown in Table 5.2:

	Barriers within technical sub-system	**Barriers within social sub-system**
Emerging economies	• Weak supplier performance • Lack of quality control • Poor inventory management	• High employee turnover • Knowledge gap • Work styles • Management style • Poor employee training
China	• Weak supplier performance • Lack of quality control • Poor inventory management • Missing long term strategy	• High employee turnover • Knowledge gap • Work styles • Management style • Poor employee training

Table 5.2: Barriers within emerging economies and China based on the literature survey.

The review showed that most of the barriers highlighted in the literature are significant for emerging economies as well as China. This overlap between barriers in emerging economies and China does not come as a surprise. By reason of similar country context factors in China and the emerging countries, such as a turbulent macro environment, low education levels, and poor labour relations, it is likely that similar barriers occur.

Nevertheless, the review also showed differences of implementation barriers between emerging countries and China. Some barriers were more evident than others depending on the research context. For example, in the literature on emerging economies, weak supplier performance was a very prominent barrier, whereas the literature on China's implementation barriers focused more closely on a lack of quality control issues.

The review indicated that the barrier 'Missing long term strategies' was found exclusively in China. The fast economic development and the booming industry of China may be an explanation for why the barrier was more evident in China than in the other emerging economies, where growth rates are lower. In times of economic boom, it is likely that companies focus on quick benefits rather than investing in the implementation of a new production system, because the market demands their products even if they do not restructure their production.

Even when similar barriers appeared in the literature review, the reasons for the barriers were not necessarily identical in China and other emerging countries. For example, the review showed that high employee turnover in China and Mexico was influenced by a movement of the migrant workforce in China towards the costal belt in the East of China, and in Mexico towards the USA. Employee turnover as a result of labour movement was not mentioned in the context of India and Brazil. This example shows that the root causes of the barriers might be different even when the barriers (here high employee turnover) appear to be the same. This is why it is so important to discover the mechanisms behind the barriers, and explain which role the national context plays.

It can, however, also be argued that the categorisation progress that I undertook to combine the several different barriers influenced the literature review in favour of similar implementation barriers. The review of studies from both research streams brought a number of different barriers named by authors. However, the literature misses detailed descriptions of the barriers. Overall, within both literature streams, the empirical evidence on the barriers was weak. Most studies did not focus on implementation barriers, and therefore authors just mentioned barriers within their study context without examining them in more detail. These cursory descriptions of barriers in the literature may have influenced me to categorise the findings in favour of similar implementation barriers. Nevertheless, my final listing aims to give the reader an overview of the barriers which are likely to emerge within the data collection.

The literature review showed that there is a gap in the literature regarding in-depth studies which explore and explain barriers within the implementation of Lean in China or emerging economies. The review showed that there is no comprehensive debate in the literature that focuses on barriers which might influence the implementation of Lean. When comparing the barriers, there was little evidence of solid academic studies which focused on implementation barriers. Most studies were descriptive and anecdotal in nature. For example, the publication from Paolini et al. (2005) describes common barriers western organisations are facing when implementing Lean in China. However, their report represents a consultancy publication which is grounded in the authors' work experience, rather than a systematic investigation. In-depth academic studies which are grounded in documented data and systematic research methods are widely missing in the Lean literature on China.

Besides the lack of solid academic studies within the literature, the review showed that the literature lacks studies which give explanations of the barriers. Just a few authors relate barriers to cultural, socio-political, and economic context factors. For example, Aoki (2008) indicates in his study missing participation and self-initiative of Chinese shop floor workers, but gives no closer explanation of the reasons. It remains to be answered whether the workers' behaviour is grounded in a general lack of motivation and unwillingness based on low payment, or whether they are just unfamiliar with a proactive response, which might be grounded in adopting a passive role as a student within a former institutional education. The review showed that the literature did not investigate the mechanisms behind the barriers which led to the root cause of the barrier.

Most studies focused on the technical side of Lean rather than considering the social side. A reason for this gap in the literature might be that authors focus on implementing specific elements of Lean in China, such as 5S, rather than conducting a holistic investigation of the implementation process of Lean. In addition, the production according to Lean principles is relatively new and not widespread in emerging economies, including China. The implementation of Lean production in China might for this reason not have become the research focus of many authors so far.

Not enough evidence was found in the literature review to develop a solid framework of implementation barriers, which enabled drawing country-specific conclusions from the findings. The barriers and the country-specific distinctions shown in Table 5.2 have their limitations and cannot be used to define barriers which are universally significant for emerging economies and barriers which are China-specific.

In summary, the review shows that there are several gaps in the literature. As major gaps the review indicated (a) a small number of in-depth studies which focus on the barriers to implementing Lean in China; (b) most of these studies were descriptive and anecdotal in nature. There was a lack of academic studies that investigate implementation barriers by using comprehensible data sets and research methods; (c) the studies which mentioned barriers do not give explanations of the mechanisms behind the barriers, which help to understand their root causes. Neither do they evaluate the effects of the barrier on the implementation of Lean. A consideration of what role national context factors play within the implementation of Lean is widely missing.

Based on the gaps in the literature, the current research examines Lean implementation barriers within China. For a successful implementation of Lean in China, it is important to investigate whether barriers can be explained by country-specific context factors. An understanding of these Chinese context factors will help overcome them and thereby facilitate the successful implementation of Lean production systems in China. STS theory is used as a conceptual lens to further explain the role of barriers and context factors.

5.4.2 Current gaps in the literature

The literature review of this thesis provides a comprehensive listing of the main barriers that are indicated by prior research on Lean in emerging economies and China. Whilst prior research only hints at such implementation barriers in a fragmented manner, the literature gives provides a detailed overview of the available studies and reports on this topic. The study gives clear indications that most studies are based on consultancy and industrial reports of practitioners and that detailed empirical studies within this field are widely missing. Therefore the review shows that researcher is not aware that this topic is highly relevant for the industry. By reviewing industrial and consultancy reports the review stresses there is a high interest among practitioners study to better understand the role of the national context for the implementation of Lean. The review also shows that most empirical studies do not in particular investigate implementation barriers and the role of the national context, however the authors came across implementation barriers and they stress the importance to investigate what role the national context does play when implementing Lean in China or emerging economies. Therefore, one of the central contributions of the literature review is that the study shows that there is hardly non empirical evidence for the main Lean implementation barriers in China and in other emerging economies.

The review fills this gap by summarising the evidence found in the literature and categorising the Lean implementation barriers into broader barriers. The review combines the fragmented details provided by the literature and therefore provides some evidence of the existence of the main implementation barriers, and gives details why each barrier is a burden for Lean. By integrating the scarce past evidence, and grouping it systematically into such barriers, the literature review contributes to the Lean literature, and also facilitates the transfer of Lean to different country contexts in practice. The barrier categories may inspire other researchers who investigate the implementation of Lean in emerging economies or China to examine whether the barriers are also relevant for their research. It may thereby be possible to work out which barriers are generic and can be found in all contexts, and which can only be found in specific countries. This may serve to build a comprehensive data set which helps researchers gain a better understanding of Lean implementation in different country contexts.

Overall, by demonstrating that most researchers within operational management previously neglected implementation barriers which are requested by practitioners the review stresses the gaps which need to be filled to overcome the implementation barriers practitioners are facing in industry. By categorising other researchers' and practitioner barriers in a more comprehensive manner, this literature review contributes to a more holistic understanding of the Lean implementation in China.

5.4.3 Research questions

The review of the literature leads to the following research questions for this study:

1. What are the main implementation barriers in the perception of the participants?
2. What are the perceived effects of the barriers on the Lean production system?
3. What are the perceived mechanisms by which context factors influence barriers?
4. What roles do the social and the technical sub-system play within the implementation process?

CHAPTER 6

6 Methods

This chapter describes the methodological approach that is adopted to address the research questions. The chapter identifies and justifies the epistemology and methodology underlying this research, before moving to the specific methods of data collection and analysis of this study.

6.1 Epistemology and methodology

Two prominent, contrasting research paradigms are commonly identified, namely the interpretivist paradigm (also called phenomenological or inductive paradigm) and the positivist paradigm (also known as realist or hypothetico-deductive paradigm). As explained by Sheffield and Guo (2007), the interpretivist research paradigm is concerned with uncovering the socially constructed meaning of reality as understood by an individual or a group, whilst the positivist research paradigm is concerned with the discovery of universal laws that can be used to predict human activity, and the physical and technological world.

'Purist' researchers argue for choosing one particular research approach regarding what one believes to be knowledge and reality (ontology), how one understands knowledge and reality (epistemology), and the process of acquiring knowledge and knowledge about reality (methodology) (See Hathaway,1995; Rossman and Wilson, 1985). Taking this purist perspective, some researchers (Guba, 1987, Smith and Heshusius, 1986) claim that the choice between a quantitative and a qualitative research approach has less to do with methodologies than with positioning oneself within a particular research paradigm depending on where one's beliefs lie. This is why some authors argue that the choice of the research approach should not be made at the method level (Guba and Lincoln, 1981), given that choices made at this method level ignore the underlying philosophical assumptions, structuring beliefs about methodology, knowledge, and reality (Hathaway, 1995). Accordingly, interpretivist research is generally associated with qualitative research methods and positivism with quantitative research methods. Qualitative researchers prefer narratives and accounts of the way their respondents interpret the world, whereas quantitative researchers tend to use statistics and sometimes mathematical models to relate research in impersonal terms (Denzin and Lincoln, 1994).

Nevertheless, the choice between a quantitative or qualitative approach is frequently made at the method level rather than the ontological or epistemological levels (Hathaway, 1995). For example, 'situationalists' argue that certain methods are most appropriate for specific situations (Rossman and Wilson, 1985). More specifically, Yin (1984) suggests that the research design and methods should be chosen based on the type of research questions that are asked.

I follow an interpretivist epistemology and, correspondingly, use qualitative methods for this study, because these are best suited to achieve the interpretivist research aims. The main research aim is to develop an understanding of employees' views of barriers to implementing Lean in their particular context, and the country context factors that contributed to these barriers. To achieve this, I needed to obtain an insider's perspective and explore barriers in terms of employees' experience. This is in contrast to the positivist aim of taking an outsiders' perspective and gaining knowledge of an external reality, independently of individuals' experience and contexts. I chose qualitative research methods, because they are known for 'being powerful for relating people's meanings to the world around them' (Miles and Huberman, 1994). Moreover, given the innovative research questions, I could not use any conceptual or empirically grounded model to guide data collection. To expose the main barriers and context factors in implementing Lean production systems in China, the research approach needed to be exploratory and flexible. Qualitative research methods serve this need, as they are sensitive towards variables which are not expected, and they allow the researcher to adjust the research questions to new issues and ideas as they emerge. I will now describe the main methods of data collection and analysis in more detail.

6.2 The case study approach

The case study approach was defined by Yin (2003) as ‘an attempt to examine a contemporary phenomenon within its real life context, especially when boundaries between phenomenon and context are not clearly evident. ‘From this definition, it can be argued that the case study approach is suitable for examining the phenomenon of barriers to Lean production in relation to the real-life firm and the country context, especially for barriers which might be explained by cultural, socio-political and economic context factors. On the basis of the detailed information of barriers in this specific context, I will identify more generic principles that are likely to be transferable to Lean implementations in other manufacturing plants in China. By comparing two cases, namely two sites of the same firm, I was also able to strengthen the confidence of findings obtained in each case (Miles and Huberman, 1994).

The case study approach also accords with the qualitative research method. It allowed me to gain access to a suitable interview sample of Chinese and western employees working in the same locations. My physical presence at both plants over a period of two months allowed me to strengthen the findings further through observations at the research sites.

6.3 Sampling procedure

Theoretical sampling was applied where possible, and convenience sampling where required. Statistical research normally aims for large samples which are representative for a population (Miles and Huberman, 1994). In contrast, qualitative samples tend to be purposive, rather than random (Kuzel, 1992). Consequently, the information gained from a qualitative sample is not considered as representative for a population. The choice of the cases was therefore determined by the initial research questions. This is in line with Miles and Huberman (1994), who argues that a conceptual framework and research questions can help set the foci and boundaries for sampling decisions. The sampling procedure with regard to the chosen industry, host company, plants, and participants is described in the following.

6.3.1 Selection of the industry

The case study is conducted within the automotive industry. The reasons can be identified as follows. Firstly, the original concept of Lean manufacturing was invented in the automotive industry. For several decades, automobile manufacturers and automotive suppliers spent a lot of effort in implementing and refining Lean production systems in their plants. The experience gained in the automotive industry helps to distinguish between universal Lean implementation barriers and those barriers which are present in a certain national context. When conducting Lean research in industries like banking or health care, where the implementation of Lean principles is a relatively recent phenomenon, there is a risk of not being able to differentiate between barriers caused by transferring Lean manufacturing techniques to the service sector and barriers caused by the national context. For these reasons, the automotive industry was seen as an appropriate industry to conduct the case studies.

Womack and his colleagues in the book: 'The Machine that Changed the World'(1990) claimed that at the time of writing, China still focused inwards, pursuing a combination of extremely rigid mass production and inefficient low quality craft production. This 'disastrous combination'(Womack et al., 1990; p. 275) gives China the distinction of the largest motor-vehicle industry in terms of employment and one of the smallest in terms of output. This makes it important to consider what has happened to this industry since 1990 and explore what barriers to implementing Lean manufacturing in China still exist.

In addition, the Chinese government defined the Chinese automotive sector as one of five core industries and agreed to massive financial support to develop the Chinese automotive production. Therefore, it is likely that Chinese automotive companies will restructure their production facilities towards modern Lean production systems. Findings of the study are therefore likely to be valuable for companies in this industry. Conducting the study in the Chinese automotive industry provides the chance to create academic research, which is of great relevance to the industry.

6.3.2 Selection of the host company

The host company is a globally operating German automotive supplier which has been represented in China for several decades and has set up several plants around China. Based on business contacts, I was able to get in contact with the German headquarters of the automotive supplier. Also, my supervisor secured a corporate level introduction to the company. A number of other factors played a part in the case selection.

It was essential that the organisation was using a Lean production system. For a number of years, the firm's headquarters have made an intensive effort to implement the company's own Lean production system worldwide. Choosing a case study company which uses Lean production systems in its production worldwide had the advantage that employees might be able to compare barriers to applying Lean production between different countries.

It was also seen as preferable to choose a foreign rather than a Chinese company, because it allowed me to obtain perspectives of native Chinese as well as western employees, and thereby gain a clearer overview of China specific and universal implementation barriers. Moreover, it was preferable to choose only a single multinational company and investigate two different production plants in different areas. By setting this boundary it was possible to keep certain technical and work organisation structures stable and examine regional differences of barriers within China.

To fulfil these criteria, two Chinese plants of the German multinational automotive supplier were selected for this study.

6.3.3 Selection of plants

Multiple-case sampling was used to add confidence to the findings (Miles and Huberman, 1994). For the present investigation, two Chinese production plants of the same German automotive supplier were chosen. Once the German headquarters approved the research study, I contacted several plants with similar products. According to Miles and Huberman (1994) findings are more robust if a finding that holds in one setting also holds in a comparable setting, in this case similar production systems (e.g. assembly line design, employee numbers within assembly lines). At the same time, contextual differences between cases (such as location) can reveal the influence of these differences. By keeping the influence of the product and firm stable, we were able to investigate the influences of the two plants' different geographic location, and their different level of maturity.

6.3.4 Selection of participants

Creswell (1981) suggests that a researcher should choose participants who are accessible, willing to provide information, and distinctive for their accomplishments and ordinariness, or who are able explain a specific phenomenon. Accordingly, I carefully selected individuals who could deliver first hand information about barriers to implementing Lean production systems in China and at the same time indicate the relationship of these barriers with the national context. Chinese participants were seen as valuable participants especially to acquire information regarding the Chinese national context factors. Because of their experience of working outside China, westerners were suitable to distinguish between general barriers and barriers that were tied to the Chinese country context. Gaining data from a western/Chinese sample further enabled the researcher to investigate the influences of intercultural interaction.

Most of the participant selection was conducted within the fieldwork trip. Just a small number of appointments for interview meetings were made before travelling to China, because respondents of both plants stated they were too busy and therefore uncertain of being able to schedule a meeting more than a few days before the actual meeting date. I therefore followed a snowballing procedure. This approach gave me access to valuable key employees. Because of a good response rate, I was able to specialise my requests towards people with detailed knowledge about Lean manufacturing or whose work was directly linked to the Lean production system.

When planning the research trip, I intended to initiate interviewees from all hierarchical levels. This cross section of participants would serve to get a balanced view of existing barriers as well as to provide a mechanism for confirming the various explanations of the Chinese context factors named by the respondents. Similarly, interviewing both westerners and Chinese was intended to add confidence to the key issues named by westerners regarding the Chinese national context, if Chinese interviewees confirmed the influences of certain context factors as well.

6.4 Plant description

Both chosen plants produce similar electrical components for automobile manufacturers, use a similar production technology, and apply the same organisational structures. Moreover, both plants use similar production layouts (e.g. assembly line design, employee numbers, workplace design) and similar Lean-support by the German headquarters. As previously mentioned, the plants differ with regard to their location and maturity. One plant was set up in 2005 and is located in Changsha, i.e. inside the mainland, around 1,000 kilometres away from the costal commuter belt of China. The second plant was set up in 1999 and is located in an industrial park in Suzhou, near Shanghai.

6.4.1 Lean strategy

Overall, the host company pursues an international expansion strategy. The company follows its main customers in new markets all around the world. With regard to China, the plant has set up more than a dozen plants within the automotive sector established in China. This enables them to deliver goods to the established customers from Europe and North America who produce in China as well as supplying products to Chinese automotive manufacturers.

With regard to the production system, the host company follows a global strategy. All plants around the world follow the same Lean production system. The production system is labelled as the "'Company Name- Production System" but in its core elements it is a Lean production system similar to the principles embedded in the Toyota production system. The production system aims to minimise inventory, has U-shaped production lines, single flow production, JIT delivery, and focuses on continuous improvement.

The host company has spent a lot of efforts in implementing the same standardised production system in every country. The host company has a department within the German headquarters which further develops, distributes and promotes the Lean production system and its production standards to other plants al around the world. For example the department conducts workshops for employees from other plants, does internal audits within plants, and provides a range of documentary and learning material about the company's internal production system.

The efforts of the Lean department aim to standardise the host company's production methods around the globe. Depending on the country's costs of labour or regulations of certain countries, the degree of manual labour within the production process may differ, but the production system and production standards remain the same.

One of the company’s core values is to ensure high product quality within all its products. The company has an excellent reputation for the quality of their goods. To ensures globally the high quality stadarts the headquarters’ strategy is to apply the same production standards by using a uniform production system. The HQ’s strategy is to produce worldwide according to the same established production standards to ensure that the output quality of their products will be the same in every market.

6.4.2 Organisational structure

With regard to the organisational structure of the plant in Changsha and Suzhou there are no major differences. Both plants have the same organisational structure. Both subsidiaries are structured according to different departments for different tasks, e.g.: Production, Purchase, Controlling, Logistics, Quality, etc. Same as the Changsha plant, the plant in Suzhou also has an in-house production engineering division which develops and manufactures machines and entire assembly lines for in-house production and external customers.

6.4.3 Supplier base

The company’s suppliers play an important role for the implementation of Lean at a new production location. The general strategy of the host company when opening a new production plant abroad is, to first deliver the newly set up plant with parts from already established suppliers which already have a positive reputation in terms of quality. Mostly these suppliers are located in Europe but also in other locations such as Korea and work for the host company for several years. After the ramp-up process of the production lines, the company tries to reduce the degree of imported parts and tries to source supplier parts locally.

The advantage of this procedure which was called “localisation” by the employees is saving cost through lower shipment costs, tax advantages, and getting part deliveries just-in-time.

In the case of the two plants which took part in this research, no detailed information of the supplier base in China could get collected. Because of confidentiality reasons this information were kept as a company secret and were not handed out. Nevertheless interviewees revealed that the general tendency of the host company was to source all parts locally through a small number of local suppliers. These were generally located close to the production plants and where small or medium sized companies with a close cooperation with the production lines.

6.4.4 The Changsha plant

Changsha is the capital city of Hunan, a province of south-central China. The city had a total population of 6.53 million in 2007 and its province population is approximately 68 million (KPMG, 2008). Changsha has seen great development over the last years, as its gross domestic product has grown at an average of 15.4 percent per year from 2003-2007, compared with the national average of 11 percent (Changsha Government Office Department, 2011). At the end of 2007, over 1,500 Foreign-Invested Enterprises (FIEs) had established a presence in Changsha, including 26 Fortune 500 companies (KPMG, 2008). However, industry in Changsha is still not as advanced as in the coastal cities such as Shanghai and Shenzhen. The town remains as a centre of rice milling and also has oil-extraction, tea- and tobacco-curing, and meat-processing plants. (Changsha Government Office Department, 2011) The low labour costs and huge volume of workers from nearby rural areas especially, attracts several FIEs to set up production plants in Changsha. The plant in Changsha where the study took place is located in the Changsha National Economic and Technical Development Zone. It is a wholly-owned foreign enterprise by the German multinational automotive supplier.

The plant started production in 2005 as a greenfield plant in a recently set up industrial zone. Since its foundation, the plant had been massively expanded by setting up new production lines and warehouses. By the time the study took place, the plant in Changsha had around 1,000 employees and it was planned to expand the workforce significantly more in the near future. Because of its relatively recent set-up, the plant was still defining its operations.

The plant produces mainly small electrical motors used by automobile manufacturers. The product range includes starter motors, alternators, blower motors, condenser motors, window-lift motors, cooling motors, and wiper motors. The plant is structured along functional departments. This organisational structure includes product engineering, a commercial department (including purchase and logistics departments), sales, quality control, and a special equipment department. The plant also deals with the production and sales of the special machines which are used for automotive spare-part production.

6.4.5 The Suzhou plant

Suzhou is a famous historical and cultural city in China, one of the most important cities in the Yangtze River Delta economic development zone, and the industrial centre of south Jiangsu Province. (KPMG, 2010) In 2008, Suzhou had a total population of 6.30 million (KPMG, 2010).

Suzhou is a well-established industrial area; various multinational companies have set up manufacturing plants here for several years. Major industries are information technology, biopharmaceutical, precision machinery, automobile and auto parts, metallurgy, fine chemicals and new textiles. (Suzhou Government Office Department, 2011) In 2008, 128 ‘Fortune 500’ companies had settled in Suzhou (Suzhou Government Office Department, 2011) Based on the competitive environment and the proximity to Shanghai, labour costs are significantly higher in comparison to Changsha.

The plant is located in a well-developed industrial park within Suzhou. The plant is located in two nearby building complexes in the industrial park. Same as the Changsha plant, it is a foreign enterprise, wholly owned by the German multinational automotive supplier.

The plant in Suzhou was founded in 1999, six years before the Changsha plant, and therefore had well-established operations. Based on multiple employment offers of international firms in the area, management spent great effort to strengthen company loyalty and team building to retain the workforce. By the time of the study, the plant in Suzhou had more than 1,000 employees, and management planned to further expand employee numbers.

Same as the Changsha plant the Suzhou plant produces mainly small automotive components such as brake systems and chassis control systems. The Suzhou plant is following the same organisational structure (functional departments) as the Changsha plant.

6.5 Participants

I conducted interviews with 16 western and 15 Chinese employees in Changsha, and three western and 26 Chinese employees in Suzhou, amounting to a total of 60 interviews (Participants details see Appendix D).

The participants are divided into three major groups according to their hierarchical position within the organisation. This mirrors with the terminology the participants used in the interviews. Employees of both plants distinguished between managers, office workers, and shop floor workers. ‘Managers’ refers to employees in higher leading positions, starting with department managers. ‘Office workers’ includes mainly employees with a university degree who are allocated a private workplace in the office area of the plant. This term refers mostly to engineers, but also to employees working in the HR department. Participants used different names to describe this group, such as ‘indirect employees’, ‘white collar workers’, and ‘engineers’. ‘Shop floor workers’ are mainly employees involved directly in the assembly process or maintenance process within the assembly lines. The majority of this group did not hold a professional degree or a lower technical degree. The highest hierarchy level of this grouping was the line supervisor or operator team leader. This cluster was also called ‘workers’, ‘indirect workers’, ‘blue collar workers’, and ‘operators’.

As mentioned, I initially intended to gain data from participants of all hierarchy levels, to explore the research question from different angles. However, the inclusion of shop floor workers within the sample failed. Several attempts to gain data by an interview with shop floor workers showed that this group was not accessible within an interview situation. One major barrier was missing or marginal English language skills. To overcome the language barrier, a translator was used. However, even with the support of the translator, no usable data were acquired. In the interview situation, the shop floor appeared to be intimidated by the presence of a translator and a western researcher. To gain honest responses or critical comments about barriers seemed to be impossible. For example, after several language-based misunderstandings among all attendees, the translator simplified the questions by asking after the main ‘problems’ rather than main implementation ‘barriers”. The workers’ repeated answer was: “No problem!...No problem!”. Moreover, it seemed that the workers did not understand the reason for the interview situation or the purpose of the research study. Low levels of education and high power distance can be an explanation for these worker behaviours.

Omitting operators as a sample restricted me in obtaining an inside view on the barriers within the shop floor. Facets of the operators’ personal views on barriers and their personal explanations of which role the national context plays have not been captured within my analysis. However, by interviewing participants who work closely together with operators, insiders’ views of the barriers within the shop floor were captured. Moreover, most operators do not a have detailed knowledge of the functions of the Lean production system. Therefore, their abilities to contribute to the understanding of barriers may be very limited. A detailed knowledge about the Lean tools and their effects on the production system is needed to provide information about barriers which can be processed by the study. Therefore, it can be argued the ‘forced’ exclusion of the operators on a wide scale had no major impact on the results. Conducting interviews with experts working closely with operators provided high quality data and helped to get a rich and detailed picture about barrier within the shop floor.

A comparison between different perceptions of implementation barriers was still possible among the other two participant groups. By comparing the perceptions of managers and engineers, it was possible to highlight barriers from a different angle. For example, managers explained employee turnover within the middle management as a crucial barrier, whereas interviewees from that work group did not consider this as a main barrier. Moreover, engineers indicated the high employee turnover among operators as crucial barrier for Lean implementation.

Within this study, the highest number of interviews was conducted within the middle management. The majority of these participants were office workers in the role of production engineer whose work was directly linked to the Lean implementation process. This had the advantage that most of these employees had hands-on experience when working within Lean production, and at the same time had a grounded knowledge about Lean principles.

Participants at management level were mostly department managers. Besides gaining important information within the interview situation, involving high level managers in the study also had the advantage that they acted as gate keepers and initiated further access to potential interviewees, by recommending subordinates that I could contact. Moreover, other interviewees were more willing to participate in my research when the research was supported by the top management. The interviews at corporate level, including one plant manager in Changsha and a division manager in Suzhou, were especially helpful in this respect.

6.6 *Methods of Data Collection*

6.6.1 Qualitative interviewing

The main strength of qualitative interviewing is its suitability for exploring meanings that the interviewees attach to concepts and phenomena under investigation (King and Horrocks, 2010). Qualitative interviewing allowed me to acquire first-hand information about implementation barriers addressed by interviewees. This enabled me to not only validate barriers found in the literature review through insider information, but also to reveal additional barriers that were important in the eyes of the participants. The flexibility of interviews allowed me to focus on specific issues during the data collection. For example, when the interviewees named unexpected factors that might influence the implementation process, I included this in the interviews. This flexibility was particularly important because the study could not draw on any established conceptual or empirically grounded model.

Moreover, qualitative interviewing enabled me to investigate perceived causal links between a barrier and certain context factors, and between the barrier and Lean success. Especially perceptions and explanations by Chinese employees supplied important information to relate barriers to Chinese context factors. Semi-structured interviewing also enabled me to draw conclusions from the detailed data which went beyond participants' literal reports. I made use of this method especially when participants were not aware of all barriers or certain context factors, for example when workers did not have detailed Lean knowledge to explain barriers, or when western interviewees were not aware of certain Chinese context factors.

Qualitative interviewing had further advantages for examining the research questions. Compared to the technical sub-system, it is harder to observe the social sub-system of Lean. For example, people's perceptions and evaluations of their own and others' behaviour cannot be observed. The interview situation enabled me to acquire information about such behaviours through participants' personal perceptions. Moreover, I was able to explain barriers within the technical sub-system from the view of the participants, rather than relying merely on observable data.

6.6.1.1 Pilot case study

Before the main interview stage, I accomplished a pilot case study at German headquarters, which helped me to refine and finalise plans for the main data collection, including the content of the data and the procedure to be followed (Yin, 2003). As Yin (2003) argues, researchers may be less scientific with regard to the selection of pilot cases than the main case study, because the main purpose of a pilot study is to clarify concepts relevant to the research design, developing questions, and practising the interview situation, rather than gathering conclusive data (Yin, 2003). The researcher can therefore choose the pilot case mainly based on convenience, accessibility and geographic proximity.

In December 2009, I conducted pilot interviews at headquarters of the automotive supplier in Germany who agreed to take part in my research. Two engineers who had spent several months in the plant in Changsha and Suzhou were interviewed. The third participant was a high-level manager responsible for worldwide employee education about the company's internal Lean production system.

The three interviews conducted within the pilot study were largely unstructured. The participants were asked simply what challenges they faced when implementing the internal production system in China. The aim was to develop an understanding of the major implementation barriers employees may face in that setting, and explore influential country context factors. At the same time, the pilot study allowed me to gain important training and practice in interviewing people for the main interview study in China.

The interviews were tape recorded and transcribed. In the analysis, I highlighted important quotes manually and took the first field notes. The analysis helped me to develop a preliminary interview guide for the planned main interview study in China. After the pilot study, the interview guide included merely the main themes that the participants mentioned in the pilot study, as well as barriers gained from the literature. To maintain openness within the first interviews of the main stage, the interview guide consisted mainly of a list of key words which I could use when interviewees did not speak about themes spontaneously.

The main barriers and influential context factors found by conducting the pilot study are listed in Appendix A – Interview guide (Early Version). Besides the main themes which the participants mentioned in the interviews, the pilot study itself was helpful for the later research trip to China. The interviews gave important insides about the different case settings. For example, the participants' explanations gave me important insights into the organisational structure of the plants, the case setting (information of production line setting, and information about the products range), differences between the two case study plants (maturity, Western-Chinese employee ratio).

Moreover, the pilot study was also important source for getting contact information of colleagues in China which were recommended by the participants. The contact information provided by the pilot interviewees showed to be very helpful to get already first contacts of Lean experts which could be contacted upfront to arrange interviews in China.

Also to conduct an interview within the pilot study in the headquarters with the manager from the headquarters' Lean implementation team brought important insights. The interview showed that headquarters was eager to roll out the company's internal Lean production system to all production plants worldwide. Moreover, the training effort, provided learning material, and worldwide Lean audits as described in detail by the manager indicated the company's disposition to implement Lean to a high standard in all their subsidiaries. Also the efforts of the host company to establish an own department which was responsible to implement the same Lean production system in all plants gave insights into the willingness of the company to implement Lean to a high standard in China.

6.6.1.2Main interview study in China

For the main interview study in China, I carried out 60 semi-structured interviews. The interviews with Chinese- and English-speaking western participants were conducted in English, and those with German employees in German. The duration of each interview was between 30 and 45 minutes, with an average of 36 minutes.

During the main data collection trip in China, I received a lot of encouragement from most of the interviewees. Several managers and subordinates recommended other employees who would be able to provide insights for my study. The interviewees' interest in my research is reflected in the effort and detail of the answers given by most of them. Almost all respondents expanded the scheduled 30 minutes of the meetings. Even high level interviewees took the interviews very seriously and did not answer incoming calls. Three interviewees also suggested and conducted a second interview when the time slot booked was not long enough.

6.6.1.3 The interview questions

The interviews aimed at the interviewees' personal perceptions regarding the following core questions:

- *"What are the main barriers when implementing the company's Lean production system?"*
- *"Can you explain those barriers by the national context of China?"*

The first few interviews were only guided very broadly. Key words from the conceptual interview guide (See 6.6.1.1. Pilot case study) were brought in when interviewees could not think of further barriers or factors influencing the implementation process. The guide was continuously adjusted when unexpected themes emerged. The progressive development of the interview guide is presented in Appendix A and B.

Throughout the study, I tried to direct the interviews broadly, according to major themes named by former interviewees. Nevertheless, the degree of openness was not reduced much over time. During the entire study, the interviews were led mainly by the interviewee rather than the researcher. The initial research questions remained the same in all interviews.

Throughout the study, I was able to detect patterns of barriers which were mentioned frequently and explained by the same context factors. For example, high employee turnover was frequently related to China's economic growth and the company's' needs for experienced labour. To investigate new themes, I brought in less frequently mentioned factors mentioned by other participants to check whether the interviewee also found these factors to be influential. Through this, emergent themes were investigated in further depth throughout the study.

6.6.1.4 The interview setting and procedure

Before the interview, I sent an email to the participants, informing them about the research project itself, the approval by headquarters and the plant manager, the confidentiality of the interview data, and the broad research questions. Generally, the interview started with a personal introduction. I mentioned that I had studied automotive engineering in Germany and was doing my postgraduate research at Loughborough University. This was followed by a brief overview of my study and the statement that the interviewee data will be handled confidentially. Highlighting that I was a PhD student from an English university contributed to my appearance as an external to the firm. Handing over Loughborough University business cards, using stationary with the Loughborough University logo, and wearing the ID card on a Loughborough University neckband were all attempts to distinguish myself as a company external. Because there was no cooperation with English subsidiaries and the case study plants, the fact that I came from England also contributed to be considered as not related to the company.

Generally, the interview took place in the company's meeting rooms. However, I arranged to pick up the interviewees personally from their workspace. This had several advantages, by picking up the participants at their work desk my presence was shown among other potential candidates. Sometimes I had the impression that being in the office as an outsider created curiosity and interest around other employees. Also, some of the interviewees seemed to feel flattered to have a private meeting with a western researcher who did not belong to the company. This might indicate that I was considered as an outsider and contributed to interviewees drawing more honest pictures regarding company-internal barriers.

By meeting at the interviewees' work spaces, I was several times introduced personally by the interviewees to other employees who later also took part in my study. When an interviewee was delayed, the time waiting at this work space in the open office was used to observe the work setting and other employees. For example, I was able to observe whether the company's Lean production system office was also promoted in the office area via information boards or other displays. Moreover, I was able to check whether the interviewees were spending personal effort in following the Lean-office standards at their own workplace. Walking to the meeting room together had the advantage that I was able to have an informal chat to warm up the interviewee, which usually contributed to a more familiar atmosphere in the consequent interviews.

The meeting rooms were pre-reserved for my study and distractions through other people entering the room rarely happened. To conduct the interview in a separate meeting room brought the advantage that in the one-to-one situation it was more likely that interviewees would mention critical comments against the company or colleagues. However, a Chinese and a German manager in Changsha explicitly stated their wishes to conduct the interviews at their manager desk within the open office. Their intention was to remain accessible for their subordinates and able to answer phone calls. However, the statements made in both interviews showed that the managers had no concerns that their subordinates were able to listen to the conversation. Both managers stated sensitive information in a more quiet voice.

6.6.1.5 Relationship with participants

King (1991) defines the nature of the relationship between interviewee and interviewer as a core characteristic of qualitative interviewing (King, 1991). Establishing a personal relationship with participants can be conducive to the data collection, as it serves to gain a better understanding of the meaning of participations' answers (Zimmermann, 2008). A second issue regards the researcher's ability to adjust the questioning style to the response style of individual interviewees. For example, if interviews are conducted in a language other than the interviewee's mother tongue, the interviewer is able to simplify the initial interview question by the use of different vocabulary, if necessary. In this study, when interviewing Chinese respondents in English, the interview questions were sometimes reworded to make it easier for the interviewee to understand them.

In the fieldwork I tried to some extent to build up a relationship with the participants before conducting the interview. For example I scheduled at least one interview a day after lunch time. I then asked the interviewee upfront whether she or he was willing to have lunch together in the company's cafeteria before conducting the interview. This had several advantages. Sharing a meal with the researcher before the interview created among the interviewees a more familiar atmosphere. In the informal conversation within the lunch break, the participants often already named issues which were relevant to the study. Those issues were brought up in the subsequent interview again and investigated in more depth. Being present in the plant's cafeteria also aroused the attention of other colleagues. Interviewees who had already scheduled a meeting with me thereby got to see me beforehand and also felt more relaxed by seeing me with other colleagues. At the same time, my presence created curiosity for my study among other employees and encouraged some to participate. This can be seen in the fact that, when first meeting me personally, several interviewees and even high level manager mentioned that they already knew who I was because they had seen me in the cafeteria.

Moreover, my former work experience in China and my educational background as a mechanical engineer were helpful in building up a rapport with some interviewees. I also showed my interest in China by introducing myself to Chinese participants in Chinese and naming several places I had visited in China, to indicate that I had somewhat of an understanding of Chinese cultural issues, which could contribute to a trustful atmosphere. My personal occupational background as an automotive engineer helped to 'be on a par with' other interviewees with an engineering background and therefore contributed to the rapport with those participants.

Another issue influencing the interviewees' behaviour is the interviewer's behaviour within the interview. Qualities such as being clear, gentle and an active listener are valuable in order to make respondents open up (Kvale 1983). Conducting the pilot study upfront helped me to develop these interviewer qualities. The initial interviews started with easy questions, regarding the work history and intercultural experience of the interviewees. Re-briefing answers, providing empathy and understanding were some of the strategies applied in order to achieve the double aim of extracting information and yet sustain a pleasant atmosphere for the interviewees.

The strategies and approaches employed appeared to be successful to motivate most of the interviewees to answer additional questions and requests by the interviewer.

6.6.1.6 Intercultural dynamics

Intercultural dynamics were also taken into account. The fact that the researcher was German might have influenced the interview. When interviewing German participants, they considered me as a member of their in-group in terms of nationality. This was evident when they used expressions such as ‘we’, ‘us’, and ‘our’ which implied that I was considered a member of the in-group. This probably encouraged the German participants to draw a more honest picture when criticising issues related to Chinese national context. Because I conducted the interviews with German participates in their mother language, there was no sign that I was considered English because of my English home university.

When conducting interviews with Chinese participants, the influence of my origin was less evident. In some interviews, I did not explicitly promote my German nationality, and some Chinese may therefore not have considered me as German. However, for most of the Chinese participants, my origin was present or mentioned in the introduction. I was surprised that the Chinese participants did mention also very critical comments regarding the German context. An explanation might be that because of their interaction with Germans, they had adopted a more direct style of communication and criticism.

6.6.1.7 Audio-recording of interviews

Using a recording device enables the researcher to pay full attention to what is being said without being distracted by note-taking (Bryman, 2004). Within the study, recording the interview conversation proved to be very useful, in particular because of the length of most interviews. As Bryman (2004) further commented, tape recording has the advantage that beside the spoken language, information is caught about the way an interviewee gives the answer. Emotional comments such as laughs or pauses may offer important information regarding the interviewee’s perceptions. Furthermore, audio-recording was helpful when conducting interviews with a translator. The conversation between translator and the Chinese interviewee was also recorded. When analysing these interviews with the help of a Chinese translator who listened to the conversation again, it was possible to check if translations errors were made within the fieldwork. By applying this procedure, it proved that translations errors were indeed made and, as a consequence, these interviews were not used for the investigation. Only a single participant felt uncomfortable with recording and refused it. In this interview, I took notes. However, within the interview, the participants showed a general disinterest (an ‘I cannot be bothered’ attitude) towards the research study.

Hand-written field notes were used to record data collected during the research trip. These notes proved to be helpful for gathering information which could be not captured in the interview. For example, notes which described if participants seemed nervous or busy could also be taken into account. Additionally, when interviewees wanted to explain an issue by making a sketch, field note sheets could be used to draft it on paper.

6.6.2 Document analysis

Miles and Huberman (1994) distinguish between contextual document analysis which refers to the investigation of documents and provides an understanding of the research context, and specific document analysis which refers to the investigation of documents which are directly relevant to the research topic. I collected contextual documents that were available either publicly or to employees, for example the plant internal monthly newspaper, worldwide company magazine, and product brochures. I used these documents to acquire information about the company, the products and the company context.

It was not possible to conduct an extended specific document analysis. Based on high security regulations that aimed to prevent industrial spying, it was not allowed to make photographs of charts or collect internal documents. Strict security checks and luggage searches when entering and leaving the plant were conducted by plant security. The use of a mobile phone was not allowed and the integrated camera was taped with a security sticker to prevent visitors taking any pictures. As a consequence, no specific documents were secured during the field research. Nevertheless, within a small scale, specific documents analysis was conducted. During the several guided tours among the shop floor, I memorised information that was published on the visual boards within the assembly lines. For example, illustrations and figure sheets at the visual boards gave me an impression of the number and type of quality deviations. Moreover, pictures on work instructions also gave me an impression of specific quality deviations which occurred within the assembly process.

Organisational charts of departments helped me to get information about the ratio of westerners and Chinese employees, and their positions. For example, an organisational chart in Suzhou showing the hierarchy of the plant's Lean implementation team helped me to get access to key employees responsible for Lean implementation. However, based on the small scale of the document analysis conducted, triangulation of the interview data through document analysis was very limited.

6.6.3 Observations

Observation is a data collection method specific to qualitative research, as the observation takes place in the natural context of occurrence (Adler and Adler, 1994). Within the field research, I spent two months in the plants and was able to observe the natural context of occurrence within both cases. Observation in the plants proved to be an effective method of developing an understanding of the context within which members were interacting. Through observations, the researcher was able to gather both direct and indirect information on implementation barriers and influential context factors.

During my stay on site, I visited the shop floor several times. Guided visits of the assembly lines by responsible engineers helped to develop my understanding of the barriers in their natural context. At the same time, these excursions gave me the possibility to observe employees during their work. The observations in these settings were aimed at gathering additional information or confirm information on implementation barriers and context factors that interviewees had named in the interviews. For example, interviewees explained certain worker behaviour by high-power distance. When walking through assembly lines with engineers, I observed that the presence of the engineer and researcher changed the behaviour of the operators. However, such observations were to some extent limited. Because of safety and industrial anti-spy rules it was not possible to conduct unguided observations within the shop floor. I recorded such observations of host company employees and the plants, as well as informal discussions with participants, in the field notes. A sample of the field notes can be found in Appendix E.

6.7 Methods of Data Analysis

6.7.1 The Use of Data Analysis Software

The interview transcriptions were imported and coded in QSR NVivo. The software allows storage and retrieval of qualitative data, coding, memo, sorting and provides a searching facility (Barzelay, 2007). NVivo proved to be very useful for data analysis, especially for the coding procedure, where appropriate segments of interview texts were assigned descriptive codes. The software had its biggest advantage within the data analysis when conducting cross comparisons. NVivo enables the user to look at certain interview data separately. For example, by looking up data gained from western and Chinese interviewees separately, it was possible to compare these interviewee groups' perceptions regarding certain implementation barriers separately. Moreover, the program proved to be a very effective way to obtain an overview of the statements all participants had given regarding certain barriers and factors. This helped to analyse which barriers and factors were seen as most important by the participants.

Some researchers criticise the use of software in qualitative studies. In particular, there are concerns that the use of software in qualitative studies leads to a loss of the relationship of the research and data (Tesch, 1990). The fear is that the researcher can lose sight of the 'ends' and purpose of the data analysis (Burton, 2000). However, considering the scale of the study, manual data analysis was inappropriate. Because of the iterative nature of the data analysis, manual data analysis would make procedures like regrouping or modification of codes within an advanced stage of data analysis very cumbersome. Moreover, conducting manual coding by using different coloured text makers to highlight different codes was seen as less practical for this amount of data.

6.7.2 The coding procedure

The data analysis started during the fieldwork phase, where I created codes to capture emergent themes. After each interview, new themes and responding codes were summarised in keywords and added to the interview guide. Therefore, the coding process was an iterative process of data collection and data analysis.

The main data analysis started after returning from the field. I used QSR NVivo 8 to analyse the fieldwork data systematically and in depth. I first coded the interview transcripts according to the coding structure that I had developed during fieldwork, which drew on both the literature and the interviews. In the more comprehensive software analysis of the transcriptions, overseen themes were identified. By carefully reading through the transcripts and making comparisons between different interview transcripts, it was possible to further modify or merge codes as well as develop sub-codes. The coding procedure also allowed me to exclude unrelated data from the further data analysis. Examples of early NVivo coding trees which illustrate the development can be found in Appendix C. During the analysis, codes (for example ‘Adjustment’ or ‘Management commitment missing’) were excluded, because the analysis showed that only very few employees indicated that these themes were influential. Moreover, a number of codes were merged throughout the analysis. For example, ‘Wrong expectation of work’ was merged into ‘Lack of industrial experience’, and ‘importance of monetary reward’ was merged with the code ‘Economic growth’.

Organising appropriate segments of the interview text and assigning them with codes contributes to the process of ‘data reduction’, i.e. the process of selecting, focussing, simplifying, abstracting and transforming the data that appears in written field notes or transcripts (Miles and Huberman, 1994). Using the main codes, I displayed data using matrices and graphics. The display of data in such forms helps to see ‘what is happening’ without processing large amounts of extended text, and to see patterns in the data (Miles and Huberman, 1994). The matrices and graphs helped to differentiate between implementation barriers and influential national context factors, and to illustrate the relationship between them. This was an important step in developing a model of Lean implementation across the participating sites.

6.7.3 Cross-Case Analysis

Cross-case analysis aims to explore patterns across cases (Ragin, 1987), and deepens understanding and explanation (Miles and Huberman, 1994). A cross-case analysis was undertaken to examine influences of the case setting on the implementation barriers and factors. For this purpose, I conducted an in-depth comparison of barriers, their effects on Lean, and context factors in relation to (a) the location and the seniority of the two plants (b) the views of western versus Chinese participants, and (c) responses at different hierarchy levels.

I started the cross-case analysis after all interviews were coded. Using the NVivo function ‘Node lookup’, I was able to look at certain interview data from the different plants and from the different participant groups separately, and then compare them to each other. I first divided the entire data set into data from Suzhou and data from Changsha. By looking at codes from different locations separately, I was able to check whether themes emerged more or less strongly at one of the plants. I also looked separately at the perceptions by westerners versus Chinese respondents on barriers, effect on Lean, and factors, in order to work out differences between these participant groups. Further, I subdivided the data according to the hierarchical position of interviewees, and was thereby able to work out differences in views of engineers and managers on particular issues. NVivo proved to be very effective for obtaining separate overviews of the statements that participants from Suzhou and Changsha had given on certain barriers and factors.

The possibilities in NVivo to look at specific data sets separately did, however, also lead to difficulties. When looking at very specific data, it was difficult to work out how the participants’ views differed. For example, when looking up a specific code mentioned by Chinese managers in Suzhou, and comparing it to the views of German managers within Changsha, it turned out that the program indicated only a very small number of participants who fulfilled the searching criteria, because they had described these points from different angles and I had therefore coded them with different codes. For this reason, it was sometimes not possible to generalise from the statements that came out of the NVivo search and detect patterns across both plants based on these statements. However, by reducing the depth of the search, e.g. looking at comments by engineers and managers without distinguishing between plants, I was able to look at a broader data set and thereby work out differences and similar patterns between both cases.

Final conclusions on barriers, context factors, and interrelations were drawn after conducting the cross-case analysis. This is in line with Miles and

Huberman's recommendation that conclusions should not be drawn too early, but only in the late stages of the data analysis, because causes and effects may not remain the same as research progresses. The results of the cross-case analysis are presented in the discussion chapter (Chapter 8).

6.7.4 Developing the Lean implementation model

A model was developed on the basis of the main implementation barriers and the most influential national context factors. The model will be presented in the results chapter (Sub-chapter 7.4, Figure 7.9). Due to the lack of prior research on Lean implementation barriers in China, the model was derived largely inductively. Within the data analysis I realised that a number of different context factors were perceived to influence a range of barriers. I therefore looked for ways of illuminating the complex role that the national context had in creating each of the indicated implementation barriers. Drafts of the first, preliminary models are presented in Appendix F.

Sub-models were developed within the data analysis of each implementation barrier (See, for example, Figure 7.1: Sub-model 'High employee turnover'), and were later assembled to an overall, final model. The sub-models include three columns, namely a list of factors, the barrier with short descriptions, and a column which states the effects of the barrier. Factors which were identified as influential are highlighted and connected by arrows with the barrier. Therefore the sub-models illustrate which context factors were influential. In the overall model, all sub-models are assembled and illustrated in one drawing.

During the data collection and initial analysis, a high number of barriers related to the social sub-system of Lean emerged. To capture this importance of the social sub-system for the implementation process, the final model indicates which of the main barriers are related to the technical or the social sub-system of Lean. Here, it needs to be mentioned that a consideration and distinction of the social and technical barriers was not planned initially. After the data collection and initial analysis, I decided that socio-technical system theory would be useful for explaining the data in more depth, because respondents explained how social factors more than technical ones were barriers to Lean implementation. After consulting the literature, I decided that this finding corresponded to socio-technical system (STS) theory. I regard STS theory as an appropriate theoretical construct to explain how important the social sub-system of Lean and its alignment with the technical sub-system are for a successful implementation. Therefore, the inductive data analysis was informed iteratively by extant theory, which accords with Eisenhardt's (1989) recommendation for developing theory from case study research. Corresponding to Walsham (2006), the choice of socio-technical theory was necessarily subjective and based on the researchers' knowledge of the literature. Walsham (2006) further argues that theory can in interpretivist studies be used in 'lighter or tighter ways' (2006: 324). I chose socio-technical system theory as a broad theory that explains certain principles of the barriers within the Lean implementation model, but does not specify them in detail. Hence, the research and the implementation model remain highly inductive, whilst they are interpreted through STS theory at a higher theoretical level.

6.8 Criteria for judging the quality of qualitative research

Within the methods chapter, I have justified the choice of qualitative research methods. It is now important to specify the quality criteria that the methods are designed for. These criteria allow readers to judge the quality of my research methods and results.

Within positivist research, the traditional quality criteria are external and internal validity, generalisability, and reliability. These criteria aim to achieve objectivity by eliminating the dependence of findings on specific observers, situations, and research instruments (Henwood and Pidgeon, 1992). Within interpretivist research, however, it is accepted that data is dependent on the study context, and interpretivist research therefore has to follow other, more suitable, quality criteria (Lincoln and Guba, 1999; Miles and Huberman, 1994). In the following, ‘credibility’ and ‘transferability’ are presented as important quality criteria for qualitative, interpretivist studies.

According to Lincoln and Guba (1981), ‘credibility’ replaces the positivistic criteria of ‘internal validity’. Instead of aiming at validity, i.e. that findings represent a single reality which is independent of the respondents’ interpretations, interpretivist research should ensure that the researchers’ representations accord with the respondents’ perceptions of reality. Findings are credible if this is fulfilled. Credibility can be enhanced by using, amongst other methods, theoretical sampling, negative case analysis (i.e. analysing reasons for contrasting views of participants, e.g. examining when interviewees had contrasting views, and thereby find out what factors made a difference), prolonged engagement, persistent observation, triangulation, and participant evaluation (See Schwandt, 2007).

A first step to enhance the credibility of my study results was to select appropriate cases and participants. As described, (See Sub-chapter 6.3) the industry, host company, plants, and participants were carefully selected through a procedure of theoretical sampling. For example, choosing the automotive industry as a target industry makes the results more credible, because the original concept of Lean manufacturing was invented in the automotive industry and over several decades, automotive companies have spent a lot of effort in implementing and refining Lean production systems in their plants. The case company was one of the early adopters of Lean in Europe and had restructured their internal production system towards Lean several years ago. Their excellent reputation for product quality, and their status as one of the major car parts suppliers in the worldwide automotive industry, may reflect that the company was able to establish their internal Lean production system in most of their plants successfully. Therefore, conducting research within a (Lean) experienced industry and one of the key players strengthens the credibility of the results. Selecting two greenfield plants within China also contributes to strengthening the credibility of the study, because machinery and employees were not influenced by any former traditional production system on that site. By achieving top management support by both plant managers I was able to get access to key employees who delivered first hand information about implementation barriers to implementing Lean production systems in China. Getting access to western and Chinese employees was valuable because Chinese participants were able to provide information regarding the Chinese national context factors, whilst westerners were suitable for distinguishing between general barriers and Chinese specific barriers.

Triangulation of my results also contributed to the credibility of my findings. Yin (2003) argues that a major strength of using case studies is that they provide access to different sources of data. I triangulated my data firstly by obtaining and comparing responses from two different plant locations and different participant groups, namely western and Chinese respondents, and respondents at different hierarchy levels. Secondly, although most data was gained in interviews, some was also obtained through document analysis and direct observations. Data from all of these data sources was used to triangulate the overall study findings. Thus, document analysis was used to triangulate information gained in the interviews. For example, interviewees mentioned the strong support sent out by headquarters to support the company's worldwide Lean production system. Document analysis of the monthly plant newspaper showed evidence of these efforts. An article referred to a recently conducted Lean workshop in the plants, initiated by headquarters' Lean implementation team. Observations made by the researcher during the fieldwork were also used to triangulate the interview data. For example, the researcher observed that within both plants, operators seemed to be much younger than most operators in Europe. This confirmed the interviewee reports regarding worker demographics.

According to Lincoln and Guba (1981), 'transferability' replaces the positivist criteria of 'external validity', i.e. that findings can be generalised to the population for which the sample is representative. In interpretivist research, participants are not sampled according to their representativeness, and findings are meant to be specific to the context of the study. The aim is therefore not to achieve generalisability to different contexts, but only to provide ‘thick descriptions’ of the context, which allow other researchers to choose similar contexts and examine empirically whether findings transfer to such similar contexts (Henwood and Pidgeon, 1992). To which degree the findings of one study are applicable to another depends on the similarity of the context to the original study. Accordingly, the present study provides comprehensive descriptions of the study context in the current methods chapter, and in the results chapter (Chapter 7). By providing contextual information in such a detailed manner the study gives indications about the transferability of the study findings.

CHAPTER 7

7 Results

7.1 Introduction

The previous chapter provided a description of the research methods used in the thesis. In the current chapter, I will report on the results regarding the investigation of the main barriers to implementing Lean in China. A description of the findings will be presented along with direct quotations from the interview data to reflect participants' perspectives.

The current analysis of the interview data is focussed around the following key research questions. The fourth research question that refers to the socio-technical systems approach is discussed in the Chapter 8:

1. What are the main implementation barriers in the perception of the participants?

2. What are the perceived effects of the barriers on the Lean production system?

3. What are the perceived mechanisms by which context factors influence barriers?

The consideration of the results will lead to an overall model which describes the implementation process of Lean in China. The final 'Lean implementation model in China' is assembled by three internal barriers and three external barriers to the case organisation. First, these external and internal barriers will be described in sections 7.2 and 7.3. In these two sections, each barrier will be described separately. Each consideration starts with the presentation of the specific sub-model. I will then provide a definition of the barrier, followed by a description of the barrier in detail. An overview of barrier definitions is provided in Table 7.1. This is followed by a consideration of the effects that the barrier has on the Lean production system. Each barrier section ends with a consideration of the influence of context factors on the barrier. In Sub-chapter 7.4, the complete 'Lean implementation model China' is presented and explained.

External Barrier	**Definition Barrier**
High employee turnover	The term describes resignations of employees by those individuals taking the initiative to leave the company. It does not reflect planned termination, retirement and any redundancies by management. Neither does the term include internal turnover when employees leave their current positions and take new positions within the organisation.
Weak supplier performance	The term describes a lack of supplier performance in form of suppliers' missing ability to deliver components with stable quality specifications, in the required amount, and at right timing.
Market conditions	Market conditions is a barrier within the external market environment which the host company is exposed to. The barrier includes interactions between the host organisation, in the role of a product supplier, and automotive manufacturers within China, in the role as business customers. The barrier also reflects problems grounded in the structure of the Chinese market place.
Internal Barrier	**Definition Barrier**
Lack of Lean knowledge	Lack of Lean knowledge refers to missing or insufficient knowledge about Lean production principles, and their practical application, among employees or individuals working with the

	host organisation. This has to be distinguished from the missing Lean knowledge which was mentioned as a context factor, where it referred to the China-wide phenomenon of missing Lean knowledge.
Intercultural communication	Intercultural communication refers mainly to communication barriers between western and Chinese employees. The term is also used to describe difficulties of communication between employees from different hierarchy levels, and between office level and shop floor employees.
Work styles	Work styles refer to employees' skills and actions that determine how the individuals or a group of individuals approaches job functions. The main work style barriers were: workers' disregard of instructions and procedures, lack of maintaining standards, and lack of problem solving.

Table 7.1: Definitions external and internal implementation barriers

7.2 External barriers

7.2.1 Definition of 'External barriers'

External barriers refer to those impediments to Lean implementation that are situated in the organisation's external environment. In contrast to context factors, which are China-wide phenomena and affect the barriers, the 'external barriers' have an immediate effect on Lean implementation in the firm. Three external barriers were found within the environment of the organisation: high employee turnover, weak supplier performance, and market conditions.

7.2.2 High Employee Turnover

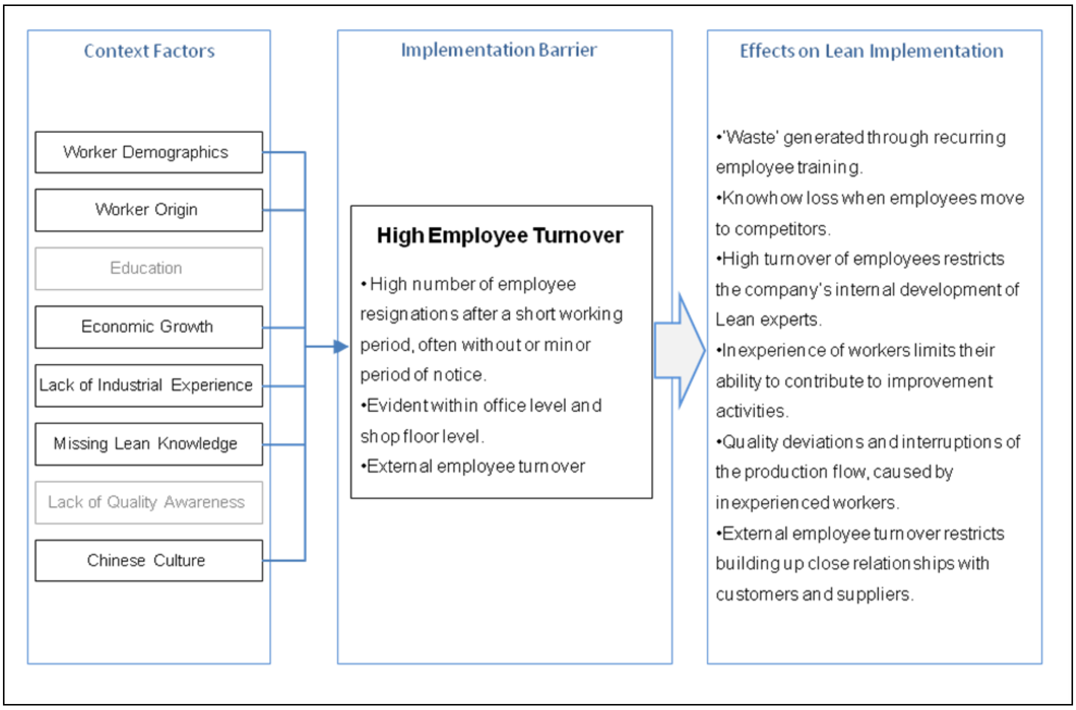

Figure 7.1: Sub-model 'High employee turnover'

7.2.2.1 Definition 'High employee turnover'

Employee turnover describes the number of permanent employees who leave the company within a certain period. The term describes resignations of employees by those individuals taking the initiative to leave the company. It does not reflect planned termination, retirement and any redundancies by management. Neither does the term include internal turnover when employees leave their current positions and take new positions within the organisation. Thus, it implies that employees within the host organisation choose to terminate their employment and work for another employer. Employee turnover was also called 'employee fluctuation' by some interviewees.

7.2.2.2 Barrier description

Almost all participants named high employee turnover as a major barrier when implementing Lean in China. Interviewees indicated that the barrier was a China-wide phenomenon and not only limited to the two plants who took part in the case study. Employees considered the plant's own situation with regard to employee fluctuation as better than the situations other competitors were facing. They indicated that they were in a privileged situation because of the company's international brand and reputation for employee development. Nevertheless, employee turnover was still considered as one of the major barriers for a successful Lean implementation in both cases.

Both plants spent a lot of effort in retaining employees and decreasing fluctuation. Several employee-retaining programmes and job-promoting programmes had been launched. Interviewees from both human resource departments were instructed to focus on a compensation system to award internal feedback and performance reviews to retain the workforce. Company internal 'service awards' were assigned to employees when they had been working longer than five years in the company. Additional team-building programs, which are not offered in the company's European plants, were launched to strengthen the employees' company loyalty, to further reduce the employee turnover. Interviewees from the Human Resource (HR) department pointed out that through these programs the company was able to achieve lower employee turnover rates than the industry average in China. However, despite these high efforts spent on retaining employees and the improvements made in the past, HR professionals stated that employee turnover was still not acceptable and a major implementation barrier. As a Chinese HR director from Changsha recalled:

> *"In China, employee turnover is an issue for most companies. Our company expects low fluctuation, influenced by the German benchmark. Currently, overall we have much better turnover rates than the market average level, but our*

management as well as the HR department are still expecting to improve the turnover rates."

When comparing the shop floor and office workers, several interviewees of both plants stressed that the employee turnover rates within the shop floor were significantly higher than among office workers. Annual fluctuation rates of up to 80% were reported within the shop floor in Changsha, and similar numbers were indicated within the shop floor in Suzhou (Because of confidentiality reasons no quantitative data about the company's annual turnover rates were handed out by the host company.).

With regard to office worker level it was reported that in both plants the employee turnover was lower than within the shop floor. However, interviewees clearly addressed that high employee turnover still remained at high levels also among office workers. Participants indicated that office level turnover was still regarded as a major barrier, because the impact of each individual resignation was bigger with regard to professionals than operators.

Beside internal turnover, interviewees also named external employee turnover as a barrier to applying Lean. Interviewees complained that employee turnover within local suppliers, Chinese partners and customers hindered the internal Lean implementation. Interviewees stressed that frequently contact persons within partner companies, who had been trained in implementing certain Lean practices, suddenly left the company. The loss of a contact person at a supplier or customer necessitated building up a new contact person.

7.2.2.3 Effects of 'High employee turnover' on Lean

Western and Chinese participants named a number of effects on the implementation of Lean caused by high employee turnover. A major effect of the barrier was that the high turnover rates generated additional waste. Employees complained that to compensate for the fluctuation, additional resources had to be spent, which consequently led to a drop in the overall productivity ratio. The cost of the extensive Lean trainings and time loss to build up new employees was considered as the biggest productivity loss within the manufacturing department. Interviewees from the Production Department frequently referred to those efforts as a major source of waste. Especially western managers stressed that the fluctuation in China was 'not acceptable' because of the financial and training effort that was lost when people dropped out after a short time period working for the company. As a German director of the Engineering Department commented:

> *"The special difficulty we are facing in our department is the high fluctuation among engineers. This is something we cannot accept. I cannot accept that employees who get extensive training leave the company after two years. This is an unacceptable situation. It means in China we need to do something so that employees stay with us for longer!"*

Moreover, participants also strongly indicated that the company's fluctuation rate was a major drawback for successful Lean implementation because of difficulties in finding suitable personnel to fill positions of resigned employees. As a German division manager from Suzhou commented:

> *"Because of the employee turnover, my biggest challenge is to find good personnel. It is a big problem first to find good employees and then to keep them. Here in Suzhou's industrial park, there is a high fluctuation. When considering changing personnel and to implement elements of Lean manufacturing, such as standardised work, importance of expert knowledge, and process repeatability, then we have a huge problem! This gives me big headaches at the moment. My division's fluctuation is half of the Suzhou average, but that's still far too high for implementing Lean."*

Especially German managers indicated that because of the high fluctuation, 'Lean experts' were missing. They often drew comparisons with the company's plants in Germany where it was common for employees to stay for several decades or their entire career. The experience collected during this time was seen as important for acquiring process knowledge and the ability to suggest improvements on the technical equipment or the process standards. In their perception, expert knowledge and an improvement mindset, often described as

‘Lean thinking’ was an important feature of successfully implementing Lean production. As a German manager admitted:

> *"A barrier or a real challenge is that this ‘Lean thinking’ we built up in Germany is missing extremely among Chinese. We lack real Lean experts here. If you look at Toyota, how slowly their employees get promoted, that is very different to China. We have the problem that when we want to build up Lean experts, they will always ask for a job promotion to get into a management position. That’s why we lack technical experts.“*

Beside western managers, Chinese employees also stressed that the acquisition of feasible employees as a consequence of employee turnover was one major barrier for the implementation of Lean manufacturing. They described difficulties in filling released positions when people dropped out. As a Chinese professional from the HR department commented:

> *“In the Chinese job market, there are lots of employees available. However, we need to find people who match our requirements and who are able to do the job. (...) Every day, we receive lots of CVs but very most do not match our requirements. We cannot find the ones we need.“*

With regard to the shop floor, the missing experience of the newly recruited operators also had direct effects on the production. Participants stated that newly acquired operators in China mostly do not have any knowledge about Lean manufacturing and are not used to working in a Lean production system and its compulsory operator tasks. Interviewees also reported examples where the lack of experience caused frequent interruptions of the production lines through part damages caused by wrong handling of inexperienced workers who had recently been employed. The interrelations between operator turnover and quality deviations are described by a Chinese process engineer:

> *"Today the work might be done by a skilled operator, but tomorrow that person will be gone. Then there is a new operator who might be less experienced, that causes problems. We had component damages many times, caused by wrong handling of inexperienced operators. The real costs (caused by scrap parts4) occur when we suddenly need to change an operator."*

To reduce the effect of wrongly accomplished work tasks by frequently changing operators, the production department in Changsha tried to reduce the effects of what they called the 'human factor'. As 'human factor' interviewees described the influences the operators' work task had on the process- or product-quality. To reduce the 'human factor', the engineers focussed on redesigning the assembly line and operator tasks to follow very simple work steps with high quality control measures after each work task. By redesigning the technical sub-system towards very simple work tasks, engineers hoped that even inexperienced operators could fulfil the assembly task with minor training. As a consequence of these changes, engineers reported that at some assembly lines just the shift leader had deeper process knowledge; the operators were just following simple assembly tasks. They further commented that as a result, the shift leader was the only worker who contributed to problem solving or continuous improvement. Simplifying the assembly tasks made the work for most of the operators mind-numbing, and as a consequence, fluctuation increased. Moreover, it was reported that despite an increase of the process robustness, assembly failures still occurred. As a Chinese manager commented:

> *"It's very hard to find skilled workers or well-educated workers who can replace the former workers. So that's why we set up our assembly line to the lowest operator requirements. Then we have a higher chance to find operators who are*

[4] Comment added by the author

able to do the job. On the other hand, the restructuring of the lines makes the assembly work so boring that many operators say after a couple of days 'I don't like this job, I will work somewhere else'. Last year we had a fluctuation rate of 80%. That means 80 of 100 operators left the company in the very early phase!"

Interviewees also saw a link between the smooth and efficient flow of the assembly line and employee turnover. Missing knowledge and experience within replacement workers was seen as a barrier with regard to the efficient running of the company's one-piece-flow principles. Employees reported that slow or unskilful handling from a single operator restricted the productivity of the entire production, especially because the plant's assembly lines followed one-piece-flow principles. As a German engineer elaborated:

"An extensive operator training is necessary to learn all handling processes and to absolve the assembly process in the given takt-time5. (...) To do the work, you need to be experienced. If suddenly a new operator joins the line, the whole flow will be interrupted until the newcomer has the experience and knows what to do."

Another effect of high employee turnover on the shop floor was that both plants needed to provide newly recruited operators with Lean production training before they were able to work in the assembly lines. The high costs caused by continuous training and health and safety introductions led to drops in the overall productivity figures within the production. The employee training provided by the company was not seen as a satisfactory cure to balance out the losses caused by dropped out operators. Chinese and German managers criticised that, besides the high training costs, a few day's workshop would not

[5] Takt time, derived from the German word Taktzeit, describes the time needed to complete the work tasks on each work station. The time has to be less than the takt time in order to meet demand.

satisfactorily prepare the employees to work accurately and contribute new ideas in a Lean production system. A Chinese female engineer who was responsible for Lean manufacturing training in Suzhou explained:

> *"The inexperienced operator first needs to have an extensive basic training that costs a lot of money and takes a lot of time. We set up a good training system what takes between one and two weeks. However, based on the high production volume, sometimes the operators need to work after one or two days training. Then there is a high chance that they will make mistakes or break some Lean rules such as not respecting the kanban system, etc. So this has a big impact for the Lean implementation."*

In the perception of many interviewees, an extensive Lean training was important for operators working in the company's own Lean production systems. Interviewees were aware that the reassignment of newly recruited employees was connected to high financial losses. With regard to Lean production, such training was considered as (unavoidable) waste. The loss of newly recruited operators is commented on by a Chinese engineer from Changsha:

> *"We do have difficulties to implement the company's Lean production system because people get trained and then resign. (...) But if you really want to implement Lean production, you need to train people step by step, for example the operators need cross training at every work station. (...) It takes at least years until a person gets familiar with the Lean production elements, gets the Lean production mindset, and independently contributes in the Lean production system."*

A further effect of high employee turnover was the knowhow transfer to other companies through employees who left the host company. Interviewees at both locations stressed that in the Chinese job market there is a high demand for people with Lean expertise. The host company has a reputation for its social consciousness and its efforts to develop skills of their employees. As a result, most employees got extensive Lean manufacturing training and personal development training. Because of the high value of those skills within the Chinese job market, the employees were frequently approached by headhunters and asked if they would be willing to work for a competitor. Interviewees had the opinion that especially companies that were working according to Lean principles might suffer high knowhow losses through employee turnover. A German department manager stated his frustration about the knowledge loss:

> *"The employee turnover is linked to a tragic extent to the knowhow loss. All the effort you invest in people flows straight to a Chinese company. Sometimes I think we are doing foreign aid like in a third world country. We train good people for one or two years, and then they simply leave the company after one month's notice. Even if we quickly find a new employee, the knowledge given to the colleague can never be transferred in such a short time. On top of it all (to make matters worse[6]), the person who drops out is just standing outside the company and is permanently talking to the new employer. Then they (the resigned employees[7]) do not care anymore. The only thing you can do is to make sure that they do not take documents or things when they leave. All our effort spent to grow an expert is then gone, and is lost."*

Beside internal employee turnover, external employee turnover of customers and suppliers also had negative effects on the company's own process efficiency. In Lean manufacturing, a long term relationship with a few customers and suppliers is promoted, to strengthen the relationship and synchronise internal processes. However, interviewees complained that the benefit of a few core suppliers cannot be achieved when the partner's employees frequently dropped out of the company. A German manager in Changsha commented on the effects of external employee turnover within customers and suppliers:

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[6] Comment added by the author

[7] Comment added by the author

"In my group, we were able to establish a solid core of people who hopefully stay with us in the recent time. However, we still have the problem of high turnover at our customers. We are facing a galloping fluctuation at our customers. This leads to the problem that we cannot get a clear specification for our products from our customers. Because their employee base is eroding so quickly that we need to tell them what they want from us. The responsible project leaders leave the company without transferring their work tasks, the new employees know about the details as much as the man in the moon. As a consequence, I need to tell the Chinese customer what they want from us."

When comparing all interviewees' comments from both plants, interviewees from Changsha and Suzhou indicated similar numbers of employee turnover. However, the negative effects of employee turnover in the Changsha plant might be slightly stronger. Interviewees from Changsha argued that because of the immaturity of their plant, not all processes were already standardised. Missing standards would make it more difficult for new employees to continue the work of a former colleague. As an employee from Changsha commented:

"Especially our relatively young plant which is five years old is sensitive regarding employee turnover, because many of the processes are not well verified or still not standardised. (...) Especially in my area, when we are dealing with failure costs or maintenance costs we still do not have a ready set up process which is standardised. When new employees enter the company, they are not able to start working according to a standard."

7.2.2.4 Influence of context factors on 'High employee turnover'

When participants who mentioned high employee turnover as a barrier were asked for their personal explanation of the barrier, they named a number of context factors which, in their perception, were linked to the barrier. As most influential context factors the participants named economic growth, lack of industrial experience, missing Lean knowledge (among the Chinese labour market), worker demographics, worker origins, and Chinese culture.

Economic growth: Importance of monetary rewards - The importance of monetary rewards was seen as a very significant trigger for employees to leave the company. Several interviewees who were involved in HRM stated that a strong focus on monetary rewards within the Chinese society was seen as the key factor for employee turnover. Here, it should be mentioned that monetary rewards are always an important trigger in most employer-employee relationships. Western and Chinese interviewees stressed that monetary rewards were especially important for Chinese employees. They explained that many Chinese people felt strongly that they had to take part in China's recent economic growth by earning high salaries. In the present thesis the term describes a very strong monetary rewards-driven motivation for employees to work for a company.

Interviewees reported that especially for shop floor workers, the main trigger for leaving the company were job offers from competing companies with better salaries. It was mentioned that most operators came from rural areas of the mainland China, which wanted to benefit from the recent industrial boom of the Chinese economy. In the opinion of several interviewees, their prior motivation to leave their homes in the rural mainland was of monetary nature. Earning as much money as possible was a common aim for workers within the shop floor, and working in industry as a manual worker was seen as an appropriate method to achieve this aim. In the view of the study's respondents, long-term career development and promising job perspectives were considered not so important.

Several interviewees pointed out that because of the low salaries paid, even minor wage differences would trigger operators to move to a competitor. Other issues such as job security, job perspectives, working environment, or the kind of work were reported as less important for choosing a job. The HRM director in Suzhou reported that the wage levels for operators within China varies between 700 and 3,000 RMB[8] (about 70-300 GBP[9]) a month. HRM employees stressed that this salary was five to ten times less compared to the Chinese professionals' salaries, but was still seen as a competitive wage level for operators working in that industry. However, Chinese and western interviewees agreed that even when considering the lower living expenses in China, the salary was low, given the rising living costs. The issue was commented on by an HR employee from Suzhou:

> *"There is a tremendous difference in the salary between an operator and an office worker in China. (...) Based on high living expenses in this area that is not much to live on. That explains why the bonding between the associate and the company is not that tight. If the operators get just 50 RMB more per month somewhere else, they will move there. Salary is the key driver for operator resignation."*

With regard to office level workers, a focus on monetary rewards was also seen as the most influential factor. Several interviewees from the HR department in both plants reported that other factors also played a role. However, the focus on monetary rewards was still seen as the most influential factor for self-motivated job termination. As a Chinese HR manager explained:

> *"It's very difficult to protect us from losing 'high performers'; we cannot give them a 30% or 50% salary increase every year just to keep them. That's incredible (impossible[10]) for us. But they simply can get a better salary from other companies who want to use their knowhow and experience, then the employees leave the company."*

[8] Abbreviation for the Chinese currency Renminbi

[9] Sterling estimate added by the author

[10] Comment added by the author

Economic growth: Multiple job opportunities – the enormous economic growth within China was also named as an important factor influencing the high employee turnover. Based on the economic development and lack of skilled employees, multiple job opportunities are offered to the company's employees. An HRM manager stressed that because of the high competition in the labour market and market growth in China, wages are not reassigned as for example in Germany. The unequal salary levels paid in the industry increased employee turnover. She reported that recently new industrial companies opened their plants, key persons and sometimes even entire teams within assembly lines left the company to work for the competitors. The retention of employees was often seen by participants as inevitable because of the economic growth and resulting opportunities for employees. The relationship between China's economic growth and turnover is described by a Chinese HR employee.

> *"In general I would say that such a level of fluctuation is in line with the growth of the economy in China, it's understandable. As a result of the fast growth, there are big wage deviations in the different regions and between employers. The individuals might always find a better opportunity either regarding position level, salary level, or a job in another company or location."*

Several interviewees in Suzhou stated that the location in Suzhou negatively influenced the fluctuation of the office level workers. They stated that the high economic growth within the industrial park in Suzhou and the close distance to Shanghai would lead to a shortage of employees in that area. As a consequence, multiple job opportunities of international companies reinforced employees to leave the company. The demand for skilled workers with international experience within international firms in the area of Suzhou was seen as a major context factor for the fluctuation especially among office level workers. Comments from interviewees from Changsha showed that this plant was less concerned about the fluctuation of office level employees, because in Changsha, there were fewer international companies competing for these employees compared to Suzhou. However, interviewees still stressed that there was a high employee turnover among both shop floor and office level employees.

Economic growth: Social success pressure – With regard to China's economic growth, interviewees also stressed the importance of social factors as a cause for high employee turnover. Interviewees indicated that the Chinese society puts pressure especially on young employees to become very successful in coherence with China's rapid economic growth. They argued that social competition between friends and social pressure from family members contributed to 'job hopping'. Several Chinese interviewees argued that there was a common assumption among many Chinese families that the economic development in China should also be reflected in the career development of their child or children. This social pressure was named as an explanation for why some people resigned from their positions and changed their job, to show their social group that they had a dynamic career. The long-term career opportunities given by western firms were often not seen as attractive enough to remain in the company for a long time. As a Chinese HR manager commented:

> *"China is constantly getting better, so automatically the Chinese people think that I can also get better. People in China have a lot of pressure from family members and a lot of competition with other classmates in terms of their own career development. (...) When employees work in the western company to grow inside, they end up getting just a better job title on their company business card. They fear that they will miss the good opportunities China is giving them."*

Lack of Lean knowledge and economic growth: High labour demand - China's economic growth created high competition among employers recruiting employees. A German interviewee criticised the common practice of companies in China to entice employees away from competitors. He called this behaviour, 'Wild-West-Capitalism", and claimed that the aggressive job market practice led to difficulties when implementing Lean. He argued that managers tended to refuse giving employees Lean expert trainings or workshops in German headquarters, because they feared losing key employees to competitors. Employees with Lean knowledge were seen by many competitors as valuable and increased their tendency to change their job after returning home. He further explained that he was not used to this kind of practice. In the German mother plant,[11] the local automotive suppliers in that region had agreed not to headhunt employees from each other, to avoid resulting conflicts. He claimed that systematic employee headhunting strategies conducted by many Chinese and western competitors in China as a further explanation for high employee turnover. Another employee (Chinese) supported the claim made by the German interviewee:

> *"In China there are no regulations or already clearly defined salaries as in Germany. There are always aggressive companies coming into the market, who will fight for employees and raise the salary benchmark".*

Lack of industrial experience: Misleading perception of western work life – Several interviewees stated that a wrong perception of the work also influenced employee fluctuation. Here it needs to be mentioned that this factor was mainly evident among young employees without much working experience. Therefore, in the same vein, participants perceived also worker demographics (workers' young age) as an additional influential factor. Chinese and western interviewees stated this factor was a China-wide phenomenon, but affected the fluctuation of office workers and shop floor workers in different ways. With regard to office worker turnover, especially engineer turnover, interviewees argued that based on China's non-industrial history and relatively recent industrialisation, there was no well-established occupational image of engineers

[11] Mother plant was also called 'lead plant' among interviewees

among a lot of Chinese people. They argued also that graduates did not have a clear picture of what working life in an industrial company, e.g. as an engineer, looked like. They argued that those wrong expectations caused disappointment and led to early resignation of employees after a short time period. German managers argued that Germany's traditional engineering background, dual education system, and industrial placements as part of the university course prepared German graduates for the requirements needed in engineering work. A German department head commented:

> *"In my opinion the employee turnover is to a certain extent caused by the missing industrial history of China. Most young Chinese engineers did not grow up in families where other family members worked as engineers or had worked in industry before. That's why, when Chinese engineering graduates start a job in industry, they want to try a lot of different things; they do not have precise pictures of what they want to do in the long term. That's why they tend to do is 'job hopping'."*

In the same vein, interviewees argued that aspects like the internationally known brand name and positive reputation of the host company gave Chinese graduates a wrong impression about the daily work within a manufacturing company. Participants reported that a lack of industrial experience among Chinese graduates led them to assume that working in a western company would be less demanding than in a Chinese organisation. Interviewees reported that graduates had the conception that working as an engineer would mainly involve managerial tasks rather than hands-on activities. A Chinese engineer involved in the company's own graduate scheme program illustrated:

> *"In Chinese Universities the students think, when you are working at western companies, you go with your briefcase to work, you sit in your very bright office, just having a cup of coffee there. Every day you just speak English with your colleagues and do 'trading' with other companies. But if they join the factory and realise that engineers need to work with their hands on machines, with grease, oil, and dealing with operators, they get very disappointed."*

With regard to workers within the shop floor, missing industrial experience was also named by several interviewees as explanation for the high employee turnover. Participants argued that many young operators quit their jobs after a short working period because of the standardised and predetermined work tasks within Lean production. In his opinion, a wrong association of modern industrial work among operators was an explanation of the high fluctuation, as he explained:

> *"We have a really high operator fluctuation. That's why these days all people, especially the young generation have a dream of becoming a big boss tomorrow. There are a lot of chances in the Chinese economy, so they want to be successful overnight. Nobody wants to be a poor operator and doing standardised assembly work."*

Chinese culture: Generation 90 and worker demographics - Interviewees also named worker demographics as an influential context factor. In particular, several Chinese interviewees named a phenomenon they called 'Generation 90' as a reason for increased employee turnover in the recent time. 'Generation 90' described all people who are born in 1990 and after. They reported there was an increase of cancellations after a short working period since operators from the 'Generation 90' were recruited. This phenomenon was mentioned primarily with regard to the shop floor, where mostly young adults from this age group were present.

Interviewees explained this phenomenon as follows: with regard to the family background they explained that most children of the 'Generation 90' were raised as single children. Most workers grew up in families in which family members were able to benefit from the China's economic boom and build up a higher economic status than in China's communistic past. Being raised as a single child in the centre of attention of parents and grandparents, and the newly generated wealth, led to soften the individuals and make them less willing to work in demanding industrial jobs. Several Chinese interviewees referred to these socio-political circumstances to explain why in recent years many operators found the work in the assembly line too demanding, and consequently cancel their jobs after a short time period. They further explained that the ’wealth‘ accumulated by the last two generations of family members allowed them to quit their job more easily than most Chinese people of the previous generations. A Chinese Engineer gave his comments:

> *“In the industry, the operators need to work very hard to get some money, but they are used to be the only child in the family, so they are treated like a kind of king or queen in their family (...), the parents and also the grandparents put all their love to this single child. Then the child thinks ‘Oh I am the greatest in the world. I can easily get whatever I want. I want this! ... And my mommy will buy it for me, I want that and daddy will buy it for me.’ Most of the operators have grown up in such an environment, that’s why they tend to find the work too hard, too difficult, and too disciplined. Some will often cry, telling their mama this job is too hard for me. Then mama will say: ‘OK come back to us, and just stay at our home, I can raise you, I can find another small job for me to support you or I can do whatever‘. That’s why some operators return to their homes. So this is also a reason why the turnover rate is high, they know ‘I still can go home I still have a backup (financial support)[12] from my family members’.“*

The ‘Generation 90‘ phenomenon as an influential socio-political factor was indicated by the majority of Chinese interviewees. However, also worker demographic was seen as an influential factor. Some participants did not mention the ‘Generation 90’ issues and considered just the young age of the operators as the reason for turnover. They explained that recently, many young people in China chose to work in production between high school and college, to earn some money for their future education. These young workers would leave the company after a short while because they did not consider being an assembly line operator as a long term profession in the first place.

[12] Comment added by the author

Chinese culture: Lack of company loyalty - In the perception of several interviewees a lack of company loyalty was a China-wide phenomenon which explained high employee turnover. Especially German managers compared Chinese with German company loyalty. They criticised that even minor disputes, or minor salary differences in comparison to competitors led to cancellations of employment by members of staff. A German high level manager from Suzhou stressed that a lack of company loyalty was a China-specific factor which directly influences employee turnover:

> *"For many years I was a consultant. I worked in 44 countries; however I never experienced a country like China where people do have such a low pain barrier to leave the organisation."*

Chinese interviewees further explained that in China the loyalty to the leader is more developed than the loyalty to the organisation. That was supported by German managers who also experienced that phenomenon. Both nations reported that there was an interrelation between the loyalty to the leader and employee turnover. Participants mentioned that when a department manager or supervisor leaves the company it is likely that Chinese subordinates also dropped out of the company because the loyalty to the leader was overridden. Examples were given where high level expatriates returned back home, and shortly afterwards, several Chinese subordinates left the company. This was seen as a China-wide phenomenon:

> *"The Chinese employee is just loyal to his boss, and not to the organisation. Loyal in the sense that there are several examples where Chinese employees resigned shortly after the boss resigned. For me, this phenomenon is particular Chinese, from experience I know that in Korea it's exactly the opposite."*

The Chinese participants elucidated that Chinese employees built up a personal 'Guanxi' between themselves and the leader or colleagues, rather than building up loyalty to the organisation. An interviewee explained that when a leader would treat an employee well and support him or her, the employee builds up Guanxi. In the interviewees' perception, this increased the 'switching barrier', because the subordinate was less willing to let the leader down. When the leader left the company, the 'switching barrier' was cleared. This factor might be more influential in the participating firm than in Chinese companies, because leading positions were mostly taken by expats who returned home after a few years.

Chinese Culture: Chinese festival weeks - Several managers reported a relation of the traditional Chinese festival weeks and an increased employee turnover. This effect can be described as indirect. Festival weeks acted in the manner of catalysts of turnover. The festival weeks are generally used by Chinese to return to their homes to celebrate with family members. Interviewees of both plants reported that after the festival holidays, a significant amount of operators did not return to their workplaces, without previous notice. According to the participants, the festival activities as well as the journey back home played a major role. Employees were seen to use over-crowded trains and buses as a communication pool to get information about job offers and career opportunities. The phenomenon was especially significant in the 'Generation 90' age group, when individuals returned to their family and decided to stay there. As a Chinese engineer stated with regard to 'Generation 90':

> *"The young operators tend to escape from here and return back to their family because they give them more money than they can get here. So this is also a reason for the high turnover rate especially during the Chinese New Year. The operators go back to their families and will stay there."*

Worker origins and economic growth: Labour movement – The movement of labour to certain areas in China was also named as reason for fluctuation. In the last decades, the booming industrial cities like Shanghai, Beijing, and Shenzhen attracted many workers from the less developed areas in the mainland. In terms of operator movement, there was a tendency that participants from Changsha explained that many operators in Changsha were attracted by the wealthy big industrial cities located in the coastal area. They argued that many operators from the rural areas in western China saw Changsha as a temporary stopover before heading west to the promising industrial areas of the coastal commuter belt. Surprisingly, however, some interviewees from Suzhou regarded the location of the Suzhou plant in the commuter belt as a disadvantage. They argued that many operators who originally came from western China were disappointed by the high living costs in the commuter belt. Operators would underestimate living costs in these areas and complained that they could not live the life they had expected to live. As a result, many operators with rural origins would return back to rural areas in the mainland after a short working period. In the western parts of China, employees were able to maintain a higher living standard even with lower wages. The migrant labour movement back from the East to the West was reinforced by the government's recent efforts to develop the rural areas and establish industry in the mainland. Interviewees from Suzhou explained that the political and financial support for these areas led to an increase of wage levels, and consequently encouraged migrant workers to return to the mainland. As a Chinese employee from Suzhou commented:

> *"Because of the development of the countryside in China, industry jobs are now available also in that area. So more and more operators leave Suzhou and go back to their home towns. (...) They can get the same money in their hometown without having high living expenditure as in the Shanghai area."*

The majority of interviewees from Changsha claimed the Chinese labour movement of the young lower and middle management to the coastal regions was an important factor of turnover. Also with regard to labour movement among office workers, the majority of participants in Changsha agreed that young professionals would prefer working in the big cities of the commuter belt. Higher wage levels and a more stimulating environment of the commuter belt were seen as important triggers for the employees within the young middle management who were born in the mainland to leave the company towards the East.

In summary, participants regarded high employee turnover as a major barrier to implementing Lean in China. The description revealed that besides internal turnover, external turnover was also seen as a barrier. The consideration of external turnover revealed that the barrier was a China-wide phenomenon and not only limited to the two plants who took part in the case study. Employees complained that to compensate for the fluctuation, additional resources had to be spent, which consequently led to a drop in the overall productivity ratio. Participants stressed that the high fluctuation made it difficult to develop Lean experts, because the newly-recruited employees had rarely any previous experience of Lean production. The analysis of the participants' comments revealed that in the participants' perception, the turnover phenomenon was linked to Chinese national context factors. Participants highlighted how high turnover was affected by country context factors in terms of economic growth, lack of industrial experience, missing Lean knowledge (in the Chinese labour market), worker demographics, worker origins, and Chinese culture.

7.2.3 Weak supplier performance

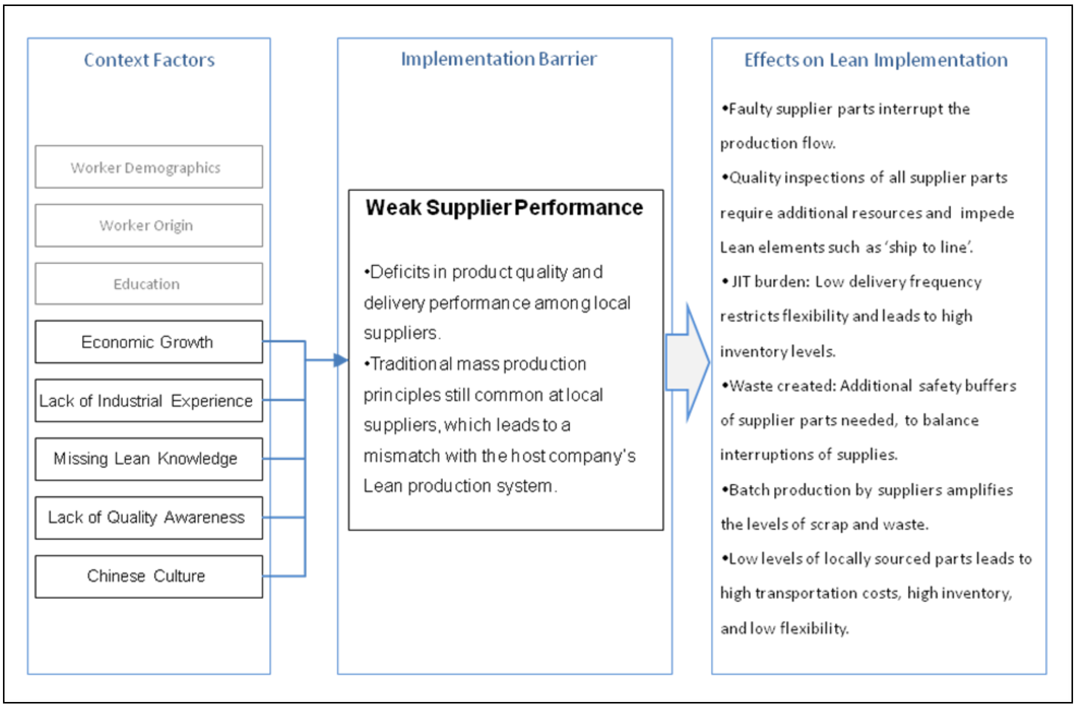

Figure 7.2: Sub-model 'Weak supplier performance'

7.2.3.1 Definition 'Weak supplier performance'

The barrier 'Weak supplier performance' describes a lack of supplier performance in form of suppliers' missing ability to deliver components with stable quality specifications, in the required amount, and at right time.

7.2.3.2 Description of the barrier

A general lack of performance within Chinese part suppliers was named as one of the main barriers hindering the implementation of Lean. Among western and Chinese interviewees, within both locations the performances of Chinese suppliers were seen as a crucial bottleneck when implementing Lean successfully. Interviewees explained that without a reliable supplier base the company's own production system cannot truly be Lean. They argued that for a successful Lean implementation the supply chain must also follow Lean principles.

Here, it needs to be mentioned that no data were collected directly from the host company's supplier sites. No interviews with employees from the suppliers were undertaken. Insides from the part supplier base, are based on the perceptions of employees from within the host company. By reason of the close cooperation between the host company with its supplier, a number of employees worked in close cooperation with supplier firms and were visiting their plants frequently. Therfore, even when the interviews were not undertaken directly with employees working for the supplier firms, the data still can provide important insides about the suppliers working for the host company.

The interviewees draw a partly-bleak picture of the local supplier base. When comparing the performance levels of Chinese and western suppliers, German and also Chinese interviewees clearly stated that the Chinese local suppliers were not able to deliver the same quality as delivered by European suppliers. To source high quality parts locally, which matches the quality standards of western suppliers, was not seen as realistic in the near future. A direct comparison between European and Chinese suppliers which indicates the immaturity and development of the automotive supplier industry is given by a Chinese engineer from Suzhou:

> *"We have some projects running, with European suppliers. We tried to implement the same projects to our supplier in China. We did some requests to the local suppliers before but they have no idea how to fulfil this requirement. Requirements which are standard from German or European suppliers doesn't make Chinese supplier happy, they can't fulfil these requirements. Our local supplier base is quite different compared to European countries - we cannot find Chinese suppliers who are able to follow the same requirements. These projects might be realisable in Europe but is hard to be realised here in China. For example, in our production we have little electronic components which need to be manufactured according to high cleanliness specifications. In Europe there are several suppliers who can do it, but in China we could not find a single automotive supplier who was able to produce according to our specifications. Finally, we*

found two hard-disc makers who can handle those specifications, but they never produced automotive parts before."

The lack of performance was closely related to the production system which the supplier was using. Interviewees stated that the use of Lean production systems was not well applied in Chinese supplier firms. It was frequently reported that most local suppliers still followed mass production principles. The majority of western expats and Chinese interviewees stated that for this reason, local suppliers were not able to fulfil orders in terms of quality, flexibility, and JIT delivery. Employees working with suppliers described difficulties based on a non-application of Lean principles from the local suppliers. As a Chinese engineer from Changsha commented:

"I personally went to a lot of Chinese suppliers to see if they applied Lean principles in their production; they showed me difficulties or gave some excuses. For example, the buffer areas in the suppliers' production area...that's a complete mess! They do not have 'FIFO'[13] *at all. The problem is that there is a high risk to mix different parts and materials."*

Interviewees disputed that if principles like JIT production were applied, they were applied mostly at just a poor level, to fulfil the host company's supplier requirements. Participants stated that among most Chinese suppliers the application of mass production principles such as batch production was still common. Quality control measures were widely not or just weakly applied, leading to quality problems of supplied parts. An example which illustrated the unpopularity of Lean production even among medium- and even large-sized

[13] FIFO stands for "First In First Out". The term was used to describe a systematic approach for keeping track of the right order in which parts are processed.

Chinese automotive companies was given by a Chinese engineer who used to work for a parts supplier of one of the big three automakers in China – SAIC[14]:

> *"For example in my previous company, it's a component supplier for automakers. One of its customers was SAIC, that's a Chinese top-level carmaker and even this production is still not Lean! It's a very traditional way to organise the production, so you can see this is the situation here. Some companies just simply don't know about Lean production."*

Interviewees stressed that a lack of supplier performance was not a location-specific barrier or a problem just the German host company was dealing with. Interviewees from Changsha as well as from the more developed town of Suzhou complained about country-wide performance gaps among regional suppliers. A quote from a Chinese engineer from Changsha indicated that a lack of supplier performance is a country-wide problem and might not be just a local phenomenon of the two towns, where the case studies took place:

> *"I just attended the company's 'Tech Meeting'[15]. They mentioned in this meeting that all the plants of our company all around China have the same problem of finding qualified suppliers. The responsible persons have retaken the task to define the requirements to evaluate which local supplier is capable to produce according our standards. (...) The main problem is Chinese suppliers can't fulfil the required standards in terms of quality issues and safety issues."*

Several interviewees stressed that the intercultural differences between the German host company and the Chinese manufacturers were not an explanation for the performance gap of local suppliers. A quote from a German department manager from manufacturing shows that also other Asian manufacturers who are applying Lean production in China facing supply chain problems:

[14] Shanghai Automotive Industry Corporation:

[15] The host companies annual strategy meeting for all plants in China

"It's not that just we are a German company we have problems. Also our locally producing Korean supplier[16] also set up a production in China. The Korean supplier has a total different way to work, a different national culture, and this Asian company, but nevertheless they also cannot deliver stable quality in China."

7.2.3.3 Effects of 'Weak supplier performance' on Lean

The interviewees in both plants gave several examples indicating that the barrier 'Weak supplier performance', affected the implementation of Lean. Almost every interviewee mentioned that the most prominent direct effect of a weak supplier performance were problems caused by a partly very poor quality of the supplier parts. Based on those quality deviations of the supplied parts, both plants had to inspect all incoming parts delivered by local suppliers. Additional sorting sessions were needed to separate faulty supplier parts. These additional checks were cost- and time-consuming and were seen as a burden to implementing JIT elements such as 'Ship to Line'[17]. A German manager from Changsha illustrated the environment some of the Chinese suppliers where producing in, and at the same time stressed the importance of delivery inspections of incoming supplier parts in China:

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[16] The Korean supplier also delivers parts, which were produced in Korea, to the lead plant in Germany. The cooperation exists since several years and interviewees praised the good quality levels of the Korean rotor shafts

[17] 'Ship to Line' describes a method often used in Lean production where the supplier delivers the parts directly to the assembly line without additional checks conducted by the customer. The method aims to reduce the non-value adding activities between the customer and the supplier.

> *"Here in Changsha, some of our suppliers can be called 'backyard companies'. One day they just simply put a CNC machine in a former cow barn and decided to start working in the automotive industry instead beeing farmers. These kind of companies, with such an background, now want to produce quality parts for our machines? Even the simplest work steps are sometimes forgotten or not done. Recently one of our suppliers delivered us milled parts, where sharp burs from the milling process were not removed! Another example was, when we got zinc-coated parts delivered where they apparently outlined a wrong galvanic process. Two days later the coated parts were full of rust again. (...) Partly the quality levels of the local parts are tremendous; as a consequence we need to inspect every single part of incoming parts from the local suppliers."*

Another effect was that the company needed to create additional safety buffers because local suppliers were not capable of delivering products in constant quality. Safety buffers enabled the company to balance the company's cycle time with the supplier cycle time if interruption from the supplier side occurred. That helped to overcome delivery bottlenecks and consequently to secure the plant's production flow. However, high levels of supplier parts stored in warehouses represent additional inventory and is considered within Lean production as a form of waste. As the general manager of the Changsha plant explained:

> *"We are having massive quality problems from our supplier side; I think this is an issue which not only concerns us, it also concerns the car manufactures here in China. If I look at our Chinese supplier base, they are not yet capable of delivering constantly products in good quality. (...) And as a consequence that makes the Lean implementation quite difficult. For example, as a result of the quality deviation, our inventory levels of supplier parts are quite high. Also, if I consider the number of additional quality checks and re-sorting actions we did in the past, then you can see that is a totally different standard from the one in Germany or Europe."*

Moreover, interviewees stated that the use of mass production systems among the local suppliers had also negative effects on Lean. By using traditional mass production methods, many local suppliers produced in big batches and delivered high quantities to the company's warehouse instead of JIT-consistent delivery of small batches in a higher frequency. This led to high levels of scrapped material, when in the production process of the batch production an error occurred. Based on the bad experience the company made with big batches of faulty supplier parts, strict rules were set to prevent that those parts being further processed. If a quality problem was detected in a supplier batch, all other parts from the same batch were refused or scrapped. As a Chinese senior manufacturing manager from Changsha commented:

> *"The Chinese suppliers can't deliver their products in the quantity and in the quality and in the frequency we require. Our company is in fact Lean; our internal processes are following Lean principles. However, the local suppliers are still producing in big batches. In order to fulfil our circle time, the supplier has to build up inventory within our storage areas. That is not Lean, because we do not reduce our inventory and consequently waste is generated. Producing in big batches brings further problems. If we discover a problem with the supplier parts during our final assembly, the big batch of parts will be claimed as scrap...a lot of waste is generated. Moreover, because of the high quantities of lost parts, such an incident may also interrupt our internal production."*

Another major effect of the weak supplier performance on the implementation of Lean was what interviewees called 'lack of localisation'[18]. Because of the performance gap of the Chinese supplier, many parts could not be sourced locally. Both plants needed to source certain parts from overseas suppliers.

Interviewees explained that, when the host company was setting up a new production plant overseas it was a normal procedure that within the first several months of the launch most parts were imported from reliable long-established suppliers. That approach decreases interruption within the 'ramp up' process of the new production lines. After setting up the technical facilities, the overseas

[18] Localisation was a commonly used term by employees of the host organisation to describe to which degree parts were sourced locally. Parts that could not be sourced within China needed to be imported from overseas suppliers.

parts will be substituted by local parts. Interviews stressed that even that after five years after setting up the Changsha plant and ten years after the setting up the Suzhou plant the company was not able to source all parts locally. The interviewees stressed that a continuous postponing of the localisation process causes several problems for Lean. Their major concern was that the long lead time for customer orders and the high cost for transportation. As a German female engineer from the logistic department commented:

> *"Without a question, the Chinese suppliers do not deliver the same quality as the European suppliers do. That's a fact! That's why we cannot localise all parts. Localisation brings a short lead time and it is much cheaper to source the parts in China, than transporting them over from Europe. We want to localise our parts because we could save transportation costs, inventory, and increase flexibility. But the local supplier quality doesn't fit. (...) We need to postpone the localisation process again and again, because the local supplier cannot deliver the quality or quantity we require."*

Besides the higher costs, the main obstacle for a successful Lean implementation was the long lead time for orders caused by the long overseas delivery. Several interviewees stressed that due to the long distance shipment and the inaccuracy of the delivery date, implementation of JIT elements such as 'Ship to Line' delivery was not possible. Overseas parts arrived in big batches and needed to be stored temporarily in the company's warehouse, as explained by a German engineer:

> *"In our production in Germany, I guess we source 80% of our parts from European suppliers with a lead time of three to four days, rarely one week. Here in China, the sea transport itself takes eight to ten weeks. As a result, we have high inventories and need to set up additional warehouses. We have completely different calculations, different costs. If we are having any trouble, due to the shortage within the production of our local suppliers, we need to get our stuff via airfreight from Germany. That's very expensive."*

As another effect related to overseas deliveries, interviewees reported that part damages frequently occurred caused by the long distance transportation. Several examples were given where urgent needed parts finally arrived after several months of shipment and the load was damaged by the transportation. These uncertainties made it difficult for the production managers to plan their production in advance and made it impossible for the logistic department to implement JIT principles.

Especially interviewees from Changsha mentioned several problems regarding the long distance transportation. Interviewees who were involved in logistics reported damages of parts caused by the overland transportation from the coast to the plant in the mainland of China. They reported that based on long distance travel on poor road conditions, and poor conditions of delivery vehicles, deliveries were faulty. Investigations showed that vibrations from the transport caused damage to the components. To a certain extent, packaging could be adjusted, however some part delivery trays and packaging were worldwide standardised and changes were not possible.

Beside the disadvantages of long distance transportation, participants also reported problems with the custom clearance procedures at the customs in China. Interviewees from Changsha stated that they frequently that had difficulties to get the overseas deliveries released from the local customs. They explained that employees from customs did not release the overseas imports in time. Minor mistakes in labelling or documentation of the goods were used as an argument by the local customs authorities to hold back deliveries for several days. Several interviewees reported that the unexpected delays caused serious trouble, especially when urgent parcels sent via air freight did not get released within a short time. Time delays based on time consuming customs clearance procedures led to bottle necks or a production stop when big batches of overseas parts arrived later than expected.

7.2.3.4 Influence of context factors on ‘Weak supplier performance’

The participants named a number of context factors which, in their perception, were reasons for the lack of supplier performance. The most important factors were missing Lean knowledge, several aspects embedded in the factors economic growth, lack of quality awareness, and Chinese cultural factors.

Missing Lean knowledge - A lack of knowledge about modern manufacturing techniques throughout China, and in particular lack of Lean knowledge was mentioned as a prominent explanation why Lean principles were not widespread among the local supplier base. Several Chinese interviewees confirmed that in China, Lean production is still considered even in the automotive sector as a new concept. Several interviewees further explained that based on the missing Lean knowledge many Chinese people see Lean production principles as controversial and they had concerns that this system had advantages over traditional production systems. Within the sample most Chinese participants were convinced that Lean principles will bring a benefit to the company when implemented adequately. Especially employees, who visited production plants in Germany or Europe, and saw Lean production successfully applied, were persuaded that Lean principles have significant benefits for the company and its supply chain. However, interviewees stressed that they had doubts that the majority of employees within small and medium-sized Chinese suppliers had enough knowledge about Lean to fully understand its benefits or even successfully implement it. Interviewees further explained that local manufacturers in China are in the main managed by people with a very basic or out-dated knowledge about modern manufacturing methods. The unpopularity of Lean in China was strengthened by several statements of interviewees who indicated that even in engineering courses at some Chinese universities, Lean principles were not extensively taught or were even not part of the engineering course.

Economic growth: Agricultural past - China's recent industrialisation was also seen as a factor that explains why Lean production methods are not widespread among the suppliers. Interviewees argued that the relatively recent industrialisation of China and its agricultural past influenced the supply chain. They explained that among a lot of Chinese small and medium sized companies traditional manufacturing methods are not considered as obsolete techniques such as in the western automotive industry. The relatively short history of industrialisation, more specifically the recent growth of the automotive sector, was seen as an explanation why local suppliers are not yet using state of the art production systems such as western automotive firms require.

Economic growth: Promising business prospective - Interviewees also indicated the economic boom in China as an explanation for the suppliers' low efforts to improve quality levels or to restructure their production systems. Interviewees explained that the economic boom caused a favourable order situation for local suppliers. They further evaluated that the promising business prospectives have held back Chinese business owners from restructuring and adjusting their outdated existing production systems towards high quality Lean production systems. It was argued that as long as the suppliers have enough customers, who do not require any changes in their production, local suppliers were less willing to implement changes in favour of Lean principles. Within Lean production, orders are characterised by small quantities in high frequency, which are most sustainable within a long term relationship between customer and supplier. Interviewees argued that due to the ease of finding customers, local suppliers were not necessarily interested in building up long term relationships and adjusting to the host company's production schedule. The delivery of small quantities of their products in high frequency was not seen as an attractive deal by local suppliers.

Another explanation closely linked to the context factor was economic growth; explaining the resistance to apply Lean in the supply chain was the additional investment in times of valuable business prospective. To transform traditional production systems to Lean production systems requires changes and additional investment and effort. Interviewees reported that company owners would not make such big efforts to get orders from the western company, because they could get enough orders from customers with lower requirements.

Economic growth: Importance of monetary rewards - Participants explained that consumption-triggered behaviour within Chinese society in recent years led small Chinese suppliers to focus on quick monetary rewards. Especially Chinese interviewees explained that many Chinese company owners wanted to take part in the economic boom and earn money fast, instead of setting up long- term relations with a company with high requirements, additional investment, and risks of failure when implementing the new techniques. The influence of the recent 'gold-rush climate' within Chinese automotive suppliers was seen as equally significant by employees of both case study locations. Major differences in the views between the nationalities were not observed. A Chinese engineer from Changsha gave his comments:

> *"Why do our local suppliers not adopt Lean principles? Because they want to make quick money! If we give them a big order today and say 'Okay, you can get our order but you must implement Lean principles'. Most suppliers are not interested. Especially the Chinese supplier are so impatient, they want to see the quick monetary result instantly. I thin, it's particularly Chinese, because in the Chinese industry there are still suppliers who produce according to their current mass production principles and also are able to make money. So they think 'why should I adapt to your way, you require me to do so much activities and I cannot get a bigger order. If I switch to another customer, I can also make money'. They still have a huge market so it's not necessary for them to introduce Lean principles to make more money. The situation is not like in Europe."*

Lack of industrial experience and quality awareness - Another explanation for the lack of performance is closely linked to the former industrial structure of the Chinese supply chain. A number of interviewees mentioned that in the past many automotive suppliers manufactured products for the commodity sector. That was seen as a reason for the lack of quality awareness among local companies. The respondents argued that, based on lower quality requirements of these products, the 'mindset' in terms of quality and quality awareness of the people working in local companies is not yet established as in comparison to western companies. China's economic past and related missing industrial experience of the local supplier were frequently seen as context factors which might explain the gap in supplier performance. As a German department manager from manufacturing commented:

> *"From my point of view, the massive quality deviation of our local suppliers is grounded in a lack of experience. They simply cannot handle the production processes yet. …The problem is that Chinese local suppliers are simply newcomers in this industry. Out of the blue there comes a German company which requires quality. It might be that other Chinese customers do not care so much about quality. But we do, for sure! (...) Sometimes when we complain, they reply 'Oh sorry we do not know this failure yet'. From my point of view, they never thought about possible deviations. They probably never used tools like a FMEA[19], or just have simply thought about what failures might occur in this production step. (...) Many times I had the feeling that they (Chinese local suppliers)[20] are newcomers. The development we had in Germany 20 or 30 years ago, in China that it's just about to start."*

This perception was supported by a Chinese engineer:

[19] '*FMEA' stands for 'Failure Mode and Effect Analysis'*

[20] Comment added by the author

> *“The suppliers are not mature; some of the local suppliers simply don’t know Lean production. So they don’t understand why we want to have per shift delivery and why we want to increase shipment frequency to three times per day. They just insist on a weekly delivery. So for the whole value stream we would like to lower the inventory, smaller sizes, high frequency, so the inventory would be low. But they don’t understand, they just focus on the cost efficiency of transportation and their intuitive thinking about the efficiency, but they don’t consider to look at the whole value stream to make it more Lean. In my opinion, the problem is most suppliers are just set up within the last years.“*

Missing Lean knowledge & Chinese culture: Traditional hierarchical structures – Some Chinese interviewees, who were directly involved in local sourcing activities and worked closely together with local suppliers, also linked the lack of Lean application within the supply chain to the nature of the organisational structure of suppliers throughout China. In their opinion, the traditional hierarchical organisational structures applied in Chinese firms also influenced the adoption of Lean principles. Chinese interviewees explained that in China, small and even medium-sized companies were mostly managed by the company owner himself. They argued that in terms of Lean implementation, that might explain why even medium-sized Chinese suppliers do not implement modern production systems. The interviewees argued that because of the traditional hierarchical organisational structure common among Chinese suppliers, convincing the owner to change from a traditional mass production to Lean principles, like JIT, would be difficult. It was argued that the patriarchal management style of the older generation made it difficult to convince the owners for the need for modern production methods. Interviewees reported that even in companies where the company owner was not directly involved in the production processes, the employed production managers had difficulties in convincing the owner to allow reorganising the production system towards a Lean system. Besides the traditional hierarchical structures, interviewees also named limited experience and a lack of knowledge about modern production systems as an explanation why the mostly older aged company owners refused to reorganise the company's production system. As a Chinese engineer introduced:

> *"There is nobody in the suppliers' sites who really understands Lean production. (...) If you want to implement Lean in a supplier site in China, first you need to convince the company's boss. If the boss is convinced than you can implement Lean principles. Most of the suppliers in China are privately owned small and medium-sized companies. The problem is, that some of the company owners are not well educated. The situation is not like in the western world, in China the boss is the owner or even the company is managed by the family. Things changed in the last years; recently some of the owners are willing to hire a management team that is managing the production. Unfortunately that still happens very seldom. So that's why to introduce Lean in the supply chain is so difficult. Big enterprises like some of our customers normally know about Lean production but the small supplier does not."*

Chinese culture: The concept of Guanxi – Because of the importance of 'Guanxi' connection for the further analysis here a definition of the term and a short overview of related literature is given before describing the role of Guanxi with regard to the barrier 'Weak supplier performance'.

Guanxi, pronounced "Gwan-Shee", loosely translated as "connections", is the latest Chinese word to gain entry into English parlance (Gold et al., 2002). The term refers to interpersonal relationships or connections, which exist in almost every aspect of life in Chinese culture, including kinship to friendship, and politics to business (Chan, 2006). Fan (2002) explained that such interpersonal relationships between people could be either in a group, or being related to a common person, which could be in frequent contact or little direct interaction at all. Farh et al. (1998) and Jacobs (1979) define Guanxi as direct particularistic ties between an individual and others. King (1991) claims that Guanxi forms a more expanded group which allow the individuals sufficient social and psychological space to build relationships with others based on real and fictive kinship. In China, Guanxi does not only exist between people who have a real kinship that bounds them together e.g. family relationships, Guanxi can also apply between people who do not share any kinship at all.

With regard to the delays within the customs clearance procedures interviewees saw the concept of Guanxi related. A few interviewees from Changsha explained that the missing ‘Guanxi-connections‘ between the host company and the local authorities may explain the delays. Western interviewees were convinced that the claims made by the custom officials were just pretexts to hold back the imports. In their opinion, maintaining a good relationship to local authorities via financial threats or presents would be important for western companies when doing business in China. Because of headquarters’ worldwide anti-corruption laws, the German headquarters did not allocate financial resources which would allow establishing Guanxi connections. The interviewees felt that the host company had a disadvantage compared to other Chinese competitors, where managers were able to do business ‘in the Chinese way’. As a German manager from the logistic department commented:

> *“Beside the high transportation costs of the overseas imports, we are facing difficulties with rigid decisions of the Chinese customs or Chinese government. For example, recently the government decided that for certain imported products, mainly screws, we need to show some kind of ‘origin certificates’. But they didn’t decide with three months’ notice, instead they decided it retrospectively! This means that all our imports which were in transit already, we couldn’t get these certificates any more, they were stuck in the customs. Our employees are having massive problems to release the goods from the Chinese customs. That’s because ... how do I explain? We need to ‘shift some cash’, then more is possible. However, our company refuses to make allowance to such a system; as a consequence, our employees have to do the job the official way. But because they are not paying, they can’t get the goods out of the local customs. These are all things where the government puts its foot down. If the government decides we are not allowed to build a new property, then that’s it. If the government decides we want to do this or that then that’s the new rule. We depend totally on Government decisions. We are not as independent as we are in Europe. That’s because of the totalitarian regime here.“*

Economic Growth: Poor infrastructure - With regard to the transport damages some interviewees named as influential context factor the partly poor infrastructure in rural China. Interviewees reported that poor road conditions and ailing delivery vehicles caused excessive vibrations during the transport. It was reported that due to snowfalls in wintertime, Chinese officials sometimes closed the main highways. The delivery vehicle drivers simply bypassed the main roads via potholed country roads. As a consequence, the sensitive goods from overseas were damaged and needed to be scrapped. Besides extreme weather conditions, interviewees reported that even under normal conditions, transportation caused damage on overseas goods. A German manager from the logistics department in Changsha claimed that also chaotically-packed and unsecured deliveries would often lead to damage. He was convinced that the poor road conditions combined with the missing quality awareness and responsibility of the Chinese employees within the packaging process and the transport were the reasons for faulty overseas deliveries. As he put it:

> *"The infrastructure here in Changsha is poor. The roads are very bad; it takes seven days by lorry to deliver goods to some of our customers. Have you seen the condition of the vehicles which are still driving on the road? Another problem for us is that we cannot predict which delivery vehicles we will get the next day. There is sometimes a five-ton lorry or ten-ton lorry, sometimes it's a ten-ton vehicle but with a different layout and different dimensions. We try to compensate for this by using a special forwarder. However, to standardise the logistics is still very difficult. But the problems are not just grounded in the poor infrastructure. The problem is the Chinese people have no quality thinking. The Chinese simply not care! It has happened that they delivered us our airfreight and the pallets were vertically loaded! Everything was scrap; we needed to scrap all parts. You can't imagine what happens here day by day..."*

Overall, respondents provided a detailed description of the barrier 'High employee turnover'. Participants stressed a general lack of performance amongst Chinese part suppliers. They argued that at the present stage, Chinese suppliers were not able to deliver parts in the required time and to the required quality. A number of effects on Lean were named. Participants explained that they had to inspect all incoming parts delivered by local suppliers. These additional quality checks were costly and time-consuming and, at the same time, created high levels of waste. Another effect was that the company needed to create additional safety buffers because local suppliers were not capable of delivering products in constant quality. Safety buffers created high inventory levels and, consequently, waste. Moreover, many parts could not be sourced locally because of the performance gap of the Chinese supplier. The ‘lack of localisation’ created long lead times and restricted the implementation of JIT principles. Additional effects included high transportation costs and part damage caused by the long transportation. As most influential context factors, the participants named missing Lean knowledge, several aspects embedded in China’s economic growth, lack of quality awareness within China, and Chinese cultural factors.

7.2.4 Market conditions

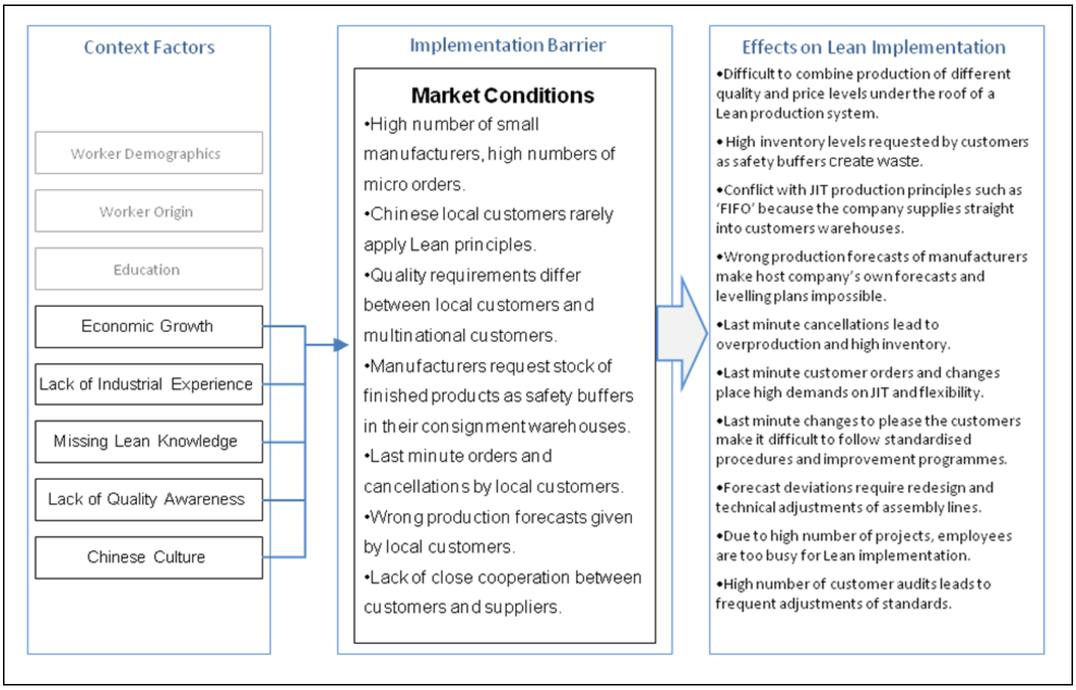

Figure 7.3: Sub-model ‘Market conditions’

7.2.4.1 Definition 'Market conditions'

The barrier 'Market conditions' is a barrier within the external market environment to which the host company is exposed. The barrier includes interactions between the host organisation, in the role of a product supplier, and automotive manufacturers within China, in the role as business customers. Moreover, the barrier reflects problems grounded in the structure of the Chinese market place.

7.2.4.2 Barrier description

When interviewees reported barriers within the external environment, a number of interviewees describe the customer structure in China as a barrier for the implementation of Lean.

Most interviewees distinguished between two types of customer groups: International operating automotive manufacturers or western-Chinese joint venture automotive manufacturers and local automotive manufacturers which were fully Chinese owned. Participants stated that the big joint venture customers mainly applied Lean principles and had similar requirements to their European counterparts. With regards to the local customers, participants reported that their Chinese customers' plants seldom applied Lean in their production.

Interviewees explained that in comparison to the big international joint venture customers the local customers had different requirements in terms of quality requirements and pricing. The Chinese customers required lower quality standards for a cheaper price than the joint venture customers. Participants reported that manufacturing two types of quality requirements within set Lean standards was very difficult to achieve. The interviewees stressed that producing according to two different quality standards was not feasible in a production plant and did not conform to the Lean principles. A German department manager from Suzhou illustrated the needs of the different customer groups:

> *"There is a big difference with regard to our customer base in China and Europe. Here we need to differentiate within our different customers. 50% of our customers are global operating companies who own branches in China, such as BMW-Peking, Mercedes Benz-Peking or Volkswagen-Shanghai. We call these customers joint venture customers. They have very similar requirements to our European customers and our mother plant. But on the other hand we also have 'real' Chinese customers. Partly they do have much lower requirements and at the same time considerably lower price expectations. To deliver to these two customers groups with different requirements that's our challenge. In principle we just want to have one production line or one product with one quality standard, but in China we need to serve the two customers groups; that isn't easy."*

As another barrier linked to the nature of Chinese customers, interviewees indicated additional safety buffers requested by all customers in China. Interviewees complained that both fully Chinese and the joint venture customers required additional inventory which acted as safety buffers for their production. The interviewees explained that even their customers who applied JIT principles required safety buffers to ensure a constant parts supply to minimise the risk of a shortage of supplier parts. The company was forced to deliver high amounts of final products in the consignment warehouses at the customers' sites. The interviewed managers were convinced that their plants would be able to deliver their deliveries JIT. In their opinion, the huge amounts of safety buffers were not needed at customer sites. Interviewees stressed that the host company was able to deliver their customer on a JIT bases and daily deliveries in customers' consignment warehouses was not necessary and not according to Lean principles. They considered their customers' requirements with regard to high levels of safety buffers as an obstacle to implement JIT principles throughout the entire value chain. A high level manager from Changsha commented:

> *"Lean production generally starts at the customer. One barrier with regard to the Lean implementation within this country is the safety buffers required by our*

customers. These buffers are definitely not Lean. Automotive manufacturers require these buffers to reduce their risk of manufacturing stops. If I consider our plant, we already deliver the automobile manufacturers in dependence of their demand. We deliver them on a daily bases in accordance to their exact orders and what their need for their daily production. However, we still deliver our products straight to their warehouse (...) this is not Lean. But that's the problem in China; the industry here is not yet as advanced as in North America or Europe."

A further barrier linked to the customer base in China was mentioned. Especially with regard to Chinese customers, interviewees named short notice purchase orders and rigorous order cancellations from the Chinese automotive manufacturer as a barrier to further develop their own Lean production system. Interviewees involved in planning logistic processes and processing customer orders frequently complained about wrong production forecasts set by Chinese customers and resulting problems to satisfy the customers. The interviewees gave several examples where customers placed last-minute orders or cancelled orders at the last minute. They stated that even a production system which produces JIT could not cope with radical last-minutes changes of order volumes or rigorous cancellations of purchase orders from the customer side. As a German engineer from Changsha commented:

"Just today one of our Chinese customers ask us to rearrange the SOP[21] of one of their new products from April 2011 to August 2010! As an explanation they told us they decided at short notice to launch their car earlier in the market. They also announced that they want to increase their orders from 200,000 up to 500,000 units. That leads to all sorts of problems. To rearrange an SOP can't be done at such short notice. But in this respect the Chinese are relatively, how can I say, unreliable. It also is feasible that the same customer will call us soon and telling us the 'bringing forward' is not needed and April 2011 is early enough for the SOP. That can easily happen here."

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[21] Start of production

When talking about barriers grounded in the external environment, interviewees frequently referred to barriers within the nature of the Chinese market place. When comparing the Chinese market place and its customers to other countries, western interviewees stressed that the Chinese market place was very different to the ones in North America and Europe. The participants elaborated that the company was dealing in China with a higher number of different customers than in Europe. They indicated that the company's market place consisted of a few big multinational companies and on top of that also a high number of small and medium-sized Chinese car manufacturers. As a result both plants had to deal with a high number of small volume orders. An interviewee from Changsha estimated that the Chinese division dealt with around five to six times more projects than the comparable division in the Germany. Interviewees explained that due to a lack of standardised automobile platforms within the Chinese automotive market, most of the company's customers required products with different specifications. Consequently both Chinese plants needed to produce various different products in small quantities.

In the perception of a number of interviewees, the diverse customer structure and the high number of different projects was seen as a barrier for the Lean implementation. Interviewees from both plants mentioned that the high number of different purchase orders led to full capacity utilisation within the production. The participants argued that because of other barriers the company's own Lean production system is not yet fully implemented to cope with the flexibility required to deal with the high number of different projects and customer requests. Project managers frequently complained about the stress they had with the management and coordination of those micro orders.

7.2.4.3 Effects of ‘Market conditions’ on Lean

The barrier ‘Market conditions’ was affecting Lean in a number of ways. Interviewees stated that to manufacture a high number of different products in small quantities sets high demands to the flexibility of the production system. Interviewees stressed that despite the advantages Lean production systems have with regard to flexibility, there are limits. They stated that producing several different products in the same assembly line and to process various different projects was a challenge. They stressed that dealing with several Chinese customers requires adjustments on technical elements of Lean. Interviewees stated that in China the assembly lines need to be capable of a ’quick tool changeover‘ even more than in the less diverse production in Germany. Another effect on the technical side was that the employees spent lots of effort to improve the logistical processes of the Kanban delivery to ensure that parts in appropriate lot sizes got delivered to the assembly lines.

Interviewees named further examples where a high number of different customers were affecting Lean. Especially western interviewees complained that because of the high number of customers they had difficulties to maintain a close relationship to their customers. They mentioned a lack of customer integration and close cooperation between the core customers and suppliers as promoted by Lean. Interviewees found it difficult to build up a solid relationship to their Chinese customers in the same manner as was common in the European market.

A further effect related to the high number of different customers was indicated by members of the Lean implementation team. They reported that the high plant utilisation restricted their ability to make improvements to further improve the production system. They argued that because the workers and engineers within the production would be ’too busy’ with their daily work to sustainably implement and maintain Lean principles. It was considered as very difficult to maintain improvement and preventive principles promoted by the Lean implementation team. As commented by a Chinese engineer:

> *"Other challenges, we have some bottlenecks like capacity, you know, the Chinese automotive market is going up very quickly, it has increased very quickly, and the key is the plant layout and the manpower and equipment investment is a little bit falling behind so we make capacity issues, we cannot fulfil … You know the equipment utilisation is almost full, near to 95%; it has not allowed us to do some new things like Lean implementation because if we want to introduce new standards, you need some kind of buffer that you can balance out problems which may occur, but we cannot do that at the moment. Once we finish our final assembly, we ship out directly, some customers are already waiting outside or sometimes we nearly shut down our customer's productions, this is the situation, capacity issues."*

A further effect of the high number of different customers on Lean was mentioned by a number of Chinese production managers. They elaborated that because of the high number of customers, frequently customers requested to make all sorts of different adjustments on the company's assembly lines. In the automotive industry it is common that within customer audits the customers visit the supplier's production to monitor the production and might give suggestions of how to ensure the product quality and improve the supplier's production methods. Within the host company these audits were generally seen as source for the production department as a chance to challenge their existing measures and replace them with measures that drive improvement.

However, the managers complained that because of the high number of customer audits, different customers requested changes on the production line. They reported that they found it difficult to establish stable processes and train the workers on the internal processes when so many changes were requested by customers. Mangers stressed that they had the opinion that some of the requests and changes were just requested by the customers for the sake of making a change. An interviewee stressed that sometimes customers even requested contradictory changes, leaving the process engineers in a dilemma. Another Chinese process engineer in Changsha stressed that Chinese customers requested adjustments at his assembly line which in his opinion were not even in line with Lean line design principles. A Chinese engineer from Changsha expresses his feelings and those of his colleagues:

> *"Yes, there are effects on our own production system. For example, here in China there are a lot of customers, and a lot of customers have different opinions, different views, angles to business and to our Lean production system. For example, they pointed out in a customer audit that our one-piece flow is okay, but at the same time complained about low safety buffers. Some of our customers complain about the use of one-piece flow and say it's too risky. They argue 'okay when this machine breaks down then the whole chain stops, if you have the buffer then production will continue'. This is another viewpoint, also reasonable, but we have to convince the customer one-piece flow is the right approach for Lean. To make that clear for them we sometimes struggle a lot. On the other hand some other customers have different opinions, For example, once we had a Toyota audit and the guy looked at my manual winding machine. He said 'Ah I'm fully satisfied with your solution, this is a really value-added process, you have manual winding, very cheap machine but the quality is fully controlled, labour cost is not so high in China, your solution is the best one'. But you know different customers do have different opinions; other customers complained about that issue."*

With regard to short notice purchase orders and rigorous order cancellations by the Chinese automotive manufacturers, a few interviewees also stated effects on Lean. They argued the 'flexibility' required by the customers also had effects on the Lean principle standardisation. Especially western managers found it difficult to follow the standardised procedures promoted by Lean on the one hand and at the same find ways to satisfy the last minute customer requests made by some customers. German managers and Chinese managers complained about the last-minute 'improvisations' they are forced to make to serve the short notice customer requests. They stated that some short-notice customer requests were not possible to fulfil and strictly maintain the process standards designed for a production under 'normal' conditions. Interviewees stressed that they were sometimes forced to compromise and improvise in terms of fulfilment of standards to fulfil the customer requests. As illustrated by a Chinese project manager:

> *"If we would act strictly according to our process requirement you need to tell the customer: no! no change! I have no cover to do so! I have no spare parts... I have no production line… and so on. And then you will lose them as customers, you will lose the customer because the customer can easily switch to another competitor here in China. China is the big market and there are also big opportunities. (...) We have to solve the problem internally or improvise somehow, but not to push this question or this problem back to the Chinese customers. Maybe we reached our limitation on the capacity but we have to find a solution. If you follow the process strictly you will not have a solution."*

Some interviewees stressed that the last minute changes of orders or cancellations also influenced the levelling procedure within Lean**.** Employees stated difficulties to apply the concept of Heijunka[22]. They explained that the customer orders in China were so unreliable that they were facing difficulties to make plans to best level the production between assembly lines. They stated that especially Chinese customers who lacked experience had difficulties to plan and forecast their production. That made it difficult to adjust their internal production to the demand of the manufacturers. Several examples were named which describe difficulties to smooth out the customer orders in a way that the similar amount products and product mix could be produced on a daily basis. A Chinese employee in Changsha recalled:

> *"We tried to do levelling, level our production to make it more smooth, to ensure our standardised work. But our local Chinese car makers may cancel the orders totally from maybe several thousand to zero today and double the next day. So it's really hard to manage the levelling pattern."*

Interviewees reported that in order to deal with the rigorous changes the plants needed to increase their inventory levels to cope with deviations of orders. To balance out variations in their demand, several customers required to store

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[22] Japanese word which describes production levelling within Lean production

inventory in their own consignment warehouses. Interviewees from the logistics department complained that this was a way for their customers to pretend to be 'Lean' but inventory levels in their consignment warehouses (Inventories belong to the suppliers) were still high. They further argued that no matter if the initial manufacturing process of the host company was working with minor levels of inventory, the company's overall inventory levels remained high, because high levels of finished products remained in the consignment warehouses at the customer plants.

Interviewees further indicated that unreliable demand forecasts made by the customers were also influencing the technical sub-system of Lean. Several interviewees involved in the design of assembly lines stated the importance of production forecasts for the development and dimensioning of assembly lines. They further explained that the configuration of an assembly line was depending on the daily production target. When after designing a production line the forecast significantly changed, massive redesign and changes were required. As a Chinese engineer from the engineering department commented:

> *"For Lean Line Design the main problem in China, okay, I find the problem is … the customer's forecast is not exact. Because for Lean Line Design, we first need an accurate forecast. (...) Just if the forecast is correct my results are optimal. But if the forecast is changed, okay, that means that we have already wasted money because that is not the best way. It happened that we designed an entire assembly line according to Lean Line Design principles around the forecasted production target. But after we finished it, we found out that there was another demand required. So our output did not fit with the new target. "*

7.2.4.4 Influence of context factors on 'Market conditions'

When participants who mentioned market conditions as a barrier were asked for their personal explanation of the barrier, they named a number of context factors which, in their perception, were linked to the barrier. As most influential factors, the participants referred to economic growth, lack of quality awareness, lack of industrial experience, missing Lean knowledge, and Chinese culture.

Economic growth: Importance of monetary rewards – Again an over-eager focus on financial benefits was mentioned. Several interviewees explained this context factor as a country-wide phenomenon by a general tendency towards monetary rewards within Chinese society. Interviewees reported an over-eager focus on price issues by Chinese manufacturers. Chinese interviewees used the term 'price pushers' when speaking about characteristics of local customers. They reported an acceptance to increase risk of failures to lower the overall costs. Among German employees this price-driven attitude towards price rather than quality was frequently mentioned as a barrier for implementation of Lean. They argued that a price-driven focus was not in accordance with the process focus promoted within Lean production. The Chinese customers' price-driven attitude put a lot of pressure on the manufacturing department to produce cheaper and cheaper. They argued that this attitude shown by their customers might lead to an unstable production process and consequently to higher total costs caused by defective processes. As a Chinese employee from the machine building division in Suzhou put it:

> *"Our customers focus only on the quantity and not on quality and sometimes when we suggests some ideas how to make the process more stable, for example: some idea, like Poka Joke, traceability. I think traceability's a good tool to trace the part and the Poka Joke also very good for the quality. And we provided this idea to our Chinese customers. They normally think: 'Ah, this is too expensive, we don't real need to have this.'"*

Another Chinese colleague mentioned that the Chinese focus on monetary rewards rather than quality was also grounded in the industrial past of China. The colleague from Suzhou added:

> *"China is developing since 30 Years. In these 30 years the economy, everything developed quite fast, before we didn't have many electronics, we had no lights here, something like this. In China you must get these benefits. Right now Chinese people still struggle to get money. It's not that we don't care about the quality and the safety or the risk or something else. But first we want to live, we want money, we need to use the economic situation. When we have achieved that, we*

can think about is it risky or safe or not. So that’s why we are money oriented because only through money your salary can get paid.“

Economic growth – The economic growth within the market place was seen again as influential. Especially with regard to last-minute purchase orders or rigorous order cancellations from the customer side, interviewees explained this phenomenon with the massive growth and dynamics within the Chinese automotive market. They explained that the automotive boom in China allows even inexperienced SMEs to enter the Chinese automotive market. In their opinion that explained the wrong order forecasts or cancellations. The economic growth and the dynamics of the Chinese automotive markets were commented on by a Chinese manager from Suzhou:

“Yeah this is a particular Chinese factor, because the market is too dynamic, we have to do a lot of things, a lot of projects running in parallel, we have a lot different customer projects. The situation here in China is that all the car manufacturers are not big in size, they’re just middle and small-sized so that means we have a lot of different customers, a lot of product types, a lot of projects and the total amount is increasing. Yeah that’s good but in general compared to this big country, it’s still not that high so we have a lot of things to do, to gain the same business like Europe. We have to do much more and get the order volumes.“

Lack of quality awareness – In the same vein some interviewees named a general lack of quality awareness among China as an explanation for the customers’ price driven attitude focus. Especially from the Germans’ perspective, among the Chinese society there was a lower perception of quality. But also Chinese interviewees spoke frequently about a Chinese ‘cost saving mindset’ in comparison to the western ’quality mindset‘.

Lack of industrial experience – Lack of industrial experience was again named as explanation for the market conditions. Interviewees explained the wrong order forecasts given by the local customers with a lack of industrial experience. Interviewees mentioned that giving detailed order forecasts a few months in advance requires experience and expertise that most newly-established Chinese customers do not yet have.

Missing Lean knowledge – Missing Lean knowledge was again mentioned. Interviewees explained that the request for big safety buffers or changes requested on their assembly lines were not in line with Lean, and can be explained by a lack of Lean knowledge among the Chinese customers. Interviewees explained that most local customers were not using Lean principles in their production and therefore were not aware of the benefits the implementation of JIT production principles or the reduction of inventory could have for them and their supply chain. The lack of Lean knowledge among local customers was commented on by a Chinese engineer from the machines building division:

> *"Yeah, the customers don't see the need for Lean, and also how to divide the process. I mean, the layout of the whole line, so if this process belongs to this station, or this process belongs to the next station. Normally the customers in audits don't have an idea how our system works. We always explain our processes to our customers but normally they don't have clear idea of how a Lean Line (Lean assembly line)[23] should be designed, or look like."*

Chinese culture: Traditional hierarchical structures – Mainly western managers reported that within the Chinese market place hierarchical structures played an influential role. They stressed that in China customers had Chinese a higher ranked position than in the West. In western interviewees' perception, accepting the customer's conditions without contradiction was seen as the business etiquette in China. Western managers reported their Chinese subordinates who were dealing with Chinese customers tend to agree overhastily to customer requests to satisfy the customer without considering the consequences to the company. The western managers found that this behaviour was based on the hierarchical structure within China and at the same

[23] Comment added by the author

time complained about the extra costs and improvisations made to fulfil the requests of the customers. Examples that were named were Chinese employees who did not want to contradict a customer's request and requested missing parts by expensive air freight. Besides cost issues, the managers stressed that this unbalanced partnership put a lot of pressure on the company. Both western and Chinese employees indicated that especially small and medium-sized customers tend to accelerate their higher hierarchical position to make advantage of it. As a Chinese engineer from Suzhou commented:

> *"Normally our customer has higher position; people in China say the customer is God. That is an expression for the high hierarchical positions our customers have in China. And that's also true for the European customer, but in China, the customers exaggerate this idea more. If we talk with the German customer, they can give us one month fixed order, twelve months rolling forecast, but we will never get that from Chinese customer. They say, 'We will tell you next week what we need', The Chinese customers need this flexibility. We as a supplier you need somehow to meet their requirement. Sometimes it causes problems for us."*

In the same vein the participants reported that the relationship to the multinational customers was more balanced. The differences when dealing with German customers and Chinese customers was commented on by a German department head:

> *"In Germany, with regard to our customers our position is more powerful. There are more possibilities to negotiate with our customers. If at home a customer requests some last minutes orders, than we say: 'ok'. We try to do our best. If those special situations require additional efforts or additional transportation costs our customers in Germany are willing to pay for it. Here in China it is not so balanced, it was always like this; nobody does something about that issue. Here, the customer has all the possibilities, maybe because the market allows it, maybe because there are a lot of different suppliers out there, maybe because many suppliers want to acquire new customers, the Chinese market is booming. Maybe that's why the customers here have so much more bargaining power here in China."*

Several interviewees stressed that the higher hierarchical position gave the Chinese customers more 'bargaining power' and that this China-specific phenomenon was often seen as explanation of problems. However, it also needs to be mentioned that hierarchical issues were not exclusively seen as a cause of the phenomenon. A quote from a German department manager indicates also that a lack of company loyalty among Chinese employees might be linked to favourable position the Chinese customers had. As she replied in the interview conducted at the Changsha plant:

> *"Our Chinese employees to not disagree with the views of our customers. They accept all their demands. They do exactly that they want. But we can't fulfil their requests. That's not possible, in terms of utilisation, or when we do not get the material, simply we can't make it. However, our interviewees accept it. As a consequence we need to pay for the additional cost for special delivery or air freight, etc. They simply don't disagree with our customers. I always ask them; 'What are you doing!? You can't agree to everything that the customer says, when you know exactly that your cannot fulfil their needs. You need to check what's possible and then negotiate with the customer'. But the Chinese employees just agree. They tell me; 'Sales department told us we should not disagree with the customer'. I tell you, they cannot be in earnest! The solution is that the company pays for it. XYZ pays, they don't care because it's not their money anyway. But they should be responsible for their actions and should care for the company they work for. That's what they haven't grasped yet."*

The present consideration of the barrier 'Market conditions' revealed that apart from the big joint venture customers, Chinese customers' plants rarely applied Lean in their production. The company therefore had to serve Lean customers and non-Lean customers at the same time, which impeded their Lean system. By using a high-quality Lean production system the company struggled to produce parts with lower quality and pricing requirements for the non-Lean Chinese customers. Another aspect of the barrier was that customers in China required additional safety buffers. Interviewees complained that both fully Chinese and joint venture customers required additional inventory levels which acted as safety buffers for the customers' production. Furthermore, participants indicated the short notice purchase orders and rigorous order cancellations from the Chinese automotive manufacturer as a barrier to further developing their own Lean production system. Interviewees further stressed the need to adjust the technical sub-system of Lean in China, by a ensuring ’quick tool change over‘, production levelling and Kanban capabilities of the assembly lines. Moreover, interviewees emphasised that the high number of different customers led to a lack of close cooperation with the core customers, and difficulties in fulfilling the requests that were made in customer audits.

7.3 Internal barriers

7.3.1 Definition of ‘Internal barriers’

Internal barriers are here defined as those impediments to Lean implementation that are situated within the firm, as opposed to the external environment. In particular, they refer to characteristics and behaviour of company employees. In this study, the main internal barriers were described in terms of lack of lean knowledge, intercultural communication, and work styles.

7.3.2 Lack of Lean knowledge

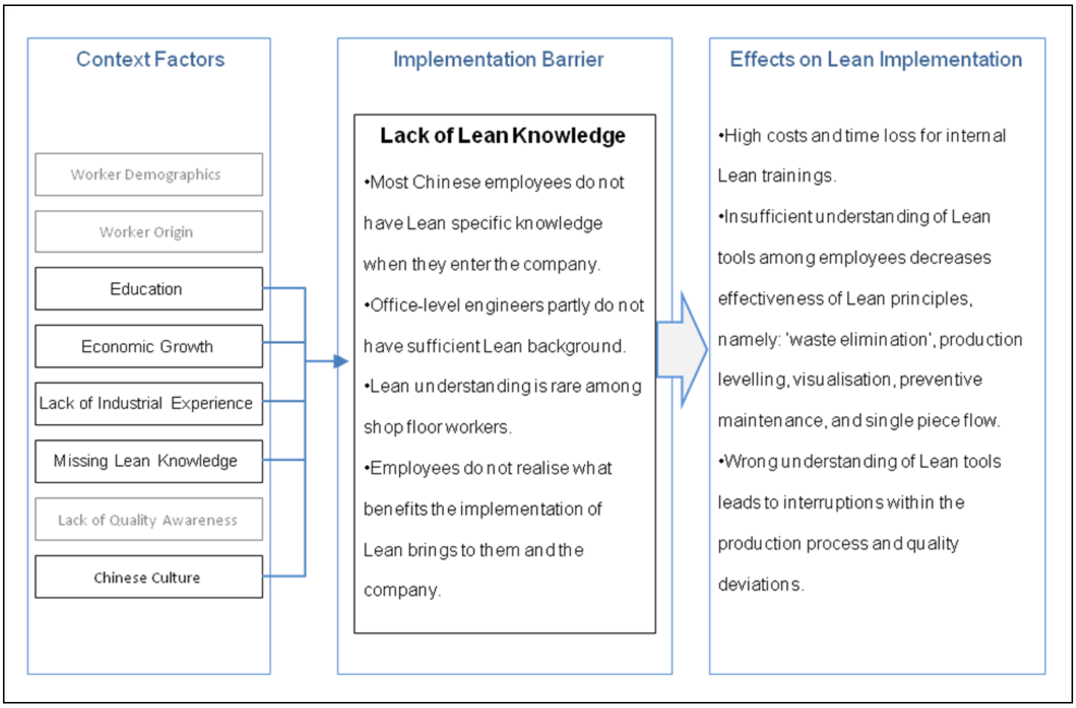

Figure 7.4: Sub-model 'Lack of Lean knowledge'

7.3.2.1 Definition 'Lack of Lean knowledge'

Lack of Lean knowledge refers to missing or insufficient knowledge about Lean production principles, and their practical application, among employees or individuals working with the host organisation. This has to be distinguished from the missing Lean knowledge which was mentioned as a context factor, where it referred to the China-wide phenomenon of missing Lean knowledge.

7.3.2.2 Barrier description

As mentioned in the section on 'High employee turnover', interviewees stressed that within China, it was difficult to recruit employees who had Lean specific knowledge or previous Lean experience. Interviewees stressed that missing Lean knowledge required company internal further education. Several managers complained that they needed to allocate additional resources to send their employees to Lean production training and workshops, to obtain a basic understanding of the company's Lean production system. Western expats stressed that training on that scale, at office and shop floor level, was not necessary in Germany. However, despite the training efforts made by the company, they complained about a lack of Lean specific knowledge among their subordinates and colleagues.

Most interviewees distinguished between the Lean knowledge gap among shop floor workers and among office workers, and mentioned that Lean-specific knowledge barely existed at operator level. Interviewees from both plants stressed that applicants rarely had any former experience of working within a Lean production system when they entered the company. Chinese engineers, in turn, stated that every operator generally received a few days long training where basic Lean knowledge was taught. However, a deeper understanding of the Lean tools and Lean elements was widely missing. Some process engineers indicated that amongst their subordinates, only shift leaders or line leaders had an overall understanding of how a Lean production system worked. As a Chinese engineer from Suzhou put it:

> *"Regarding Lean knowledge among operators … Here, they do not have very deep knowledge of the Lean, let's say, they do not know anything about the Lean. For the shop floor supervisors, I think … it depends. It depends on their interest, some supervisors do know, even in the direct area they know much about the Lean, but mostly they just have general managerial skills, but they cannot really communicate these kinds of Lean activities to the operators. They know the basics, but they cannot link the Lean elements together."*

When talking about the office level, Lean specialists and managers indicated that basic Lean knowledge was generally available, but not at a sufficient level. Several interviewees complained about the deficiencies in Lean-specific knowledge of their colleagues. Members of the Lean implementation teams stated that they had frequently made the experience that, even at engineering level, colleagues considered Lean production as a term for a 'tool set' applicable to the shop floor. The interviews conducted with the members of the

Lean implementation teams revealed that they constantly had to convince their colleagues that certain Lean projects would be further established and, in the long run, they would benefit from Lean. A Chinese member from the Lean implementation team in Suzhou gave her comments:

> *"The people here have no holistic system thinking. You know Lean is not only applying tools like, 5S, TPM, and the others. (...), Many employees always think, for example when we have a Lean implementation meeting, some engineer asked me: 'do you have some new tools to introduce to me?' They always want to know some new things, any good tools, but I would tell him, the tools are always the same, but most importantly you need to understand how you can link them together like a system, then have the best utilisation, this is quite important."*

A Chinese engineer from Suzhou also commented on the lack of Lean knowledge among his colleagues, but found more drastic words:

> *"In my area maybe from the end of last year we started to implement Lean production. But the big issue for most of the employees is (…) what is the Lean production system? For most of them just copying something from our overseas departments, but nobody knows what it is!"*

In the same vein, these Chinese and German managers exposed that some engineers, including recent graduates, considered the implementation of Lean tools as an 'additional job'. Those interviewees who supported the Lean implementation were convinced that because of a missing understanding of Lean production, their colleagues or subordinates did not realise what benefits the implementation of Lean might bring to them and the company. A Chinese department manager from Changsha commented on this issue:

> *"The major challenge to us is to make the people have real Lean thinking. I asked my engineer to work very hard on further implementing Lean but I have the feeling sometimes some young engineers think that Lean means an additional job on top of their daily tasks because they think 'oh Lean asked me to do this and that'. They don't realise the benefit. The main problem is to make them fully understand what Lean thinking is! Normally it is not easy to see the logic from the formula, from the table and so on, from the procedure, sometimes it's hard to see what is the link to Lean thinking behind that, what will be the benefit, we can gain. So I've tried a lot to gain Lean thinking. I analyse with my engineers together*

what is the Lean production request, what is the target and what is the thinking behind it. To make them understand and to establish the magic of Lean thinking is the most difficult portion of the whole job."

Accordingly, comments made in the interviews suggest that some participants were not aware of the potential benefits of Lean manufacturing for the company. An engineer from Suzhou considered the implementation of Lean principles as a 'show' and benefits gained by implementing Lean tools would not justify the investment. As he put it:

"First of all if you look at this, Lean production system, in my personal opinion (...) I just have a feeling in this plant that Lean production is just a tool to make some kind of picture, some kind of show. I always ask what benefit after we implement Lean production. You know the core target, the main target of Lean is to eliminate the waste, or cut down waste and perfect quality, and maybe other things, but from my personal point of view all these activities are just a kind of a show to our company or other people. It is just my personal feeling but if you go around the plant there are some areas you can make a nice film that shows a nice Lean picture here. However, if you do these kinds of Lean things, how much money we already spent for the implementation and how little benefit we just get. (...) And for the, another principle is waste, dealing with waste. Always I found we spend much money to build much less inventory around the production line to be able to reduce the size of the supermarket (internal temporary warehouse24), but in the end what is the benefit?"

Some Chinese and also two non-German employees had yet a different view. They argued that the German managers lacked true Lean understanding. They stressed that some German managers showed an over-eager focus on details when implementing Lean principles; for them their behaviour was grounded in a lack of Lean knowledge. Participants named examples where the Germans initiated time-consuming and complex improvement projects aimed at

[24] Added by the author

structuring the shape of assembly lines to match requirements set by Lean line design. Another example was given where German management was setting up work benches for maintenance workers to fulfil the company standards with regard to workplace design. In the view of the participant, these costly actions were not necessary and reflected insufficient Lean knowledge by the Germans. These participants regarded this focus on implementing certain Lean tools and attention to detail shown by some German managers as not in line with the principles of the true Lean philosophy invented in Japan. As a Chinese engineer stated:

> *"If we look at some maybe Lean plants in Japan you can find a very different situation. They don't make the entire Lean line design layout, just for the sake that the assembly lines look the same. Or changes aiming that the shop floor is running with minor inventory. (...) When the new plant manager came, he always wants everything very clean, 5s, etc. But if we build some shelves like the Japanese would do, with material which is not shiny aluminium, then we always got complaints from the Germans. They argue this area is not so clean, so we had to buy some shelves which simply looked nicer. Or in order to follow Lean line design principles such as a u-shaped assembly line layout we needed to create additional space for production machinery. Just because it looks like Lean, line design principles were followed. In my opinion it is just wasted money. If I were the boss I would kill the costs."*

The reasons for these different perspectives about the Lean knowledge of the Germans might be linked to the participants' job positions. The work tasks of those participants who criticised the German Lean approach included mainly cost saving efforts. Therefore it can be argued that the participants were biased, because of their focus on cost saving issues rather than Lean implementation issues. The purchases aiming at further Lean implementation might have contradicted their cost-saving point of view. A thorough reconsideration of the data set allowed for the conclusion that this theme reflects just the view of certain interviewees involved in cost saving issues.

7.3.2.3 Effects of ‘Lack of Lean knowledge’ on Lean

A number of effects of a lack of Lean knowledge were introduced. Participants stressed that due to the lack of Lean specific knowledge, employees were not focusing on ‘waste elimination’ and especially the ‘elimination of less visible waste’. An example was named by a Chinese interviewee from Changsha who complained that employees did not consider additional transportation of goods as a form of waste, to be avoided according to waste elimination principles. As he explained:

> *“Yeah, it is easier to eliminate visible waste, I mean if you say ‘okay we have to eliminate, reduce the scrap’ scrap is waste, then everybody will realise ‘yes this is waste’. But invisible waste, for example transportation, storage and so on, it’s not fully understood in our organisation like the logistics. I told them a lot of times ‘why you are moving the parts from this location to that location? Why do you have to move it? I told them; ‘Why did you not move this directly to the usage position and so on?’ This is really not fully understood, what is the waste, invisible waste? This is more difficult that the whole organisation understands it.”*

A German logistics manager from Changsha also linked the lack of Lean knowledge with missing ‘waste elimination efforts’ when she complained about deficiencies in ‘production levelling’. In her opinion, her subordinates from the logistic department did not pay enough attention to levelling out the demands actually needed in the daily production and the supplier parts delivered into the temporary warehouse. She explained this by her subordinates’ lack of understanding that parts not used in the production which remained in the warehouse for a later use created waste in the form of using temporary space.

A further effect of missing Lean knowledge was mentioned with regard to ‘visualisation’ within the production. A few interviewees in managerial positions stressed doubts about the proper use of the visualisation boards placed in front of the assembly lines. In their view, the visualisation charts were not used in the production to check the production status or development of CIP projects over time. They assumed that some process engineers who collected the data created the sheets and graphs simply to fulfil the company standard. This behaviour indicates a clear lack of understanding.

When interviewing process engineers who were responsible for assembly lines, ‘preventive maintenance’ emerged as another prominent Lean element affected by the lack of Lean knowledge. The interviewees indicated that the idea of preventive maintenance, as part of the company’s total productive maintenance programme, was not fully understood by some workers with maintenance responsibilities. The supervising engineers indicated that because of this, the maintenance workers sometimes did not see the need to change worn-out parts of machinery or do preventive replacements before the machines breakdowns occurred. For the interviewees, the maintenance workers were not aware that slight deviations from the production schedule caused by unplanned machine breakdowns could lead to major interruptions within the production flow.

Single-piece flow was another element which was affected by a lack of Lean knowledge. A Chinese production manager named an example where assembly line workers had continued working at their workstations although the line was stopped, because a problem further downstream had occurred. The workers further upstream who were not directly affected continued their assembly tasks and started piling up the produced parts. Creating such buffers of unfinished products does not accord with single-piece flow principles. The manager reported errors when production continued and work steps were accidently skipped because the workers lost track of which piles of semi-finished products had passed the process already. Besides potential quality deviation, this procedure reduced the problem solving potential among the workers team, because upstream operators were still involved in production and therefore did not join in the problem solving process further downstream. Engineers stated that a lack of very basic Lean knowledge among operators made it difficult to cultivate continuous improvement from the ‘bottom-up’.

7.3.2.4 Influence of context factors on 'Lack of Lean knowledge'

When participants, who mentioned 'Lack of Lean knowledge', were asked for their personal explanation of the barrier, they named a number of context factors which, in their perception, were linked to the barrier, namely education, lack of industrial experience, missing Lean knowledge, economic growth, and Chinese culture.

Education: Institutional education system - Several interviewees raised issues with regard to the Chinese education system when explaining the lack of Lean knowledge among the Chinese employees. Several interviewees blamed China's school and university education system for the low Lean awareness among engineers. Managers and Chinese engineers indicated that Lean manufacturing was not part of even the most technical university courses.

Chinese engineers and also German managers mentioned a lack of general education among operators. They argued that because of the low level of institutional education most operators had, operators were not able to use simple tools such as PDCA cycles or Fishbone diagrams. The lack of basic knowledge to understand complex links within the production system was also commented on by a Chinese engineer from Changsha:

> *"When we talk with the operators, we find in our understanding they sometimes cannot understand what we trying to explain to them. Even when we try to explain them simple, general things or why it is our intention to do what we do, or what's the benefit they don't understand. From my understanding one explanation for that is the very basic general education most operators had."*

Lack of industrial experience and missing Lean knowledge - As another factor linked to the lack of Lean specific knowledge, interviewees named the low level of familiarity within Lean manufacturing among the Chinese industry. Participants indicated that Lean production systems were not widespread within

Chinese industry. Even mature employees who had worked in production before had no experience of working within a Lean production system. Several interviewees made comparisons of Lean manufacturing in Japan and China and stressed the differences in terms of Lean familiarity. Chinese engineers named a China-wide lack of Lean implementation among the manufacturing industry as explanation for the missing Lean thinking among Chinese employees. A Chinese engineer from Suzhou gave his comments:

> *"I think it's about the whole system, maybe it's the culture. For example the Japanese companies, all the supply chain has that kind of Lean thinking. Therefore it's easier to implement Lean production. But in China our customers or suppliers don't even know about Lean production. That's why for our company itself it's very hard to achieve the Lean implementation We can make our production relatively smooth but not the total value chain, we cannot."*

A second engineer commented the lack of Lean knowledge among shop floor workers. As she put it:

> *"Comparing Japan actually I think the Japanese have already a more established Lean thinking. In China I feel this Lean thinking has only just arrived at our office-people level. It has still not yet arrived among the shop floor people. But in Japan it's present at all levels; they started working on this Lean thinking already since ten years, or 20 years ago. So that means in terms of penetration it's already arrived in the shop floor level. In China, we need more time, I think."*

Economic growth: High demand for Lean specialists - Again China's economic growth and its influence on the job market was seen as influential. Managers complained that because of the high demand for specialists, especially by western companies, it was very difficult to recruit Lean specialists on the Chinese labour market. The fast development of the manufacturing industry and the high demand of employees with Lean background among the labour market were seen as an explanation why specific Lean knowhow was so rare.

Chinese culture: Lack of company loyalty - As also mentioned in the section on 'High employee turnover', missing employer loyalty and its effects on employee turnover was frequently mentioned with regard to the lack of Lean specialists within the company. Managers explained that because of frequent job changes of non-loyal employees, employees did not obtain a deep understanding of Lean principles and were not able to develop Lean thinking. They stated that it was difficult to overcome the knowledge gap by simply offering training courses or additional Lean workshops. Furthermore, the interviews showed that some German managers refused to send employees for training purposes to plants in Europe. They explained that they had experienced in the past that employees would leave the company after the stay, because international experience is still seen as a bonus in the Chinese industry and increases the career options.

The present consideration of the barrier ‘Lack of Lean knowledge’ revealed that most Chinese employees did not have Lean specific knowledge when they entered the company. Office level engineers partly did not have sufficient Lean background, and Lean understanding is also rare among shop floor workers. As a consequence, employees do not realise what benefits the implementation of Lean brings to them and the company. Some engineers considered the implementation of Lean tools as an ’additional job‘. Participants also complained that the missing Lean knowledge among most Chinese employees required company-internal further education. Additional resources had to be allocated to Lean production training and workshops, for Chinese employees to obtain a basic understanding of the company’s Lean production system.

Participants named a number of effects the barrier had on the production system. Based on a lack of Lean knowledge, employees in leading positions stated difficulties in making their subordinates aware of the benefits of ‘waste elimination’, ‘visualisation’, ‘preventive maintenance’, and ‘single-piece flow’.

Participants named education, lack of industrial experience, missing Lean knowledge, economic growth, and Chinese culture as influential context factors.

7.3.3 Intercultural communication

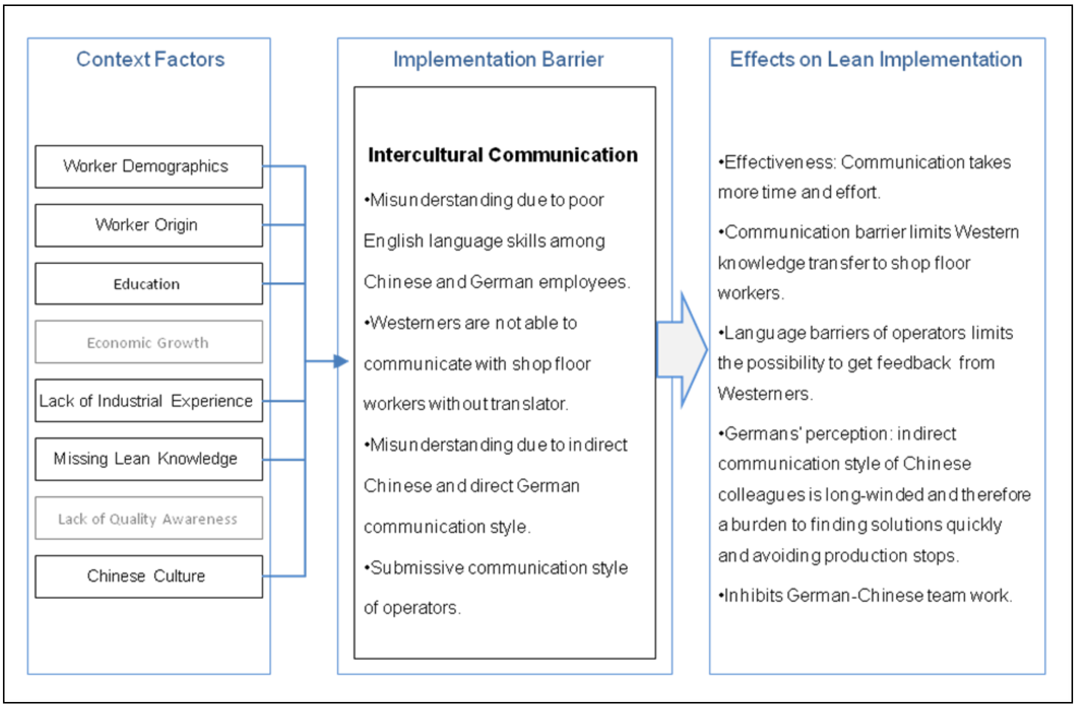

Figure 7.5: Sub-model 'Intercultural communication'

7.3.3.1 Definition 'Intercultural communication'

Intercultural communication refers to barriers to communication between western and Chinese employees. The term 'Intercultural communication' is also used to describe difficulties of communication between employees from different hierarchy levels, and between office level and shop floor employees.

7.3.3.2 Barrier description

The low automation degree of the assembly lines of the Chinese plants led to higher numbers of employees involved in the production as in most western plants. Interviewees indicated that for this reason, communication played a crucial role. Because the Lean implementation involved employees at all levels, good communication was seen to be particularly important for a smooth production process.

The majority of interviewees regarded communication difficulties as the major barrier in the Chinese production. When talking about barriers, most interviewees mentioned communication issues first. Western and Chinese participants gave numerous examples where intercultural communication and also communication among colleagues acted as a burden in their work life.

However, most participants did not describe communication issues explicitly as a barrier to Lean, but indicated this only implicitly. Comments made by interviewees led me to conclude that communication issues did act as a burden for Lean. It is obvious that communication is essential within Lean, to ensure that the changes made within the CI process are being readily accepted and implemented by everyone at all levels. Moreover, the explanation of the previous barriers indicates how important Lean knowledge transfer and receiving worker feedback and suggestions are for the successful implementation of Lean. Clearly, communication is essential for passing on Lean knowledge and for feedback to other employees. Good communication is also vital for employees who act as middlemen between the assembly lines and upper management.

Interviewees distinguished between language issues and communication styles as barriers. No participants in both plants were native English speakers. The official company language of the company was English. Therefore, the large part of communication between Chinese and western employees was in English.

Both interview groups reported that there was a lack of English language skills of both Chinese and western employees. Several Chinese and westerners reported examples where written and verbal communication in English led to misunderstandings and a loss of information. As a Chinese engineer from Changsha commented:

> *"I think it is always a barrier that almost none of the employees of this organisation are English native speakers. So I won't say that the barrier is only from the Chinese part, the Germans also have difficulties to communicate in English. Both sides cannot always express themselves clearly. One side is already losing certain percentage of the true meaning of their expressions when they translate into English, then the person who receives the message will lose another percentage of meaning. Finally, the effectiveness of the intercultural communication will drop."*

Several interviewees saw difficulties in communicating with shop floor workers as a prominent barrier to develop the implementation of Lean further. Mainly westerners complained that the majority of Chinese workers within production spoke no or very little English. Also, nearly all westerners were not able to speak Chinese, which led to the problem that they were not able to communicate without the help of a translator. Frequently, westerners complained about huge efforts to transmit basic information to the shop floor workers. A German interviewee commented on the ineffectiveness of communicating directly with Chinese workers:

> *"One major barrier is definitely the language barrier. In my job, I work closely with maintenance technicians within the shop floor, and among shop floor employees, there are very little English language skills. The younger guys might speak a bit of English, but I often still need to consult one of our translators from the offices to help me out. To communicate with the shop floor, I need to use hands and feet … that takes a lot of time and a lot of effort."*

With regard to Lean, this was seen as important because the westerners were hardly able to transfer their expert knowledge to the workers. This was particular a barrier in building up Gemba-leadership between western employees and shop floor workers. Respondents argued that because of missing language skills, operators were not able to benefit from the skills of the western Gemba leader, compared to employees with English or German language skills. Difficulties in getting direct feedback straight from the workers were again seen was a burden for CIP. Throughout the study, this was also often seen as important when talking about ‘bottom up improvements’.

A Chinese production manager descried the importance of communication with operators and close relationships for getting feedback and insights about the assembly lines:

> *“During my work as a planner and later as a deputy production manager, I experienced that the most important is the communication, to get the best out of the production line. The most important thing is to be familiar with operators and also the team leaders; their methods and knowledge is totally different from what I have learned in school. So communication with them is very important for me to share the same understanding with them and to get their feeling and opinions about decision or guidance I am planning to make.”*

As a further barrier for implementing Lean, which is related to communication issues, interviewees named difficulties when communicating with German headquarters. This barrier was only mentioned in the less mature plant in Changsha, because the Changsha plant had recently purchased assembly lines from headquarters and therefore relied more on their support. Chinese interviewees complained that even minor changes on the assembly lines or production processes needed to be approved by German headquarters. Interviewees argued that communication difficulties slowed down the implementation process of Lean. A few interviewees from Changsha also mentioned the time differences and different bank holidays as an obstacle when dealing with the German leadplant.

Indirect vs. direct communication - Besides the language issues, communication style was also seen as a barrier. Both Chinese and western interviewees saw major differences in the communication styles of Chinese and western people. Frequently, interviewees named examples of how the indirect communication style of Chinese and the direct communication style of westerners were a barrier when working with the opposite culture.

German interviewees indicated that the indirect communication style of Chinese made it hard for them to understand what their Chinese colleagues were trying to tell them. Several examples were given by western interviewees where the indirect communication style of Chinese led to misunderstandings. As a German engineer from Changsha commented:

> *"When Chinese people speak, it's like 'bla-bla-bla', and afterwards you still don't know what they really wanted to say. The problem they are so 'indirect' that you do not know what the initial information is or the problem is they wanted to transfer. In comparison, the Germans communication style is very clear, in an analytical manner, preferably the message is concluded by using very specific words … 'bam'! that hit you like a blade."*

Similarly, several Chinese interviewees considered the direct communication style of western colleagues as inappropriate when dealing with Chinese people. Examples were given of Chinese considering the German communication style as too direct or even rude. As a consequence, some Chinese interviewees felt insulted or uncomfortable when communicating with western supervisors. The conflict between western and Chinese communication styles are summed up by a Chinese employee from Changsha:

> *"Communication for sure is one of, I think, the most important topics. The way of communication and also the context we bring in a Chinese surrounding and inter-country surrounding is different. The communication style in the German companies is much more direct, even sometimes for Chinese would be rude, or too direct. On the other hand, the Chinese communications for Germans are too ambiguous, not clear enough and they have to really push around to get to the point. (…) Chinese will never be German; German will also never be Chinese."*

Another Chinese interviewee stressed that the direct communication style of the Germans did not leave him the space to express his ideas. For the engineer from Changsha, the German communication style was a burden to expressing his thoughts when working in multinational teams.

> *"Communication is the old problem. (…) The way of the German communication style is sometimes too strict that the other ideas have no chance to get accepted. My ideas are sometimes completely thought through, they are so strict. I can't*

> *make the conclusion at first. I want to speak and discuss the ideas and maybe find agreement later on. But if I suggest my ideas to the Germans, in the first step when I am still speaking about the detail, but the conclusion is not speaking out yet, then they may stop the communication and my raw idea of the conclusion is still not being communicated out."*

It can be assumed that such communication difficulties restricted Lean implementation, especially continuous improvement efforts, when Chinese employees were not able to enforce their improvement ideas to their German supervisors.

The style of communication was also named as a barrier when communicating with operators. Especially western managers, but also Chinese engineers, reported the communication style of operators as a barrier. Beside the already-mentioned language barriers, they reported difficulties which were based on the communication styles. They complained that operators often did not indicate difficulties in the assembly line to management directly, and used a devote communication style to indicate improvements. However, such behaviour can also be linked to the lack of problem solving or disregard of instructions which will be considered in the chapter on work styles (Chapter 7.3.4). This behaviour may also be linked to differences in power distance, because engineers reported that operators would often be frightened by the presence of Chinese managers and especially German managers. Interviewees explained that operators were not used to the fact that within Lean production, management was interested in the operators' perceptions and suggestions about their workplace. Again, interviewees saw the non-active communication style as a burden for getting first-hand feedback from the working level. They regarded a good communication with operators as crucial for the continuous improvement process.

When comparing the communication issues in the Changsha and the Suzhou plants, the barrier was more evident in the less-mature plant in Changsha. With regard to the office level, this difference may be linked to a better degree of English language skills among employees in Suzhou. It was commonly agreed that differences existed between the English language level of employees in the mainland and the more developed coastal regions. The plant manager in Changsha commented:

> *"One of the biggest problems we have in this plant is the English language level of our employees and graduates in this region. You cannot compare the English level here with the level in the coastal cities like Shanghai or Beijing. The poor English level is a phenomenon which is linked to the city and the province where we are located. But these are issues which our company tries to change. We try to internationalise Changsha and the Hunan province, that's why we are trying to initiate that the Universities here teach more English and implement courses which are held in English."*

Moreover, communication issues based on intercultural differences might be less evident in Suzhou because of the lower number of expats in this plant. Moreover, interviewees at the more mature Suzhou plant stressed that they adjusted to the German direct style of communication over the years. An employee from the HR department in Suzhou elaborated:

> *"At the beginning I had some difficulties with the German communication style. But because I have done this job now for almost five years, after several years I think there it is no big difficulty for me anymore. However, at the beginning, we had some difficulties with regard to communication and the way of thinking, but after several years working with the western expats, we and also the expats changed. I also changed my way of thinking; now I think I am much more direct. When I just talk with my family or with my friends they all just think I am very direct ...[laughs]. Because if there is something, I will just tell them, I do not think anymore whether they accept it or not [laughs]."*

Another reason for fewer communication problems at the Suzhou site may be that Chinese employees learned to accept the German communication style over time. Some comments by Chinese interviewees indicated that they accepted the German communication style to a certain extent, because they were employed by a German company, even though they were not necessarily satisfied with this communication style. These circumstances might also explain why not many western interviewees considered that their own communication style might act a barrier when communicating with Chinese employees. Chinese interviewees also reported that they would not accept this communication style if Chinese managers were to use it. As a Chinese from Changsha commented:

> *"Because it's a German company a lot of the managers are still from Germany. So in this situation, psychologically the Chinese employees will somehow accept the way that they are communicating. Let's assume if a Chinese manager is doing the same or a Chinese colleague is doing the same then the colleagues won't accept it. We have one German manager in the perception of some Chinese is very direct, sometimes emotional, even rude. But we accept that because we know he's a German, he's coming from a different background and somehow then we're more tolerant. We have another Chinese manager, probably also looks like a little bit bossy and being direct and using more aggressive gestures, in that case the Chinese employees feel really insulted by his behaviour."*

7.3.3.3 Effects of 'Intercultural communication' on Lean

Most of the examples and comments about effects of the barriers were not explicitly linked to the Lean implementation. However, it can be inferred that the barrier affects the Lean implementation process. Several interviewees complained that intercultural communication took more time and effort than communication with fellow nationals. With regard to the direct German and indirect Chinese communication styles, both parties felt that communication was less effective. It can be assumed that ineffective communication slowed down the implementation process of Lean, because Lean implementation involves a high number of employees at all levels. Moreover, high efforts needed to communicate with employees from another nationality may restrict the continuous improvement process. It is possible that employees are less inclined to initiate small improvements, to avoid long lasting and difficult communication with colleagues. A German engineer commented on the communication style of his Chinese colleagues:

> *"It is such a hassle, if you ask a Chinese a very specific question, which we Germans would answer with a clear yes or no, you will end up getting a half an hour long talk. Afterwards you still need to ask two or three further questions until you get a yes or no."*

An effect of missing English language skills was that a western manager felt uncertain whether their subordinates understood orders and instructions. An example was given by a German manager:

> *"In a half-hour meeting I explained a certain task to Chinese metal workers. It seemed that the Chinese agreed to the content by nodding their heads. It seemed they understand the task. They looked interested ... and agreed to most explanations. In the end of the meeting I asked a few questions in the group; nobody could answer my question. After checking their understanding in small groups, I realized the Chinese metal workers did not understand very much of the content I was presenting."*

As further effects on Lean, western interviewees stressed that because of the urgency to solve problems a quick and effective communication was essential to avoid production stops (due to low levels of safety buffers within Lean). The Germans perceived the indirect communication style of Chinese colleagues as long-winded and as a burden to find solutions quickly when problems occurred within the production. As a German high-level manager from Changsha commented:

> *"When we have a problem in the production, we need to solve it as soon as possible. If we can discuss the problems in a straight and direct manner, it's easier to find a solution. If we avoid conflicts and not discussing problems to the point then we lose time until we are in big trouble!"*

With regard to language issues, the fact that none of the employees were native English speakers also affected the work in international teams. Confusion had occurred when employees spoke to colleagues in their native language within multinational meetings. This led to confusion, as a Chinese interviewee explained:

"When we have a meeting together with Chinese and Germans, normally we will speak English because we can't understand each other, but suddenly, we Chinese talk Chinese to each other, the Germans speak English, because they cannot understand. But sometimes the Germans will suddenly speak German. But most of the times, that happens just in certain situations, for example when they have difficult challenges or there is something that makes them very confused."

7.3.3.4 Influence of context factors on 'Intercultural communication'

Participants named worker demographics, worker origins, education, lack of industrial experience, missing Lean knowledge, and factors that relate to the Chinese culture, as influential.

Worker demographics – western interviewees reported that communication difficulties were less evident when working with office level colleagues who were in their twenties or early thirties. They stressed that generally their English language skills were better than those of older colleagues. Also, they found that the communication style of the younger generation was already more westernised. Interviewees mentioned that the younger generation had also adapted to a more direct communication style. As a German manager commented:

"I need to admit that the young Chinese engineers are a bit more open and more westernised in their way of thinking. The older generation are more 'shaped' by the traditional Chinese way of thinking, for example indirect communication and grammar. The young Chinese who can speak English already know how to ask and answer questions when communicating with westerners. In contrast to the older generation, the younger generation was able to answer questions with a simple yes or no, or asking a specific question."

Here it should be mentioned that this phenomenon was reported only with regard to office level employees. Among shop floor employees of all ages, English language skills were still widely missing.

Worker origin – As mentioned in the 'barrier description' section, the barrier was less evident in Suzhou than in Changsha. The origin of employees was seen as one of the explanations. Interviewees revealed that the more developed coastal regions were already more westernised and had better English language skills than the more rural areas in the mainland. This was taken as an explanation for why the lack of English language skills was less evident in the Suzhou plant.

Lack of industrial experience and missing Lean knowledge – A lack of industrial experience and missing Lean knowledge was also linked to the communication difficulties within the shop floor and office level. In the perception of some interviewees, the lack of experience of most employees in China of working within Lean production systems restricted their ability to communicate suggestions and feedback to the managers.

Education – Interviewees frequently blamed the Chinese school and university education system for the lack of English language skills among Chinese employees. Interviewees stated that in many Chinese public schools and universities, foreign language education was insufficient.

Chinese Culture: Guanxi – Several interviewees stressed the importance of an interpersonal relationship and good Guanxi to overcome communication barriers. In the perception of Chinese and western interviewees, a good Guanxi relationship with colleagues would lead to more effective communication. As described by a German engineer:

> *"A particular challenge when working in China is the communication with Chinese people. As far as I have understood, when you have good communication, you get*

better and more direct information. It is very important to have a close relationship with Chinese people. If you just ask 'please give me these data' they will answer 'ok', but you will never get the required data. You need to become closer to a Chinese person to build up the 'Guanxi connection'. That takes a lot of time, but it finally helps you to get the information you need."

Chinese Culture: Traditional communication style – Chinese interviewees commented that their indirect communication style was grounded in the national Chinese context and communication customs within Chinese society. Again, Confucian values, the concept of face, and Guanxi relations were seen as influential. A Chinese commented on the differences of how Germans and Chinese dealt with information:

"The indirect style of communication can be explained by the Chinese traditional customs. How to say … in China it is important that you keep a good relation, not argue so much. This is a Chinese tradition, but that is different than in Germany. The Germans may work it out, there it doesn't matter to argue, and it doesn't matter to keep the relation or break the relation."

Chinese Culture: Traditional hierarchical structures and the concept of power distance – The importance of hierarchy and high power distance within Chinese society was also seen as an explanation for communication difficulties. Interviewees explained that the lack of communication between managers and operators might be influenced by the hierarchical distance among these groups. They explained that besides a lack of English skills, the operator may be intimidated by the presence of the managers because of their higher level of hierarchy. As a Chinese engineer from Suzhou elaborated:

"Yeah, besides the English language skills, hierarchy is a problem. When some of the department heads, or German, or foreign directors want to communicate with the operators and team leaders and they cannot speak English, this is a barrier and also the hierarchy which is existing. Shop floor workers tend not to escape their hierarchy level when communicating. They will not directly talk to the department heads or section manager. They just report to the next higher level which is their supervisor."

The present consideration of the barrier 'international communication' revealed that communication issues did act as a burden for Lean. Participants distinguished between language issues and communication styles as barriers which hindered passing on Lean knowledge and feedback to other employees. They indicated that a lack of written and spoken English language skills led to misunderstandings and loss of information. Difficulties in communicating with shop floor workers were also seen as a prominent barrier. Westerners stressed a lack of getting direct feedback from the workers due to the lack of language skills on both sides. Due to communication difficulties, westerners were also hardly able to transfer their expert knowledge to the workers. Besides the language issues, communication style was also seen as a barrier when working with the opposite culture. A number of examples were named where the indirect communication style of Chinese and the direct communication style of westerners were perceived as a barrier. As effects on Lean, the participants complained that intercultural communication took more time and effort than communication with fellow nationals. Moreover, employees were seen to be less inclined to initiate small improvements, and they avoided long-lasting and difficult communication with colleagues. The participants stressed that given the lack of safety buffers within Lean, there is a particular need to solve problems urgently in a Lean system. A number of context factors were also linked to the barrier, namely worker origins, education, lack of industrial experience, missing Lean knowledge, and Chinese culture.

7.3.4 Work styles

7.3.4.1 Definition of 'Work styles'

Work styles refer to employees' skills and actions that determine how the individuals or a group of individuals approach job functions. The main work-style barriers were: workers' disregard of instructions and procedures, lack of maintaining standards, and lack of problem solving. A sub-model will be presented for each barrier.

7.3.4.2 Workers' disregard of instructions and procedures

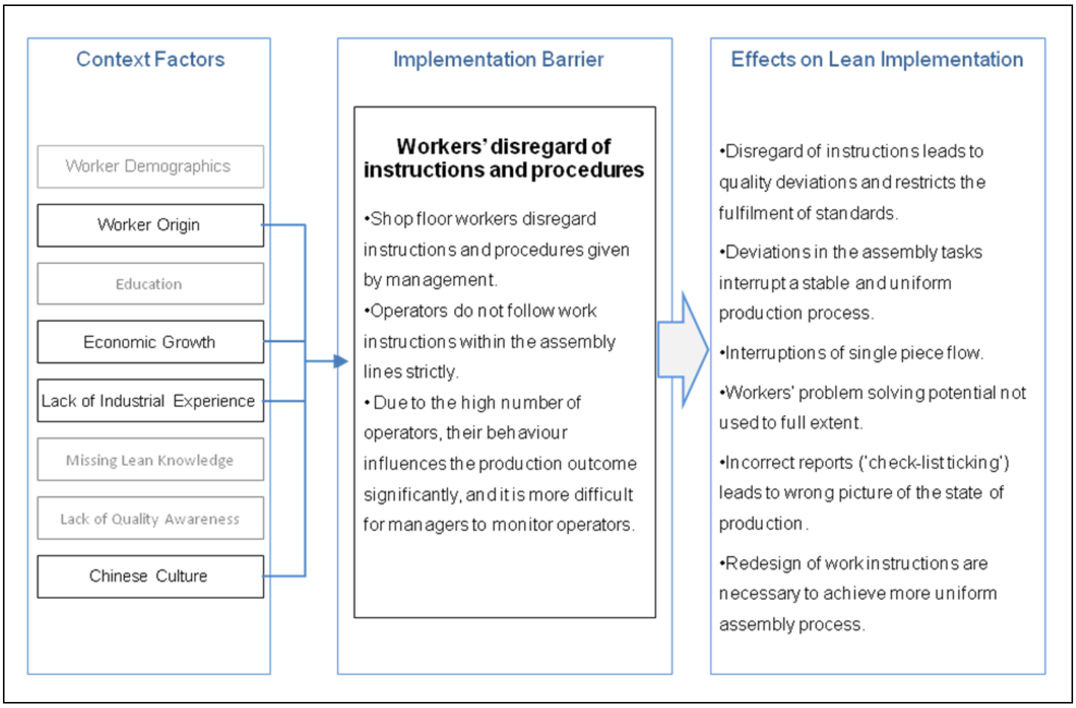

Figure 7.6: Sub-model 'Workers' disregard of instructions and procedures'

7.3.4.2.1 Definition of 'Workers' disregard of instructions and procedures'

Workers' disregard of instructions and procedures refers to shop floor workers' behaviour and actions which are not in line with the company's requested work instructions and tasks, as well as instructions given by the shop floor workers' supervisors. When talking about issues regarding workers' disregard of instructions and procedures, participants sometimes also called this barrier 'lack of discipline'.

7.3.4.2.2 Barrier description

In comparison to high-cost labour countries such as Germany, the automation degree of the Chinese assembly lines was lower. This led to a higher number of operators working on the shop floor. Interviewees stressed that, as a consequence, the quality of the production process in China relied more than in Germany on the performance of the shop floor workers. Interviewees also stressed that to ensure a reliable production process, the work force had to respect the instructions and follow standardised procedures.

In the perception of several interviewees, work styles of shop floor workers were a barrier to Lean, firstly in terms of their disregard of instructions and procedures. Westerners and Chinese from both plants reported several examples related to the disregard of instructions and procedures, which included lack of responsibility, lack of discipline, refusal to follow orders, inconsiderateness, and irresponsibility. Several interviewees complained about situations where workers intentionally refused to follow orders given by management. Most interviewees considered their behaviour as a barrier for Lean. Chinese process engineers who worked closely together with operators gave several examples where workers were not following their advice, or sticking to the tasks suggested in the work instructions. In one interviewee's perception, the shop floor workers intentionally did not follow the required work steps to make their work easier. He explained that some operators calculated the risk of getting caught and fined by management on the one hand, and their own benefit on the other. He gave an example of workers intentionally breaching instructions to finish their work earlier, knowing that the chance of getting caught by the management was low. An employee of the HR department in Suzhou claimed that many workers did not follow work instructions accurately and did not accomplish orders set by the management. As she put it:

> *"For example, wall instruction, wall instruction is on the wall, everybody can read it and everybody knows the content but not everybody will 100% strictly follow the wall instruction. We are expecting that the operators can follow orders, so this is a very clear message I get from managers. However in reality, not everybody can or will fully follow up the orders. For example I mentioned the working instructions. It is very clearly indicated but in reality they do not follow it."*

Both Chinese and western employees further indicated problems that workers were not following standardised procedures, even when they were aware of the importance of standards to ensure a stable and uniform production process. Engineers who were working closely together with operators stressed that the disregard of instructions and procedures was not grounded in a missing understanding of the instructions given by their supervisors. In their opinion the operators' disregard of instruction was done intentionally and was not triggered by a lack of understanding of the requested work task. Several examples were given which underline their views. For example engineers complained that during night shifts frequently operators where smoking in areas within the shop floor where smoking was not allowed because they knew that at night times their misbehaviour would not be detected by the management which was not present at these times. Non smoking signs placed all around the plant should clearly indicate that smoking at the plant building was not allowed. An engineer also complained that some operators did eat snacks on their work stations during working hours even when this was by reason by quality reasons strictly not allowed in the special designed dust-free areas. When considering the disregard of these simple instructions it is likely that the employees did break this rules intentionally rather than by an oversight through misunderstanding of the instructions.

Managers reported that the operators first tended to follow instructions and work manuals, but after a while did not strictly follow the rules set by the management.

They further complained about a missing ability to follow orders over a long time period. For example, one Chinese engineer who was responsible for assembly lines reported that Chinese operators tended to try and find ’easier’ ways of accomplishing their assembly or maintenance tasks. This was seen to bear the risk of deviations, such as forgotten production steps, wrong assembly orders, safety risks, etc. In their perception, this was a barrier to Lean, especially regarding standardisation. As reported by a Chinese engineer from Changsha:

> *“For example, lack of discipline, when operators cheat on something or if you ask them to make an operation according to standard work. At the first day they do it, but after two days they will make it out of their own experience. They will say ‘ will do it different, that is more convenient for me’. (…) Some how I understand them; they have an eight- hour day which means seven-and-a-half hours operation. Of course they will feel tired after a while, and they want to change some habit or change some operations but everything which differs from the standard, that’s not good for the product quality!”*

Respondents also stressed that because of the high number of operators working in the production lines, management was not able to control every movement of all workers. As a Chinese engineer from Suzhou put it:

> *“Another challenge is for us to monitor our operators. If we have one project, maybe one a day, this is easy. But for our production we have several projects and we cannot do it every day. We can’t monitor them closely like this. So the rule for the operators is, the standardisation must be followed every day, no changes are allowed to be mad. But to maintain that is a big challenge for us. (...) We cannot check the operators every day. When we have different operators working in different ways, at the end we have no control over our processes. We don’t know what they did and if they really followed the work instruction, that’s the problem.“*

Several interviewees indicated that the described barrier was particular present in China. German managers and also Chinese engineers who had spent time in the German lead plant compared operators’ tendencies to disregard instructions between these two countries. They stressed that a lack of following orders was more present among workers in China than in Germany. This view is reflected by a quote from a German department head who has worked in various different plants worldwide:

> *"Inconsideration and lack of discipline, these are topics I never experience that to the same extent like here in China. (...) But to be honest, at my previous employer we also hat sometimes problems with worker discipline. Once in the night shift the 'ghetto blaster' was placed at the PCB[25]-machine with such a high volume tunrned on that it nearly fell in the solder bucket. No worker really cared about the risk emerging vibration might have on the process! ...music was forbidden anyway.(…) I want to point out that we also face discipline issues on the German shop floor. However, not the same extent as in China. In China these issues are more present than in Europe, the West or even countries like Korea."*

7.3.4.2.3 Effects of 'Workers' disregard of instructions and procedures' on Lean

Several interviewees reported negative effects on the production quality when workers were not following instructions or procedures. They stressed that for example the complex assembly processes and specified takt-times would leave very little space for operators to do something different than directed in the work instructions. An engineer from Suzhou named an example within the PCB assembly where quality problems of the final product occurred because operators picked up fragile and sensitive electronic components which had fallen on the floor, although they had been instructed clearly not to use any components which they had dropped on the floor.

Not following instructions also had effects on the production flow. An engineer from Suzhou reported that operators working on an assembly line disregarded

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[25] PCB stands for printed circuit boards. The boards are complex and fragile electronic elements in the plant used within the ABS sensor production. Under no circumstances should these boards be dropped on the floor or contaminated with any form of dust.

instructions to ensure the single-piece flow within the line. She stated that when a problem at one workstation occurred, the operators were not willing to stop their assembly task on their own workplace and support problem solving activities at the affected workplace. The engineer explained that the operators were however instructed to support the affected workplace. She elucidated that the workers wanted to continue their work to get some extra break time. She elaborated several effects on Lean production. For example, the problem solving potential of all workers remained unused. Therefore it could take longer to solve the problem. It was also stated that workers further upstream continued their work and stored semi-finished parts in the assembly line. This brought the risk that work steps were skipped and products were passed further downstream. As the interviewee explained:

> *"We want to produce according to one-piece flow. For example there are three stations in total. The station one has some problems or they are interrupted by maintenance or other guys. However, the second operator and the third operator will still continue to work because they don't want to lose their time in the traditional sense. Because they might think; 'If I do finish my work there, I can get more break time'. But actually according to Lean concept, they shouldn´t do this. If station one stops, they should stop immediately and join problem solving. So that's one example of a conflict with the daily work. We have trained them for a long time but they still don't follow the rules."*

Some interviewees stated that the disrespect of orders within the shop floor also influenced the application of Lean tools, such as the housekeeping tool 5S. An engineer from Suzhou stated that the operators do not 'follow very well'. He complained that workers do not independently accomplish the tasks required by 5S on a daily bases. He pointed out that audits and checks by the management demand that workers maintain the level of tidiness required by the company.

German interviewees named further effects of the workers' behaviour on Lean. A German engineer gave an example where workers' disrespect of orders influenced the outcome of a process quality visualisation tool. He elaborated that some workers tended to simply 'tick off' checklists without seriously checking the tasks required by the checklist. A direct negative effect was that management got a wrong picture of the state of the production, and there was a risk of breakdowns.

Interviewees claimed that the named effects were based mostly on the workers' disregard of instructions rather than a misunderstanding of orders. Several interviewees who were involved in the assembly line management explained that they put a lot of effort in the redesign of work instructions. With this task they wanted to ensure that Chinese operators understood the requirements. Within all plants of the host company, every assembly line workstation was equipped with work instructions which defined the work task and highlighted the key points and safety risks the operators have to take into account. The redesign had effects on the work instructions. The work instructions in both Chinese plants were far more detailed than in German plants where just the basic tasks were described. The Chinese work instructions in the assembly lines included a comprehensive description of the work task and several examples pictured which showed all sorts of deviations. The engineers' intention was to ensure that the work was done exactly according to the standard, to ensure product quality. The differences of the work instructions are commented on by a Chinese engineer from Suzhou:

> *"Have you seen the working instruction in German plants? It is only very easy, five lines. In Germany it says; 'What you need to do, for example load the ECU and ensure that there is a good connection between two parts'". That's all. In China, five pages, with a very exact picture, 'Push which button, how long, load the ECU and which position, put your hands on left or side, use your left hand to load the ECU, right hand to put the button', everything taught you exactly what you do. (...) If you do not have five pages, very detailed, and five lines, operators will question themselves, 'Which hand should I take the ECU, because in my last position, people told me left hand the ECU, right hand push button'. (…) You need to be that detailed because the operators here like that; they need instructions."*

The disregard of orders and rules within the shop floor was also observed by the researcher. In an early morning meeting with an interviewee in the

Changsha plant, cigarette butts were lying in the meeting room. The interviewee complained that again, night shift workers had apparently used this room for a cigarette break, even though smoking was not allowed inside the building.

7.3.4.2.4 Influence of context factors on 'Workers' disregard of instructions and procedures'

In the following, the context factors, Chinese culture, economic growth, worker origin, and lack of industrial experience will be presented.

Chinese culture: Generation 90 - Several Chinese and western interviewees linked the workers' disregard of instructions and procedures with the cultural characteristic 'generation 90'. Most workers in both plants were adult teenagers or in their early twenties and therefore born in the 1990s. 'Generation 90' was a term often used by interviewees to explain certain behaviour of the workers. The term referred to certain characteristics of the 1990s generation rather than the actual age of the workers.

Mature interviewees with several years of work experience pointed out that there are significant differences between worker behaviour of the recent generation and workers of the same age group several years ago. In the perception of a Chinese HR employee from Changsha, there was a significant difference between the generation 70, 80 and 90 with regard to following orders and work motivation. As she stated:

> *"Now actually generation 90 joins the society. In our current situation, the generation 70 and the generation 80 are both willing to work in production or as blue collars. However, generation 90 is somehow reluctant to work in production so they are looking for much more ... they're looking for the office work or work where they can be well dressed, well paid or even the not well paid but at least to be respected by others in this kind of jobs. So ... this is in the general tendency."*

Several Chinese interviewees further explained that in their perception the negative characteristics shown by the young workers on the shop floor are driven by the economic and social background they grew up in. They explained that most of the operators are raised up mostly by their grandparents and were benefiting from the economic success the parents generated. As a consequence, most members of the ‘generation 90’ grew up in a wealthier environment than the generations before, which made them more reluctant to work hard.

Beside Chinese interviewees, western interviewees also used the ‘generation 90’ phenomenon as an explanation for the workers’ disregard of instructions and procedures. Westerners stressed that changes in society and social background of workers might be an explanation for the workers’ behaviour. As a German manager from Suzhou who spent more than two decades in China commented:

> *“Most young Chinese had a relative easy past and are now profiting from their parents. The last Generation was hard-working and could generate a higher living standard. The recent workers mostly were raised up by their grandparents; they had everything and never needed to care about anything. Out of this environment, suddenly they should start a job as operators. How should I say… they do have problems with the reality of life as an operator? They are lacking discipline. For example we have problems with 5S. Because the basics are missing: tidiness, cleanliness, to come in on time. They are clearly lacking orderliness and discipline. That’s very bad. That is a recent phenomenon, operators born in the 60s and 70s do have a completely different drive. (…) The Generation 90 operators, they are too easy-going. When they start working in our plant, then the problems start. For example computer games, a very big problem, you cannot play games all night and then come to work. Discipline at work, communications among them, teamwork all this are issues present with in the ’Generation 90’”.*

Economic growth: The economic growth of China was also seen as an explanation of the behaviour shown by the young employees. Interviewees explained that because of the wealthier situation, especially within the developed eastern part of China, the effects of ‘generation 90’ were more present. In the opinion of some employees, these effects were more obvious for workers from the East than for workers from the more rural West. He commented:

> *"The workers' families' economic situation is better than before. It might be, if some family has money the children will never care about their education or work, especially in the east of China. Many of the children don't care for study. If you go to the West you will find a different picture ... Students in the west of China still care about study but if you look at Suzhou or Shanghai or Jiangsu Province, many of the children, many of the students don't care to study. Some of the families are very wealthy. So basically the children, they don't care about the work in the future, because the family have money to support them."*

Chinese culture: Single child policy - However, the vast majority of interviewees did not consider the 'generation 90' as a phenomenon which can just be found in the commuter belt. Even interviewees from Changsha, where most operators come from the less developed rural areas in western China, considered the 'generation 90' as a Chinese-wide phenomenon.

Participants explained that there are links between the emergence of the phenomenon 'generation 90' and the 'single child policy' introduced in China in the 1980s. Many interviewees used the terms 'single child policy' and 'generation 90' interchangeably when talking about behaviour patterns of the worker generation. However, some interviewees stressed explicitly that political factors such as China's population control policy were influential. In their statements, they did not take into account effects triggered by the wealthier situation the current generation grew up in. They stressed that even social factors, such as being a single child, might be linked indirectly to some of the problems they had to deal with when implementing Lean.

Lack of industrial experience and worker origin: Agricultural past – Lack of industrial experience was again seen as an influential factor. In the perception of some interviewees there was a connection between the workers' lack of experience and the disregard of instructions and procedures. For example, an HR employee from Changsha pointed out, that some workers who come from rural areas even had no clear picture of what working as an employee in a company means. She complained that some operators were not even aware of how to deal with rules within a company and how they should position themselves as a worker in the organisation.

A Chinese engineer from Changsha further argued also that the farming background of most operators played a role. In his perception, the more self-determined and self-dependent work style when living as farmers was influencing the operators and their behaviour at work. In his perception, the social background they grew up in would make it more difficult for those workers to work according to strict rules within the production system.

Chinese culture: Chinese attitude towards rules - A small number of interviewees explained the workers' disregard of instructions and procedures by the general association of rules in Chinese society. In their opinion, Chinese people tended in general to obey to rules less strictly than people in some other countries. In their opinion, these differences were an explanation for the workers' reluctance to abide by management rules and instructions. A Chinese interviewee from Suzhou explained this phenomenon by the history of China's legal system. He argued that Chinese people stick to rules less strictly because China does not have a long history of today's legal system. He argued that in the past, Chinese people were mainly managed by the country leader and not according to laws. This was why Chinese people still considered the 'law' as something written on paper, and not necessarily needing to be followed strictly. This respondent explained:

> *"China has a long history, but China doesn't have a long history of 'following the law'. There were times when China didn't have a very strict law system. Chinese people followed the leader. They were managed according to the leader and not according to the law. The law is largely done on the paper, everyone should obey*

the law. That's why Chinese people don't obey the law so strictly. Chinese culture has a long history, but we don't have this kind of law management."

A Chinese interviewee from Changsha supported his colleague's claim. He also saw a link between the workers' behaviour and the perception of rules in the Chinese society:

> *"I think the workers' behaviour is also related to the culture. I also thought about how the culture influences their behaviour. Most of Chinese people think: 'If you do the wrong thing but nobody is watching, that means nobody catches you, then that will not be the wrong thing. The wrong thing only means the things are not wrong only being found out by other people. I've broken the rule in the street, but if there is no police, that's fine then. (...) This thinking influences the operators."*

Another Chinese interviewee from Suzhou illustrated the differences in following rules by an example of how among Chinese people follow traffic rules. He compared how people in Germany strictly followed traffic rules whereas in China, people tended to disobey traffic rules. In his opinion Chinese people were generally more 'flexible' in following rules.

In summary, several reports related to the disregard of instructions and procedures by workers, which included lack of responsibility, lack of discipline, refusal to follow orders, inconsiderateness, and irresponsibility. Several interviewees complained about situations where workers had intentionally refused to follow orders given by management. Several examples were also given where workers had not followed the managements' advice, or did intentionally not follow the required work steps to make their work easier. As effects on Lean, the participants claimed that a disregard of instructions leads to quality deviations and restricted the fulfilment of standards. Further effects were interruptions of single piece flow, lack of application of the housekeeping tool 5S, workers' problem solving potential not being used to its full extent, and lacking application of quality-visualisation tools. The participants gave indications that Chinese culture, economic growth, worker origin, and lack of industrial experience played a role with regard to the barrier

7.3.4.3 Lack of maintaining standards

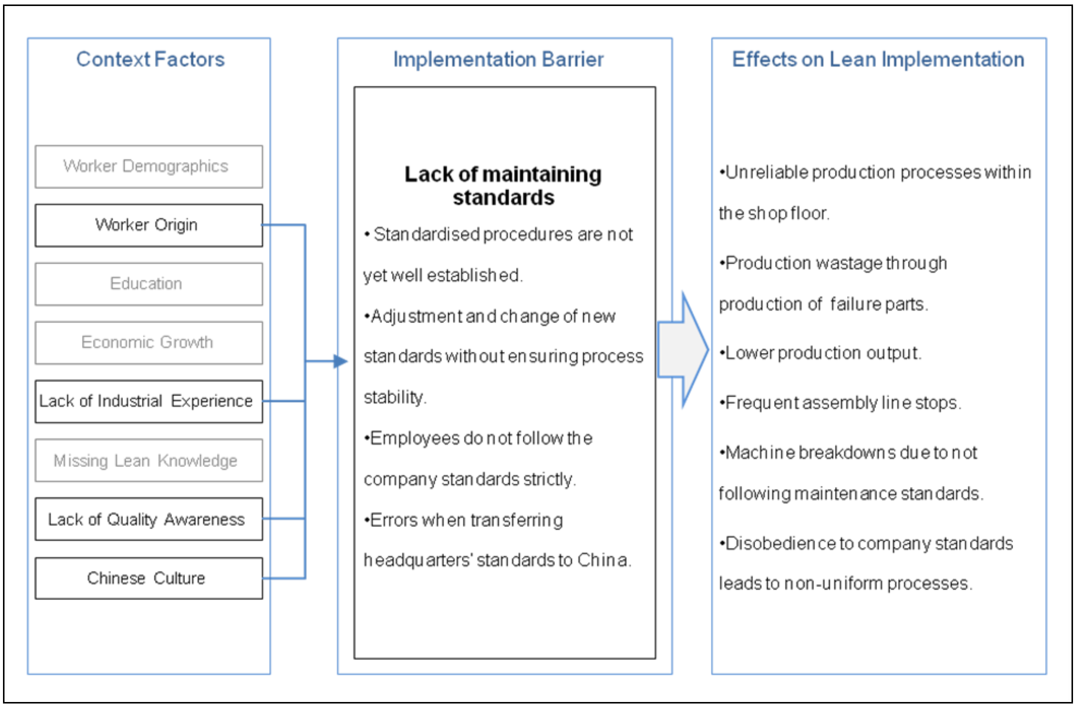

Figure 7.7: Sub-model 'Lack of maintaining standards'

7.3.4.3.1 Definition 'Lack of maintaining standards'

'Lack of maintaining standards' refers to impediments to Lean implementation through insufficient implementation and maintenance of standardisation, both at engineering and shop floor level.

7.3.4.3.2 Barrier description

Several interviewees complained about a number of barriers which will be integrated under the main barrier called 'Lack of maintaining standards'. Participants named unreliable processes, difficulties to apply headquarters' standards, wrong understanding of standards, difficulties to detect deviations from standardisation as barriers for the Lean implementation in their plants. Most of the interviewees were aware of the importance of standardised processes for the success of Lean production. In the perception of most interviewees, establishing standardisation was essential for a successful implementation of Lean manufacturing.

There is an overlap between the present barrier and the barrier 'disregard of instructions and procedures'. The previous barrier focuses on the behaviour of the workers, whilst the current barrier focuses on the lack of maintaining standards that is due to a range of reasons apart from operators behaviour.

Several interviewees complained that standardised procedures were not yet well established in the production. Interviewees from different departments gave examples which indicated that procedures which should be standardised were not applied appropriately. Interviewees recalled that they found it difficult to follow Lean standards when difficulties occurred.

A Chinese engineer reported difficulties when implementing the workplace organisation tool 5S in Suzhou. He reported that the 5S standard itself was too immature and that his team were not certain if this 5S procedure was an appropriate standard:

> *"On the shop floor, we may misunderstand the 5S in some parts; 5S does not simply mean what kind of things should be put away as the standard. (…) We should put it here exactly and nowhere else, but this is not the most important part. The most important part is to do some visualisation and standardise the work and therefore work efficiency will be improved. This is our goal target of the 5S standard. But the problem here is the standard itself. The standard is so immature, we don't know if this standard is good or not. We just set up the standard; the improvement of the standard itself is missing."*

Especially interviewees from production departments complained that the production processes were not yet reliable and stable enough to run smoothly according to the standards. Especially German interviewees complained about the process reliability in the Chinese plants and further stated that the standards would not run as smoothly as in headquarters' production. But also Chinese interviewees supported the claim made by several Germans. A Chinese engineer in the Lean implementation team in Suzhou stated that a lot of deviations in the daily operations meetings were reported. He complained that the Lean implementation team was mainly busy ensuring that the production ran according to the standard, rather than focussing on their initial aim to further improve the standard. In the same vein, he mentioned that managers from production departments kept adjusting and changing standards without ensuring process stability. He elaborated that the frequent changes of the standards made it hard for workers to take the standard in and accomplish their assembly task according to the requirements. As he stated:

> *"Stability of standards… maybe I can tell you my personal feelings of Lean implementation in the production line. Maybe we don't need a very good, mature or perfect solution or standard at the beginning, it's understandable. I communicated several times with the production managers, they said: 'We need to have a standard and keep it for a while, not so dynamic, every day we keep updating this standard'. So the standard itself should have a certain stability then the operators or the employees can stick to a standard. No matter if it's a good standard, perfect or not, it's a standard that's stable and everyone can understand it and work towards it and keep the production running. (...) Here the problem is that our standard is in some cases too dynamic. We need to slow down the standardisation process. As long as it works, no matter how perfect or not you have to make it stable."*

Most German interviewees did not consider the transfer of the standards from Germany as a core problem. However, a few interviewees named the transfer of standards from headquarters as problematic. They explained that most of the standards are global company standards which were taken over from German headquarters by both Chinese plants and other plants all around the world. Most systematic approaches were taken over, such as Lean-, construction-, and quotation-checklists that were essential for quality assessment and risk management. Some interviewees reported difficulties applying the headquarters' standards. As a German logistic manager from Changsha introduced:

> *"To successfully implement Lean, first we clearly need stable processes. That's for sure. But that's what we are missing at the moment. The standards do exist; we had them transferred from our headquarters. The production, even the plant, everything is built according to the same worldwide standards. The problem here in China: The standards exist, but they weren't applied appropriately. They are partly not established in people's minds."*

This issue was also commented on by some Chinese interviewees. They explained that certain global standards that Chinese workers needed to follow were not appropriate for the Chinese setting, because they had not grown on the Chinese shop floor. Moreover, a German manager had concerns that potential translation errors within process descriptions might be a cause for the difficulties of adopting certain standardised procedures.

Western and also a few Chinese interviewees also reported that Chinese employees did not follow standardised procedures strictly. There are parallels to the barrier 'workers' disregard of instructions and procedures', but the claims made in the following applied also to office workers. A small number of German managers indicated that some of their Chinese employees tended to bypass certain standards. For example, a manager in Changsha had the opinion that some of his employees spent more energy and effort on bypassing standards than on following the required standard procedure. It was therefore seen as a challenge to motivate and train his employees to follow the company's standardised procedures step by step.

When comparing the interview data from Changsha and Suzhou, it was evident that the indications for the barrier 'Lack of maintaining standards' were less strong in Suzhou than in Changsha. Despite certain complaints by interviewees from Suzhou regarding a lack of standardisation, the interviewee comments let us conclude that in Suzhou, standards were more established and more stable than in Changsha. The six-year-old plant in Changsha was, at the time of the research, expanding its production capacity massively. Several assembly lines had recently started their production or were about to start it. Besides setting up new assembly lines, the Changsha plant was also expanding its employee numbers, both of office workers and shop floor workers. It is likely that under these circumstances, some procedures in Changsha where less established than in the more mature plant in Suzhou. This might be why the lack of maintaining standards was a more important barrier for interviewees in Changsha.

7.3.4.3.3 Effects of 'Lack of maintaining standards' on Lean

The interviewees named a number of effects of the lack of maintaining standards on Lean implementation. The majority of effects were related to unreliable production processes on the shop floor. Several employees gave examples of quality deviations within the assembly lines, when tasks were not fulfilled according the standardised procedure. Interviewees named production wastage through parts failure, production line stops, or machine breakdowns as direct effects. These incidents affected the production system mainly in the form of a lower production output.

Effects on the production output caused by shop floor workers who did not follow Lean standards are already discussed in the previous section - workers' disregards of instructions and procedures. The interviewees mentioned mainly effects on the production, rather than effects on departments other than manufacturing. However, as an effect in the office area, a logistic manager from Changsha explained that employees were not following the standardised procedures strictly when using managing inventory. Instead of using the company's SAP logistic software for certain logistic procedures, some of the Chinese employees were not using the program defined by the standards. Instead, they created their own Microsoft Excel sheets to keep track of certain inventory positions. The use of personal Excel files to keep track on inventory positions caused confusion when inventory levels in the department internal records differed from the company's SAP system.

7.3.4.3.4 Influence of context factors on 'Lack of maintaining standards'

In the interviewees' perceptions, a number of Chinese context factors were influential, namely: lack of industrial experience, Chinese culture, lack of industrial experience, worker origin, and lack of quality awareness.

Lack of industrial experience – China's recent industrialisation and missing industrial experience among Chinese employees was again seen as an influential context factor. A German manager from Changsha stressed that in comparison to Germany, modern production was still a recent phenomenon in China. He stated that the skill set developed among German employees was grounded in a long industrial history of German companies. For him, the different industrial past of China and the lack of industrial work experience of Chinese workers were linked to this barrier. As he explained:

> *"Here, there are many young and inexperienced workers. They haven't seen certain things yet… That's my personal explanation for the bad application of standards. If you have worked in Germany, you get used to standards. Your mentor tells you: 'look, that's the way we do things here'. Over years, we could develop this mindset. But the Chinese don't know this; they have started from scratch. There was nobody who could show them how to follow standardised procedures. What is the norm and what's a deviation from the standard. I think we should not underestimate the skill level we could develop in Germany over the years; you will be fooled to think that we are able to teach the Chinese these skills overnight."*

Lack of industrial experience and worker origin: Agricultural past – Closely linked to the previous mentioned context factor, several interviewees named the agricultural background of many Chinese operators working in the production as influential. Interviewees from Changsha and also from the plant in

Suzhou argued that especially when applying the standardisation tool 5S, the agricultural background of many workers played a significant role. A German top manager from Suzhou explained that a major part of his subordinates working on the shop floor had grown up in rural and agricultural areas with the simplest living standards. He stated that it was a bigger challenge to train operators from these areas to follow 5S standards in comparison to instructing workers from industrial countries like Japan or Germany on these standards. As he explained:

> *"With regard to 5S and issues like tidiness and orderliness … I think for Chinese employees it is more challenging to maintain these standards than for Japanese or German colleagues. I mean I led 700-800 employees, maybe 500 of them grew up in rural areas. On their farms, they didn't have any electricity or running water, and lived in very basic houses. To teach them our standards is definitely a challenge. I am not a specialist on whether this can be classified as a cultural factor or a historical factor, but I definitely observed that it's a bigger barrier here in China in comparison to Germany or Japan."*

Chinese culture: Chinese citizens' compliance to rules – Some interviewees mentioned the acceptance of rules within Chinese society as influential for the lack of maintaining standards within the firm. A few interviewees associated the ability to work according to standards with the degree to which citizens followed rules in their daily life. A German manager from Suzhou compared how Japanese, German and Chinese people follow norms in public. He named an example of how people from these nations line up when queuing and described the line up in China as 'chaotic'. In his perception, there was a link to the citizens' tendency to accept rules and how employees were willing to maintain standards at work. As he explained:

> *"In Japan, everyone lines up properly in a queue. In Germany, it also works, but in China it's chaotic. I think that nationwide phenomena can also link to the implementation of Lean. Our German employees do follow the standards, but I need to admit that our Chinese employees are relatively far off from following the standards properly."*

Another German manager supported the view of his colleague. He also specified the tendency not to follow rules as a context factor which is particular to China. As he commented:

> *"There is a Chinese saying: 'You need to know rules, but you don't need to obey them'. This means that that rules will not be followed, for me that is typical Chinese. I have been living in Asia for the last four years; I have never experienced this to the same extent anywhere else."*

Chinese culture: Traditional leadership style - For a German manager in Changsha, the traditional authoritarian leadership style in China played a role when Chinese subordinates did not follow standards in the firm. He argued that because of the traditional Chinese authoritarian leadership style, Chinese people were used to work under close supervision of a leader who monitors and guides the subordinates' work. He further argued that Chinese people were therefore not used to following standards independently. As he put it:

> *"When a Chinese employee is supposed to check whether the standard is successfully applied, he looks at his checklists and will tick all the boxes without monitoring the status, because nobody controls him. The problem is that Chinese people are used to working according to clear instructions and control by their supervisors. In my eyes, this is a typically Chinese method, which they have learned over years in the planned economy."*

Lack of quality awareness – A lack of quality awareness among many Chinese employees and workers within China. Interviewees stressed that a lack of quality awareness made it difficult for operators to judge if the standard was applied appropriately. Especially with regard to the application of the housekeeping tool 5S, a different perception of cleanness among operators or their supervisors was frequently discussed.

In summary, the present consideration of 'Lack of maintaining standards' revealed that interviewees complained that the production processes were not yet reliable and stable enough to be run smoothly according to the standards. Many standardised procedures were not yet well established and the production processes were unreliable. The Lean implementation team was mainly busy ensuring that the production ran according to the standard, rather than focusing on their initial aim to further improve the standard. The consideration also indicated that managers from production departments kept adjusting and changing standards without ensuring process stability. As effects on Lean, the interviewees named a lower production output, line stops based on quality deviations, and machine breakdowns. Examples were given where a disobedience to company standards led to non-uniform processes. Interviewees perceived this barrier to be influenced by the following context factors: lack of industrial experience, Chinese culture, worker origin, and lack of quality awareness.

7.3.4.4 Lack of problem solving

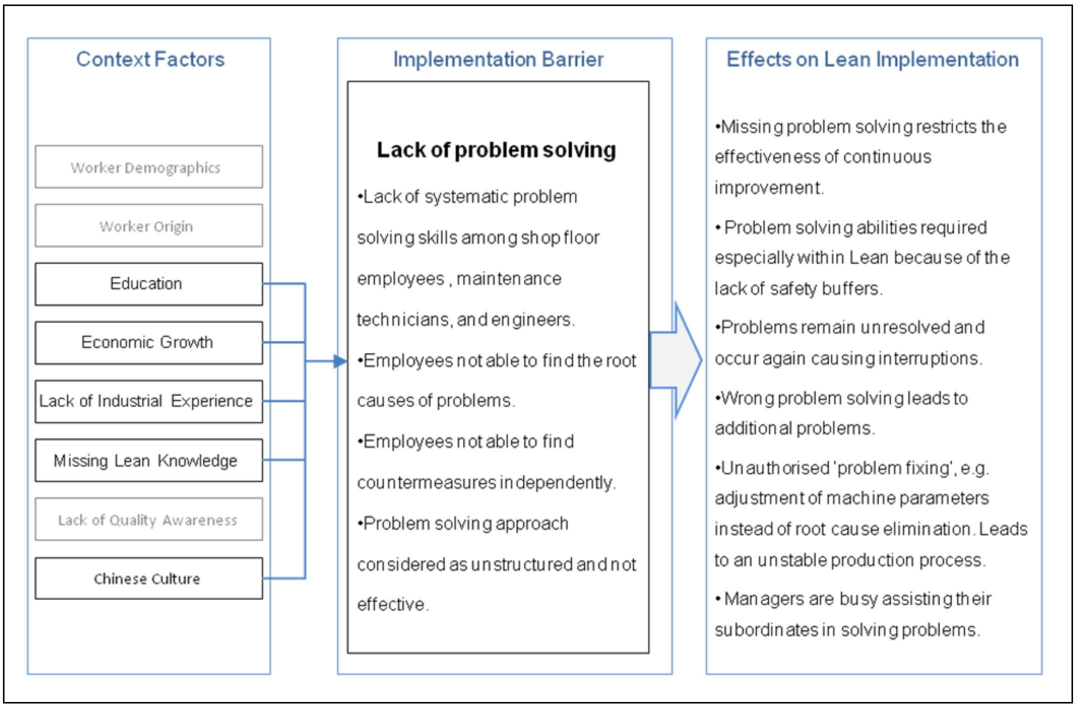

Figure 7.8: Sub-model ‘Lack of problem solving’

7.3.4.4.1 Definition ‘Lack of problem solving’

Lack of problem solving refers to missing or insufficient problem solving activities, both at engineering and shop floor level. Lack of problem solving power refers to the missing ability of an employee to adjust countermeasures to overcome problems independently. The barrier ‘Lack of problem solving’ is interlinked with the barrier ‘Lack of Lean knowledge’, with respect to employees not having an understanding of problem solving tools. For example, to solve a problem in a systematic manner might be more difficult for employees who do not have the knowledge on how to use tools such as cause-effect diagrams. However, problem solving was a distinct theme which was frequently named by western and Chinese interviewees from both plants.

7.3.4.4.2 Barrier description

The theme ‘Lack of problem solving’ was named by interviewees mostly with regard to the missing ability to solve problems which occurred at the assembly lines. Interviewees in managerial positions reported that their subordinates were frequently not able to find the root cause of the incident which caused quality deviations or a line stop. They also complained that their subordinates were not able to adjust countermeasures to overcome the problem independently.

Especially western managers named a lack of problem solving among Chinese employees as a barrier when implementing Lean production. When describing the barrier, they often referred to a non-structured problem solving approach applied by their subordinates. Westerners from both plants complained that their employees lacked the ability to solve problems systematically. As a German department head from Changsha recalled:

"My Chinese employees, they do not solve problems in an analytical manner. I do not see that they investigate the problem first and solve it in a structured way. (…) They do not start with a current state analysis, followed by a thorough investigation, draw conclusions, and finally try to solve the problem. (…) No, here in China it is still common to rush to the problem and start doing something and try to solve five problems all at the same time. (…) My employees lack the ability to solve problems in a systematic and sustainable manner."

Several managers in the production departments stressed that even on engineer level, problem solving was not applied appropriately. Some managers complained that their Chinese subordinates tended to make a cursory investigation and adjust countermeasures without eliminating the root cause of the problem. They complained about a general tendency for the Chinese workers to try and solve problems by adjusting parameters, rather than investigating the cause of the problem in more detail. A German engineer expressed his feelings and those of his colleagues:

"We have a huge problem here. The people here, the process engineers, tend to adjust parameters on the machinery without even knowing if that solves the problem in the long run. Without checking the root cause of the problem, they just try different things; they randomly change machine settings, and see if the workstation starts working again. They don't know what they are doing. I continually try to explain how to solve problem systematically, but they always think the machine itself is the problem. That's a general problem among Chinese; they adjust machine parameters, because they think the root cause always lies in the machine itself. They adjust machine parameters until somehow the machine works, then they say 'great, now it works again'. But two hours or two days later, the problem is back and everything is worse …they do not investigate in all directions, They solve problem in a chaotic manner!"

However, beside westerners, several Chinese interviewees also commented on the problem solving issue. A Chinese, female engineer from Suzhou stressed that maintenance technicians who did have a deeper understanding of the technical equipment and processes than operators, lacked the ability to apply problem solving methods. As she put it:

> *"Normally, for the maintenance technicians, they cannot always find the root cause. This is a major problem for problem solving. Sometimes when there is a machine breakdown it is not only caused by one factor, maybe there was a loose nut, but you need to ask yourself why was the nut loose? Our technicians sometimes cannot think more deeply about the cause of the problem. The problem will occur a second time, and again. So that means we need to have a systematic problem solving method to think more deeply, work more completely."*

Another aspect of the barrier was what interviewees called 'lack of problem solving power' among shop floor workers. Chinese and westerners at both plants stressed that suggestions to solve more complex problems were made by engineers or section managers rather than operators or technicians. They stressed that operators were rarely able to contribute to the problem solving process. The problem solving potential of the shop floor remained mostly unused. Process engineers stated that operators were focusing on the assembly process and were rarely willing to give up time to repair or give suggestions. It was argued that operators would not consider themselves as responsible for problem solving in the production.

7.3.4.4.3 Effects of 'lack of problem solving' on Lean

Interviewees stressed that problem solving is an essential requirement for continuous improvement within Lean. The root cause of the problem needs to be understood to take countermeasures and improve the process. Based on low levels of inventory safety buffers within Lean, problems which occur within the product production process need to be solved immediately. This puts pressure on the employees who then need to detect, indicate and solve problems to ensure the flow of production. Moreover, CIP can only work to the full extent if workers have the ability to solve problems. When in an assembly line a problem occurs, the Andon system helps to indicate and visualise problems occurring in the assembly line. The ability given to operators to stop the production line helps to detect problems immediately and ensures that defective parts are passed to a workstation further downstream. However, stopping the entire assembly line when a problem on a single workstation occurs requires employees to solve the problem immediately to continue production. Interviewees stressed that the employees working in Lean production need to be able to find the root cause of the problem and make sure that this problem does not occur again. This helps to continuously improve the production process and smooth the production flow.

Interviewees named several examples where a lack of problem solving resulted in incidents which lowered the efficiency of the production system, such as line stops, machine break downs, and production of faulty parts. A German manager from Changsha gave an example, which reflects that a lack of problem solving capabilities of employees led to the production of faulty parts. As he explained:

> *"The Chinese employees lack the ability to solve problems systematically. The lack of problem solving skills has effects on the production. For example, a machine was not running in the production line. Faulty product parts with wrong dimensions restricted some machine parts. The machine parts could not reach a sensor; the machine indicates a problem with the process. And what do the Chinese do? They mill the mechanical machine end stop away! Now the machine reaches the sensor again, but nobody realises that the supplier parts have the wrong dimensions. They did not consider that the incident occurred straight after new parts were delivered to the line. They think the problem lies in the machine and not in the supplier parts. (…) This means a systematic problem solving approach is missing."*

Interviewees reported that through a lack of problem solving among employees the same problems occurred again and again, which led to an unstable production process. A process engineer from Suzhou explained that within her line, a pile of problem reports existed, and despite daily CIP meetings, several problems remained unresolved. She felt overstrained with the task and requested support to find the root causes of complex problems. As she recalled:

> *"My feeling is that we don't have the problem solving power to really fix these problems, such as machine problems and all the maintenance problems or technical problems. (...) Every day, we had maybe thirty PDCA[26] cards which indicate a problem occurring in the line. Simply, no one takes care of it because we cannot resolve the problem. The technicians can make the machines start running again but one or two days later, it shuts down again. So the root cause is not found and the countermeasures are not implemented, just a short term solution. We have already a thick stack of PDCA cards that are not resolved, that means the capacity of problem solving power is not enough, that's the signal that the cards tell me."*

In the same vein, interviewees stressed that a lack of problem solving resulted in wrong countermeasures being implemented. Several interviewees complained about a tendency to 'fixing' problems to continue the production immediately. Interviewees saw a conflict between this approach and ensuring a stable production process by eliminating the root causes of a problem. An example which illustrates the unauthorised 'problem fixing' is given by a manager in Changsha. In this case, workers in the night shift frequently just 'fixed' problems by readjusting the machine parameters until the machinery's sensors indicated a successful process. However, the problem was caused by wrong supplier parts and problems occurred in the final assembly of the product. The German manager reported that careless 'fixing' happened so often that he installed safety screws at machinery parts (e.g. sensor positions) to prevent the workers from adjusting these parts. The safety screws could not be unscrewed without a special key. The manager was so frustrated by similar

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[26] PDCA stand for Plan–Do–Check–Act, a four-step problem solving approach, also known as the Deming circle

incidents happening in the past that he kept the special Allen key tool locked in his personal cabinet.

As a further effect, several managers indicated that their work was slowed down due to a lack of problem solving among their subordinates. They reported that as part of the company standards, problems which could not be solved by the responsible person needed to be escalated to the next management level. Manager complained that their subordinates were frequently not able to find the root cause of problems and consequently they got personally involved in solving the problems. The managers felt stressed, because frequently, problems were escalated to their responsibility and they became involved in problem solving activities which should normally be solved by their subordinates. As a German manager expressed:

> *"They can't solve the problems independently. In the end, I need to decide what to do, what the next step will be, should we go left or right … Many times, I personally can't do this, I do not have the time to get deeply involved in every problem. I also consider my personal hit rate to make the right decision lower than the one of my employee who knows the wider context. If I don't know the answer to the problem because I have never encountered this problem, there is a chance that I make a wrong suggestion, just because I couldn't t oversee the entire context."*

7.3.4.4.4 Influence of context factors on 'Lack of problem solving'

Several country context factors were named as explanations for a lack of problem solving, namely: lack of industrial experience, lack of Lean knowledge, education, Chinese culture, and economic growth.

Lack of industrial experience and lack of Lean knowledge: - A lack of Lean knowledge and industrial experience among Chinese employees was seen as a major explanation why Chinese employees having difficulties solving certain problems independently. Chinese and western managers complained that even engineers lacked expert knowledge and experience to successfully apply certain problem solving tools, and lacked a deeper understanding of the effects on the process. When considering problem solving at shop floor level, there was a general agreement that the operators' knowledge was too limited to get involved in complex problem solving activities. Some comments suggest that several Chinese engineers did not even expect operators to get involved in any form of problem solving activities. In their opinion, the operator skill level and experience was not sophisticated enough to contribute to complex problem solving activities.

Some interviewees also referred to the high employee turnover in China as an explanation why root causes of some problems remain unsolved. It was argued that long-term employment was necessary for building up experience and knowledge about the processes to contribute effectively to problem solving.

Education: Institutional education system - When mentioning a lack of experience and missing knowledge, some western interviewees linked the lack of structured problem solving skills to the institutional education system in China. Interviewees blamed the Chinese school education and its focus on memorising and lack of interactive teaching as reason for the lack of independent problem solving. As a German manager explained:

> *"I believe that the Chinese, within school or vocational education, were never taught how to solve problems independently. I believe a big part of this is due to their education system. Their education system is just based on regurgitating. If you are only taught, and learn in a repeating manner, I think then you lack the problem solving ability, because you have never learned how to do it. In Germany, we start to learn this already in primary school. We need to solve our maths homework in three steps, question, equation, answer… Questioning problems, or independently looking into a problem, I personally believe that doesn't exist in Chinese education. The personal drive to get to the bottom of a problem and solve it, that's what I miss among my subordinates."*

Chinese culture: Concepts of face and Guanxi – Surprisingly, a number of interviewees also named traditional Chinese cultural values as explanations for a lack of problem solving. Some interviewees saw the concept of 'losing face' to be linked to the lack of problem solving. In the interviewees' perceptions, Chinese people tried to avoid confronting somebody with a problem. They further explained that problem solving in an assembly line often involves confrontation within other staff members, and sometimes blaming somebody who is responsible for the root cause of the problem. Interviewees felt that Chinese employees tended to try to prevent this situation, to avoid the person losing face when confronted. A Chinese engineer saw the concept of face as an explanation for why operators were not willing to make suggestions for problem solving. As he explained:

> *"Operators focus only on implementation and not problem solving. They don't want to make it more complicated for them. Because when they suggest a solution or try to solve the problem by themselves they think they risk losing their face. Because in Chinese culture the concept of face is very important. They think if the solution they suggest is maybe very naive or not so mature, they will lose face."*

From some interviewees' perception, there was also a link between avoiding losing face and keep a good relation to an individual and the 'cursory fixing' of problems. They argued that when a problem occurs, the Chinese employees tended to find a very quick solution to restart the production line, to avoid highlighting somebody who might be responsible. They would even conceal a root cause to avoid confrontation or to avoid blaming somebody else. As a French manager explained:

> *"It is very important in China to consider this Guanxi network and losing face thing. In Lean we want to find the root cause and to definitely solve the problem. You will not restart the asssembly line if you still have a risk that the problem is not fully resolved. This does not fit with the Guanxi network you have in China. In China the goal would be to restart as quick as possible to avoid, to show a responsibility, to avoid to highlight someone who has done the wrong thing. Or the goal would be to restart and to find a very, very quick solution to restart but without solving the problem. This is one of the challenges, finding the root cause and working on the root cause without blaming somebody. I mean for us in Europe, that's okay. Since we are young we say okay, we can make a mistake, I mean everybody can make mistakes and you can, even the guy who is saying I did*

a mistake can look more clever than the guy who says nothing. Here in China it's not the case. A lot of Chinese people will prefer to say nothing, to avoid someone or somewhere is losing the face and then to restart quickly."

Chinese culture: Power distance – As part of Chinese culture, high power distance among Chinese employees was also seen as influential. Some interviewees saw a link between 'cursory fixing' practices and the high power distance in China. They explained that some Chinese employees avoided escalating a problem to the next management level because they feared the confrontation with their boss. The comments of a German department head strengthened this argument. He recalled that in his department he had developed the experience that he first needed to build up a strong and friendly relationship with Chinese subordinates before they were willing to indicate problems which led to a line stop.

Western managers stressed that the previously-mentioned cultural values did not play such an important role in the western context. There was a big difference in how westerners and Chinese employees dealt with self-inflicted mistakes at work. Partly, they showed a lack of understanding of their Chinese colleagues' behaviour and stressed at the same time that in the western context, people tended to be more open when dealing with their own mistakes and taking responsibility. In their perception, these phenomena were China-specific.

Chinese culture: Confucian values - Some German interviewees saw Confucian values and the Chinese ambition to keep harmony as an explanation for differences in westerners' and Chinese peoples' ways of dealing with problems at work. They linked the lack of problem solving at work with a general attitude towards confrontation in Chinese society**.** In their perceptions, there was a tendency in Chinese society to avoid any form of confrontation, and this tendency was reflected in the way Chinese people dealt with problems at work. As a German manager explained:

"In Germany, we are interested in solving problems. That means if there is a problem we go straight into it. Here in China, this approach doesn't work at all. (…) They are masters in bypassing problems or not mentioning them. This is linked to the Chinese concept of face, keeping harmony, and staying in balance. That's the only explanation I have for their behaviour. Yes, that must be linked to the national culture. Furthermore, they also have a flowery way to express themselves. They are not as hard-boiled as us Germans. We say:,there is my destination, there I want to go, and there is nothing that can stop me'. In China, they look for ways of avoiding confrontation. (…) In China, everything is still very, very much shaped by Confucian values. Very, very strong, Confucius is the ultimate!"

Chinese culture: Differences between Chinese and German work styles - A German manager showed an understanding of the often-criticised, less-structured problem solving efforts shown by his Chinese colleagues. He explained the often-requested systematic approach and 'attention to detail' by his German colleagues by a particularly German work style. He argued that the interest of German engineers to get deeply involved in technical details and find the root cause of problems or minor deviations explained why his colleagues considered the Chinese work style as so unstructured.

Economic growth – Interviewees also linked the economic growth of China and resulting business growth to the fact that root causes of some problems remained unresolved. Chinese engineers responsible for assembly lines argued that because of the massive expansion of business and high numbers of different projects they had to deal with, they simply did not have the capacity to get deeply involved in problem solving on the shop floor.

Overall, the present consideration of the 'Lack of problem solving' revealed that there was a lack of systematic problem solving skills among shop floor employees, maintenance technicians, and engineers. As a consequence, employees were often not able to find the root causes of problems and find countermeasures independently. Managers perceived the problem solving approach within the company as un-structured and not effective. The interviewees stressed that problem solving is especially crucial for Lean, because of the lack of safety buffers and the related urgency to solve problems immediately. Examples were given where problems remained unresolved and occurred repeatedly, and wrong problem solving led to additional problems. Interviewees complained about unauthorised ‘problem fixing’ instead of root cause elimination. Managers complained that because their subordinates lacked problem solving skills, they needed to assist their subordinates in solving problems, which they did not regard as their responsibility. As influential context factors, the interviewees named: lack of industrial experience, lack of Lean knowledge, education, Chinese culture, and economic growth.

7.4 Lean implementation model China

Chapter 7.2 and Chapter 7.3 provided a detailed overview and descriptions of the main implementation barriers in China. The results clarified why interviewees perceived certain issues as barriers for a successful Lean implementation in their company in China. The indicated effects of the barriers on the Lean production system should make the reader aware how these implementation barriers affect the successful implementation of Lean within the case company. The consideration of the context factors indicates that the Chinese national context influences the barriers. Participants provided a number of examples which highlight mechanisms by which context factors influenced barriers. The consideration of the results led to an overall model which describes the implementation process of Lean in China. The model is developed by assembling the sub-models together. Figure 7.9 presents the ‘Lean implementation model China’.

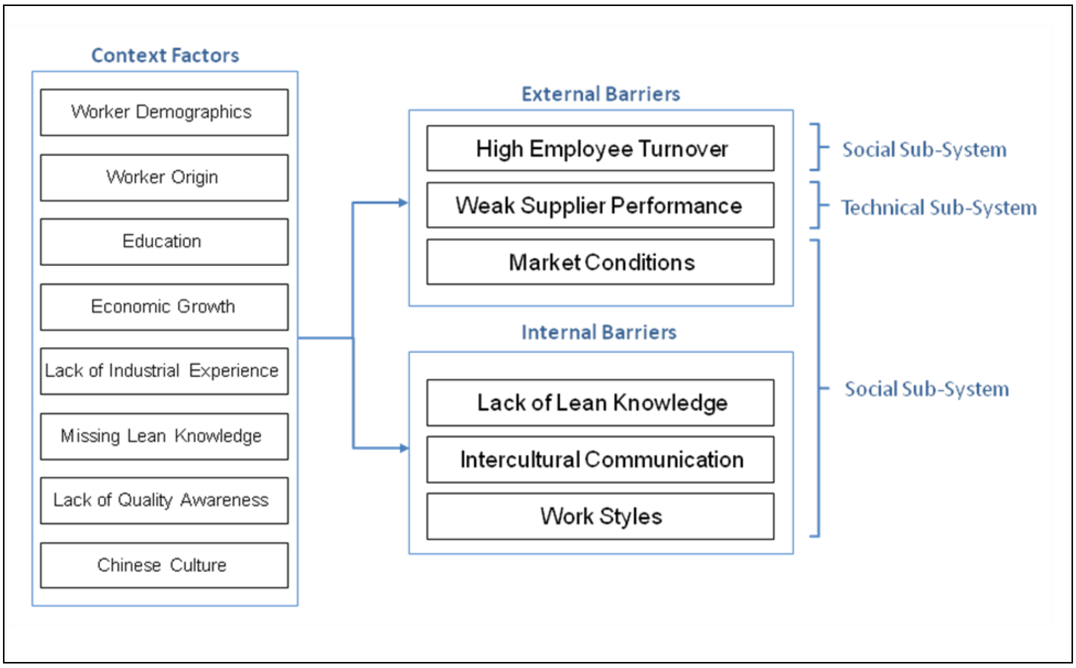

Figure 7.9: Lean implementation model China

The overall Lean implementation model indicates the most influential factors, namely worker demographics, worker origins, education, economic growth, lack of industrial experience, missing Lean knowledge, lack of quality awareness, and Chinese culture. Arrows indicate the links between the national context factors and the main barriers. The main Lean implementation barriers are divided into external barriers and internal barriers. The model also indicates which of the implementation barriers are related to the social sub-system and the technical sub-system of Lean. It becomes obvious that most of the identified barriers were part of the social sub-system of Lean, and only one was part of the technical sub-system. This observation will be presented in more depth in the discussion chapter (Chapter 8)

External barriers are high employee turnover, weak supplier performance, and market conditions. As internal barriers, the model distinguished between lack of Lean knowledge, intercultural communication, and work styles. A bigger version of the model and sub-models is attached in Appendix G.

In the next chapter (Chapter 8) the main implementation barriers will be discussed. In the first part of the chapter, I will make comparisons between results from the different sites and different participant groups. In the second part of the chapter, I will discuss the barriers and the context factors with regard to prior research and contributions, and I will interpret the findings in the light of socio-technical systems theory.

CHAPTER 8

8 Discussion

8.1 Introduction

In the discussion chapter, I first conduct an in-depth comparison of the findings obtained in different participant groups. Overall, these comparisons corroborate my Lean implementation model. Where relevant, I will refer to relevant research and highlight the contributions of the study to this research.

Second, I discuss the main implementation barriers and their links to Chinese context factors with regard to contributions to the literature, and I interpret the barriers from a socio-technical systems perspective.

8.2 Comparisons between groups

In this section, I conduct an in-depth comparison of the findings obtained in different participant groups. I conduct comparisons between (a) the location and the maturity of the two plants (b) between the views of western and Chinese participants, and (c) participants at different hierarchy levels. These comparisons serve to scrutinise whether the Lean implementation model generalises across the two sites and the different participant groups, or whether it depends on any specific context or group characteristics. Moreover, as highlighted in the methods section (6.8), the comparison of the data I obtained at different sites and from different participant groups is a major method of triangulation, which serves to strengthen the credibility of the findings.

8.2.1 Comparison between the plants' location and plants' maturity

As mentioned before, the current research is based on two case sites located in different parts of China. Both of these two plants used similar Lean production systems with nearly identical production set-ups and similar products. The influence of the layout of the Lean production system, product, and industry on barriers was therefore minimised. The main differences between the plants were the geographical locations and their maturity. As mentioned, one production plant was located in Suzhou, which is in the Yangtze River Delta in eastern China, close to Shanghai. The other production plant was in Changsha, which is situated in western China, on the lower reaches of Xiangjiang River. The Suzhou plant was set up around ten years ago and the Changsha plant was set up six years ago (see 6.4 Plant description). In the following, the influences of the plant location will first be discussed, followed by consideration of the differences within the plants' maturity.

8.2.1.1 Influences of the plant location

The findings show that overall, the location where the production plant was situated had no major influence on the perceived barriers or context factors. Regardless of the location, participants identified the same barriers and links to context factors within the implementation of Lean.

This striking finding is in contrast to the studies that suggest that an organisation's location in China plays a significant role on the plant's operations and therefore its choice of location in China (e.g. Du, Lu and Tao, 2008; Lo et al., 2010). Because of the vast scale of the country, diversity among different local cultures and customs, and the differences of economic development between central China and the coastal commuter belt, I had expected that the different geographical locations of the plants would lead to different barriers and different linkages to national context factors.

One explanation of why the current findings are in contrast to the literature is the specific attention it pays to the implementation of Lean in China. Other, related studies do not investigate Lean production systems, but tend to focus on location choice for foreign direct investment in general, and have paid attention to different factors, such as intellectual property rights, government intervention, and corruption levels (Du, Lu and Tao, 2008) or bureaucratic efficiency (Lo et al., 2010) which depend more strongly on the geographical location.

The finding that geographical location did not have a strong influence on Lean barriers can also be explained by the importance of the work force within Lean production, compared to traditional mass production systems. Within Lean production, the commitment and actions of the workforce are vital (See 3.5.5 Participation and Job role), as stressed by Liker and Meier (2007). In the current study, the high number of identified barriers which relate to human aspects confirms that employees play a particularly crucial role in Lean production systems. Studies that investigate other production systems are therefore likely to find that the workforce has a smaller impact on the production system.

The current research data stresses that particularly the shop floor workers' missing skills and actions were linked to certain barriers. (Most prominent barriers which were linked to the shop floor workers were: 7.2.2 High employee turnover, 7.3.2 Lack of Lean knowledge, 7.3.3 Intercultural communication, 7.3.4 Work styles). This confirms that the majority of barriers were linked to issues of the social sub-system of Lean. The group of shop floor workers in the current case study was the 'same' in both plants. The study revealed that at both locations, the firm employed mainly migrant workers within the shop floor, who had moved from rural areas to bigger industrialised cities to work in industry. The importance of the workforce for Lean combined with the use of the 'same' migrant workforce explains the small impact of the location on the findings.

Certainly, as the two plants were of the same organisation, they used very similar Lean production systems. It was therefore likely that especially those barriers that are linked to the technical sub-system of Lean would be found in both locations. However, given the variety of different barriers, and the complex relationships with the Chinese context factors, it remains striking that the different locations within China had a small impact on the Lean implementation.

Overall, the current findings imply that the Chinese national context affected the barriers in a similar manner at the two sites. However, the findings denote that the mechanisms by which the context affected the barriers were not completely the same across locations. When looking at the influences of the national context on employee turnover (See 7.2.2 High employee turnover), interviewees from Changsha explained that one key factor causing employee turnover among operators at the Changsha plant was the movement from migrant workers from the mainland to the more developed areas in Eastern China. Respondents in Changsha saw themselves in an unfavourable position, because of the location of their plant within the mainland of China. At the same time, they anticipated that management at the Suzhou plant was in a more favourable situation. In their opinion, because of the 'attractive' position (higher salary levels) of Suzhou for migrant workers, management in the coastal location did not face any barriers related to the migrant movement of operators. This Labour movement within China is a well-researched context factor in the literature on the Chinese labour market (e.g. Carrillo, 2004; Zhang and Song, 2003).

The current findings did, however, emphasise another phenomenon of China's labour movement. Interviewees at the Suzhou plant also named workforce migration as a factor influencing employee turnover, but explained the mechanism of influence differently. The participants in Suzhou indicated that the movement from migrant workers away from the developed coastal areas back towards the central mainland of China was one key reason of employee turnover among operators. Employees from Suzhou complained that the migrant workers with origins in western China were returning back to their home regions. They explained that the operators' motivation to move away from the big cities within the commuter belt was grounded in changing job perceptions and cheaper living costs in central China (See 7.2.2 High employee turnover).

In this manner, the same barrier, employee turnover, was found at both locations, but the migrant worker movement influenced the barrier in different ways. In other words, the east-west movement and the west-east movement created the same barrier: employee turnover.

8.2.1.2 Influences of plant maturity

The use of similar Lean production systems in both case study sites allowed me to elaborate on the influence that plant maturity had on barriers and context factors. The plant in Suzhou was founded six years before the Changsha plant. However, the findings indicate that the Suzhou plant's greater maturity did not have a major impact on the implementation barrier and consequently on the implementation process of Lean (Differences of plant maturity see 6.4 Plant description). Nevertheless, it is likely that after the processes within the plant's production become more settled, many sources which cause barriers for Lean will be under control and counter measures will be found. In this manner, I expected plant maturity to make a difference.

One reason why the current findings did not show major differences of barriers and related factors depending on plant maturity could be the nature of their workforce, a factor which I have mentioned with regard to the influence of plant location (See 6.4 Plant description). As the success of a Lean production system is highly dependent on the skills and commitment of shop floor workers, a number of barriers were linked directly to those workers (e.g.: 7.2.2 High employee turnover,7.3.2 Lack of lean knowledge, 7.3.3 Intercultural communication, 7.3.4 Work styles). The use of the 'same' migrant workers with the 'same' background and skill level at both plants can explain why the plants' maturity played a minor role with regard to Lean barriers. Despite the maturity of the Suzhou plant, the same inexperienced operators with the tendency to leave the company worked in the more mature Suzhou plant and in the less mature Changsha plant. The high employee turnover at the shop floor created a continuously change of operators in both plants. This restricted the more mature plant in gaining a significant advantage over the less mature plant over time.

Besides workforce-related issues, certain characteristics of the barriers can be seen as an explanation for the small impact of plant maturity. The current results demonstrate that a number of implementation barriers were external barriers (See: 7.2.3 Weak supplier performance, 7.2.2 High employee turnover, 7.2.4 Market conditions). The ability of the organisation to control or adjust to the external environment was, naturally, limited. The fact that the Suzhou plant was established six years longer than the Changsha plant did not enable the Suzhou plant to adjust to or change the external environment. For example with regard to the barrier 'Market conditions', the study indicated that the organisation's local customers rarely applied JIT principles, and therefore the automotive manufacturer requested high levels of inventory. The plant's position as a supplier limited their ability to overcome these issues with higher maturity. Also, the firm's ability to reduce the external barrier 'High employee turnover' was limited. The maturity of the Suzhou plant helped to develop loyalty schemes. However, the tendency towards short-term employment throughout the Chinese labour market remained the same. Regarding market conditions, both plants were exposed to the customers' tendency towards last minute orders and cancellations. Adjustment to these customs within the Chinese market place therefore remained difficult over time.

It has to be stated, however, that some barriers were found to a different extent depending on the maturity of the plant. The more mature Suzhou plant had well-established operations and was not expanding to the same degree as the younger plant in Changsha. At the time of data collection, the Changsha plant had recently launched several new products and a number of assembly lines were being set up. As a consequence of this recent expansion, a higher number of expatriates worked in the Changsha plant than in the Suzhou plant. To support the start-up phase of the new production facilities, a number of German experts had been sent over from the German lead plant. Different to

Suzhou, most of the leading managerial positions in the Changsha plant were manned by experienced Germans who had worked in the German lead plant before. These expatriates were still part of the first or second generation of expatriates supporting the plant after its opening. In the Suzhou plant, over the years, most expatriate contracts had run out, and only high level management positions were manned by German delegates.

The smaller numbers of westerners in the more mature plant in Suzhou had an impact on barriers within the social sub-system of Lean. Conflicts based on intercultural differences were less present at the Suzhou plant. The findings showed that the barrier of intercultural communication was less present in the Suzhou plant (See 7.3.3 Intercultural communication). In the more mature plant, the Chinese office-level employees placed a less strong emphasis on intercultural communication issues than the ones from Changsha. This finding may transfer to other organisations employing expatriates, but may not be relevant in organisations which employ employees from a single nationality.

8.2.1.3 Conclusion of the comparison of the plants

Overall, the research findings denote that the same barriers were evident in both plants. There were also no major differences in the mechanisms by which the context factors influenced the barriers at the two plants. The current research therefore indicates that the different plant location and plant maturity did not have a major impact on the implementation process of Lean in China. This provides some indication that firms will encounter similar barriers in different locations within China, and they will not be overcome with increasing maturity of their plants. However, depending on the different locations, the national context did affect the barrier ‘High employee turnover’ in different ways. With regard to this important barrier, there may therefore be more variation depending on location. The findings also showed that depending on the maturity of the plants the barrier ‘Intercultural communication’ was evident to a different extent. Foreign firms may therefore be able to improve their intercultural communication barriers over time, or circumvent them when expatriates are withdrawn over time.

8.2.2 Comparison between Chinese and western views

Overall, the findings show that there are no major differences in the views of Chinese and western employees regarding barriers to the Lean implementation. Both Chinese and western participants indicated the same major barriers. Also, the interview data show that both groups explained most mechanisms between the barriers and the national context in a similar manner. The congruence in the views of the two participant groups regarding barriers strengthens the evidence that these barriers are present within the company. The finding that both Chinese and westerners were aware of the companies' Lean barriers implies that the indicated barriers were prevailing barriers which hindered Lean implementation.

Here it needs to be mentioned that within the data analysis it became evident that the congruence in the views of the two participant groups was not grounded in the circumstances that one participants group "taught" their views on the barrier and related context factors to the other participants group. A thorough analysis of the comments made by the interviewees revealed that interviewees had no settled pre assumptions which may be taken on by colleagues. The detailed descriptions of examples of personal experience with barriers given by most participants supports that the participants were not affected by assumptions by their colleagues.

The investigation did, however, show that some expatriates perceived some barriers as a bigger threat for Lean than their native colleagues did. Even when members of both nationalities described the same barrier, western interviewees tended to emphasise more than the Chinese did that the barriers present in China were very difficult to overcome. This might be linked to a better understanding by westerners in comparison to their Chinese colleagues of the effects that the barriers had on the implementation of Lean (7.3.2 Lack of Lean knowledge). Westerners demonstrated such deeper understanding of the effects on Lean by explaining the negative consequences of the barriers on Lean. For example, western participants mentioned explicitly that high levels of inventory reduced the urgency of solving root causes of problems which caused interruptions. This inhibited the production process within the assembly lines to becoming more robust and problems being eliminated immediately. In contrast, some Chinese engineers' comments suggest that they were not to the same extent aware of the negative effects that high inventory had on the production system in the long run. Several locals saw the main problem of high inventory levels in the allocation of additional warehouse space.

The expatriates also tended to compare the barriers present in China with the situation in the plants in Europe in which they used to work in before. The barriers found in China were either not at all present at the expatriates' former work places, or to a much lesser extent. The ability to compare the production in China closely with the one at home explains their views regarding the scale of the barrier in China.

The differences in the perceptions of the scale of the barriers are also linked to a different interpretation of Lean by non-German compared to German respondents. Some non-Germans (comments made by Chinese engineers, a Brazilian manager responsible for production and a French engineer responsible for purchasing (Benchmarking)) seemed to have a different interpretation of Lean, probably because they had not experienced the way Lean was practised in the German plants. Some of them criticised the Germans' view on the Lean implementation as too perfectionist. In their view, some Germans showed an over-eager focus on details when implementing Lean principles. Non-German comments suggest that they interpreted the Germans' view on Lean as partly too pedantic. In their view, the Germans initiated time-consuming and complex improvement projects aiming to fulfil certain company standards, without considering the costs these changes caused the company. That was criticised by non-Germans as a misconception of Lean by the Germans (See 7.3.2 Lack of Lean knowledge).

The different perception of the barriers can also be linked to the leading job position of most expatriates, and their higher level of responsibilities within their job roles. Some barriers, such as lack of Lean knowledge available on the Chinese labour market, might be more present and threatening to people in managerial positions, such as department heads, than employees without human resource responsibilities. Such barriers exerted a lot of pressure on the managers who had to deal directly with the consequences and find solutions to overcome the barriers.

Another reason for the expatriates' views on barriers may be their stronger career drive. The expatriates had generally high expectations for their own achievement during their relatively short stay as expatriates in China. The expatriates might also be under more pressure to show evidence of improvements than their Chinese colleagues, when they had been sent out to China by the lead plant especially to overcome certain difficulties within the production. However, the current research did not focus on expatriates' motivational issues, and consequently no data supporting these assumptions were collected.

Another explanation why the expatriates perceived some barriers as a bigger threat for Lean than their native colleagues might be their stay in a foreign context. Western expatriates' personal experiences made in the Chinese context, including frustration, confusion, and misunderstanding, may have also affected their perception of the barriers and possibilities to overcome it. For example, in the beginning of an interview, an expatriate female engineer from Changsha described the dramatic situation the company was facing in China. Throughout the interview, she indicated that she felt stressed because of difficulties of adjusting her private life to the Chinese context.

When comparing the views of participants of the same cultural background, the data also showed that not all participants of the same nationality mentioned all barriers to the same extent. Depending on the individuals' job position, certain barriers were perceived more evidently than others. For example, people from the HRM department frequently evaluated the high employee turnover within the company in great detail, whereas process engineers who worked closely with operators described the workers' work styles as a burden in greater detail. Despite the different focus of certain interviewees, a comparison between Chinese and western responses showed no differences in the major implementation barriers they mentioned.

With regard to national context factors, the views of Chinese and western participants did also not differ greatly. Surprisingly, both participant groups saw the national context factors to be linked to the barriers in the same way. The match between the explanations given by the Chinese and western participants may come as a surprise. One may expect that explanations by a Chinese insider would differ from a western outsider perspective. According to each groups' cultural background, one might expect Chinese natives to be more familiar with the national context, and have a deeper understanding of the role of their 'own national' context in comparison to western expatriates. However, the current research findings indicate that western participants offered an equally detailed and in-depth understanding about the national context and its influence on the barriers as their Chinese counterparts, even when considering the specific case study setting. Moreover, because of the engineering background of most western participants, one may anticipate that they would be less aware of the Chinese national context than western employees with an educational background in social sciences, such as members of the HR (Human Resources) department. Most of the western expatriates were sent out to the Chinese plants because of their technical experience and expertise when working on similar production facilities within the lead plants in Germany. However, westerners expressed the same level of understanding of the national context compared to their Chinese colleagues. For example, when explaining the barrier workers' disregard of instructions and procedures (7.3.4.2), a western expatriate from Suzhou identified the 'Generation 90' phenomenon as explanation for the disregard of instructions among young operators. His explanations were congruent with the ones from a Chinese native employee from Changsha. She also stressed that the behaviour of workers changed since employees from the 'Generation 90' were recruited. Again, this evidence shows that westerners are to the same degree sensitive to the influences of the national context on Lean as their Chinese counterparts are.

The cultural awareness of the western engineers might be explained by the theoretical cultural concept introduced by Schein (1996). Schein (1996) argues that within an organisational context, outsiders do not take cultural norms for granted, as natives might do. The western and therefore outsider backgrounds may therefore have even been conducive to the expatriates' awareness of the role that the Chinese context plays in the implementation of Lean. Moreover, as stated before, the expatriates' comparison to Lean implementation in Germany made them aware of China specific barriers.

The current research data does at the same time, show that Chinese participants were aware of western cultural norms and in particular German country-specific context factors. This might be linked to the fact that a high number of Chinese interviewees had international work experience. The company had sent the majority of Chinese participants to the German lead plants for further education purposes. Also, to some degree, a cultural interest towards the western culture might be expected when Chinese employees decided to work for a German company. The former international work experience of most Chinese and their self-motivated decision to work for a German company might explain that the findings are not in line with some findings in the prior literature. For example, Kaye and Taylor (1997) conducted research on culture shocks of expatriate hotel managers within China. They found that due to working in an unfamiliar environment, non-Asian managers had greater intercultural sensitivity than natives who used to work in the Chinese context. This was not confirmed by the current research findings, where the Chinese natives were to the same extent as their German colleagues aware of the influences of the national context on the implementation barriers.

Most Chinese participants were open minded towards the research questions and also believed that certain barriers were grounded in the Chinese context. Surprisingly, the Chinese respondents supported the partly very critical views of some westerners about working in China, even when these views were in contradiction to their own cultural concepts and customs. For example, western participants complained about the ineffectiveness of the hierarchical communication style in China. In their opinion, the Chinese vertical communication slowed down the continuous improvement process because their Chinese colleagues tended to communicate mainly to their boss rather than share improvement ideas among colleagues. Similarly, a Chinese engineer found the less hierarchical and direct style of communication practiced by their Germans colleagues to be more effective. She further explained that she had even changed her communication style towards a more direct style of communication in her private life, which was met with incomprehension by her family.

It has to be noted that in a very small number of interviews Chinese participants did not show cultural awareness which regard to the interview questions. Whilst many westerners strongly believed that certain barriers were grounded in the Chinese context, a few Chinese participants did not make this link very explicit in the beginning of the interview. For example, a Chinese native from Changsha argued that the barriers within the plant were of a ‘general nature’ and not linked to the Chinese context at all. At the same time, the participant stressed that China was now a modern country, and the Lean barriers were not linked to the Chinese national context. In these single cases, Chinese interviewees seemed to feel insulted and uncomfortable to link cultural context factors to barriers which occurred in the company.

The behaviour of these particular Chinese employees might partly be explained by Schein's theory. Schein (1996) argues that because natives were raised in a country-specific environment, they take some influential context factors for granted. Accordingly, some Chinese natives did not make much effort to explain the role of certain context factors in the implementation process. However, these were only a few cases, and expressions made by these individuals implied that those individuals felt more uncomfortable with the research question than the other Chinese participants. These individuals gave me the impression that they felt they would be blaming their own country when linking the Chinese context to the barriers the company faced in China.

The overall match between the insider and the outsider view with regard to the influences of context factors serves as a further triangulation of the findings. The match of views corroborates the linkages of the barriers with these context factors in both plants.

8.2.3 Influences of participants' level of hierarchy

Within the data analysis, I distinguish between the views of participants from three hierarchy levels: (a) managers, (b) office level employees (including engineers), and (c) shop floor employees (including operators) (See 6.3.4 Selection of participants).

The current research findings indicate that there was a general consensus of views between managers and office level staff. The data denotes no major differences between the perception of the Lean barriers and linked context factors across these two participant groups. This congruence of views strengthens the finding that these barriers existed. Managers however, tend to have a deeper understanding of the functionality of the Lean production system and of the effects that the barriers had on the implementation process. Because of their managerial position and broader overview over the performance of the entire production system, they were more aware of the negative effects of the barriers than the office level staff was. Access to workshops which focussed on the performance of the production system further explained their greater Lean awareness. Office level employees who were members of the Lean implementation team also showed a more comprehensive understanding of the functionality of the production system than their office level colleagues did.

Regarding views of shop floor employees, I was not able to acquire first-hand information about implementation barriers directly from more than a very few employees working on the shop floor. However, through detailed reports by office-level participants who worked closely with operators, I was able to collect valuable indirect data about the shop floor workers' views. These reports indicate clearly that the shop floor employees were not, or were to a much lower degree, aware of Lean barriers than employees from the higher hierarchy levels, as indicated with regard to the barrier 'Lack of Lean knowledge'. Unlike managers and office level employees, operators would therefore not have been able to detect the major implementation barriers and linked context factors.

8.3 Contributions to the literature

In this section, I discuss the main implementation barriers and their links to Chinese context factors with regard to contributions to the literature, and I interpret the barriers from a socio-technical systems perspective. The findings of the current research will be used to interpret the differences and new findings to the literature. In the following sections the six main implementation barriers will be discussed with regard to (a) comparison of the barrier with the literature (b) discussion of the links to Chinese context factors (c) consideration of the barrier from a socio-technical perspective.

8.3.1 High employee turnover

8.3.1.1 Comparison of the barrier with the literature

The current findings indicate high employee turnover as one of the major external barriers. This finding does not come as a surprise. Within the Lean literature on emerging economies, there are a number of studies which indicate turnover issues when implementing Lean (Wallace, 2004; Kenny and Florida, 1994; Mefford and Brunn, 1998 and Humprey, 1995). Also in the Lean literature in China, employee turnover is mentioned frequently (Aoki, 2008; Brown and O'Rourke, 2007; Aminpour and Woetzel, 2006; Taj, 2005, Paolini et al., 2005). Brown and O'Rourke (2007), for example, describe the high rate of employee turnover as one of the biggest challenges for plants in China. Brown and O'Rourke (2007) describe the constant influx of new workers, and related continual training costs, lower productivity for initial work periods, and increased accidents and safety incidents as challenges and hazards when implementing Lean in China. Therefore, the reviewed literature is in line with the descriptions of the participants and therefore strengthens the present findings.

These above-listed studies mainly name the scale of the turnover rates but do not explicitly evaluate the consequences for Lean. Most of the studies indicate exclusively the fluctuation rates within the companies' shop floors, but not explicitly evaluate the turnover rates and consequences within the office level. In contrast to the reviewed studies, the present thesis evaluates the barrier's effects in detail and also differentiates between turnover among the shop floor and office level. As expected, both turnover rates were high, and the present study gives details about the effects of each group on the production system. The findings reveal the interrelations between operator turnover and quality deviations. Through the detailed data set, it was possible to show that the turnover within the shop floor influenced the quality levels directly and consequently increased levels of waste. The study is able to show the link between turnover of operators and a drop within the quality level of the production output. With regard to the shop floor the study showes that the missing experience of the newly recruited operators had direct effects on the production. The inexperienced operators who had recently been employed where not familiar with the work tasks and the lack of experience caused frequent interruptions of the production lines through part damages caused by wrong handling. The wrong handling by inexperienced operators caused high scrap rates. The data analysis also elaborates links between the smooth and efficient flow of the assembly line and employee turnover. Employees reported that slow or unskilful handling from a single operator restricted the productivity of the entire production line. The data highlights that especially JIT production systems, with their single-piece flow design, are dependent of the work of an individual because it determines the pace of the entire production line. (See 7.2.2.3 Effects of high employee turnover on Lean).

Another finding which was not highlighted in the reviewed literature was external employee turnover. Interviewees stressed difficulties to maintain a close relationship with its Chinese suppliers and customers to develop further JIT production capabilities, due to employee turnover on their part. The described erosion of the workforce within Chinese partner companies additionally stresses that not only foreign companies face difficulties to remain their workforce. Even if the case company was able to overcome the internal employee turnover, the required integration of customers and suppliers within Lean would still cause problems. These findings were not indicated by the reviewed Lean literature.

8.3.1.2 Discussion of links to Chinese context factors

Many context factors which the participants mentioned have been examined previously, namely by the literature on international human resource management in China. External factors such as high labour demand within the industry, multiple job opportunities, and the importance of monetary rewards, are frequently named as reasons for high employee turnover in China (e.g. Ma and Trigo, 2011; Melvin, 2001). This congruence with the international human resource literature strengthens the study findings and at the same time confirms the interrelation between the named context factors and employee turnover in Chinese industry.

The study results confirmed links with regard to the economic growth within the Chinese industry, lack of industrial experience among employees, and factors based on traditional Chinese culture issues (See 7.2.2.4 Influences of the context factors on high employee turnover). Also, less obvious retention factors named by prior research such as loyalty with supervisors (Chen, Tsui, and Farh, 2002; Wang, 2008) did surface in this study.

Not all context factors named by the reviewed Lean literature were, however, confirmed by the results. The respondents did not mention certain factors that prior research identified as important for turnover of highly qualified employees in China, in particular missing training and career opportunities in the firm (e.g. Newman, Thanacoody, and Hui, 2011; Walsh and Zhu, 2007). Possible reasons why the findings did not reflect those explanations might be the nature of the case company. The case company spent a lot effort in internal employee training and internal job promotions. Therefore employees within the host company may felt satisfied within the internal career opportunities. By reason of the expansion of both plants and increasing growth of the plants' production the plants were in the position to offer their employees attractive internal job promotion opportunities.

Secondly, the data set did not confirm the findings of Oliver et al. (1998). In their study, they discovered that 'iron rice bowl' job security practices are still applied in China and lead to high layoff rates. The context factor 'iron rice bowl' (and what it designates) was not mentioned by any participant. It was therefore not confirmed that the employment policies of the former communist system, where the communist party influences the numbers of employees within companies, were still evident at the company's local customers or suppliers. As expected, participants explained employee turnover, especially in the Changsha plant, by a tendency of workers from the less developed western part of China to be attracted by the wealthy big industrial cities located in the coastal areas. As stated in Sub-chapter 8.2.1.1, this phenomenon of the labour movement of migrant workers towards the coastal areas is an often described phenomenon in the literature. Surprisingly, however, some interviewees from Suzhou saw the location of the Suzhou plant and its proximity to Shanghai as a disadvantage. They described a labour movement among operators with rural origins back towards to the less developed mainland. The return of migrant workers to the rural areas within China (return migration) is a relative recent phenomena which has to a lesser extent been investigated within the literature (e.g.: Chan, 2010, Zhao, 2009; Zhao 2002).

8.3.1.3 The barrier from a socio-technical perspective

The investigation of the barrier ‘High employee turnover’ highlights the crucial role of the social sub-system within Lean. The analysis revealed that high operator fluctuation caused incorrect handling of parts by new, inexperienced operators, leading to component damage (See 7.2.2.2 Barrier description). To fight this problem, engineers tried to reduce the effects of what they described as ‘human factor’, and redesigned the assembly line and operator tasks to follow very simple work steps with high quality control measures after each task. This resonates with Aoki’s (2008) findings, which also describe the reduction of the human factor within a Lean production system in China. In one of Aoki’s (2008) case studies, a Japanese automotive company implemented a policy to prevent faulty production by reducing the complexity of each worker´s job (Aoki, 2008). This action was initiated by production engineers in the Japanese head office that prepared tools for the Chinese plant. In the Japanese mother plant, an operator handled six machines in his/her daily operation, whereas in the Chinese plant each operator handled only one machine. Aoki (2008) suggests that a reduction of human factors may also be applied in other companies in China, to reduce the effects of the high turnover ratios within the Chinese shop floors. However, he does not expand on what kinds of effects these changes would have on operator turnover.

The present study also indicates that the redesign of the technical Lean sub-system towards very simple work tasks did not help in overcoming the effects of turnover on technical performance of Lean. Instead, simplified work tasks led to lower motivation and therefore reinforce turnover levels. In other words, the difficulties in the social sub-system, namely the fluctuating workforce, led engineers to try and reduce the effects of the social sub-system. This was not possible, though, due to the effects on worker motivation. This means that human factors, which are part of the social sub-system, could not be eradicated. Instead, trying to reduce the influence of the social sub-system harmed another component of it, worker motivation, reiterating the initial problem (turnover) within the social sub-system, and perpetuating the consequent failures in the production. This finding demonstrates that the social component of the Lean system cannot easily be downsized, and it is therefore crucial to overcome barriers within this social sub-system.

8.3.2 Weak supplier performance

8.3.2.1 Comparison of the barrier with the literature

The current research results indicated weak supplier performance as one of the major barriers for Lean. That weak supplier performance is a barrier for Lean is in line with the literature on Lean in emerging economies. Studies of this research area similarly indicated a lack of qualified local suppliers and the related independency of manufacturers on overseas imports (e.g. Kenney and Florida, 1994; Mefford and Bruun, 1998); Wallace, 2004). With regard to Mexico, Kenney and Florida (1994) also highlight evidence of weak supply chain as a barrier for Lean. Oliver et al. (1998) also describe high inventory levels due to lose supply chain coordination in Mexico. The match of the study finding with the findings in the literature on Lean in emerging economies further strengthens the relevance of supplier performance as a barrier for the implementation of Lean.

The findings are also supported by studies which focus in particular on the implementation of Lean in China. A number of authors also addressed a weak supplier performance as a barrier to apply Lean in Chinese plants (Comm and Mathaisel, 2005; Taj, 2005, Oliver et al. 1998; Paolini et al., 2005; Lee, 2004). As indicated in the current research, the authors name a lack of supplier reliability and the dependency of Chinese assemblers on overseas imports as major explanations for the weak supply chain. Comm and Mathaisel (2005) explicitly stress that suppliers play an important role in achieving just-in-time production, by reducing the amount of time required to wait for parts and arrival of materials; manufacturing companies can place an order after they are certain of the quantity and products desired by their customers. Oliver et al. (1998) also indicate that companies in China were unable or unwilling to source components from local Chinese suppliers due to the absence of an established and efficient industrial infrastructure. The consistency of the case study findings with the Chinese-specific Lean literature supports the importance of weak supplier performance as a Lean implementation barrier in China.

The evaluation of the barrier provides detailed information about the supplier situation in China, which is in contrast to the studies from Taj (2005) and Paolini et al. (2005). These studies miss detailed explanations and analysis of the barrier and its effects on Lean. However, Comm and Mathaisel's (2005) study highlights the effect of the missing supplier integration in China on Lean and further strengthens the study findings. They state that a better integration of the supplier and the implication of a JIT production system can greatly reduce 'just-in-case' inventories in the system and therefore reduce the production lead time. The present findings are also supported by Oliver et al. (1998) who also explain the high inventory levels found in China by the absence of a short distance JIT delivery between suppliers and manufacturers. Like the present study, these studies thus highlight the barrier and its effects on the production system.

Despite giving information about the performance of the local suppliers, the current study also highlights the preferred production system used by Chinese suppliers within the automotive industry. The study widely indicates the use of traditional mass production methods and at the same time highlights the conflict when synchronising with requirements of plants using Lean. The reviewed prior studies did not provide such detailed information about the production system used by local supplier industry and synchronising difficulties when manufacturer and supplier are using different production systems.

By comparing the state of the performance of western suppliers and Chinese local suppliers, the research is able to frame the barrier and give indications of the scale of the performance gap of Chinese suppliers. This comparison of the actual state of the supplier industry in China with the supplier industry in other countries is missing in prior studies on Lean in China.

By obtaining inside views of people working closely with Chinese local suppliers, the study gives indications of the time frame the barrier display in China. The study suggests that sourcing high quality parts, which match the quality standards of western suppliers in China locally, is not seen as realistic in the near future. Most studies, such as Comm and Mathaisel (2005) and Lee (2004), do not provide insights into the likely future development of supplier performance in China. The current findings further stress how important it is for companies, who use JIT production principles in China, to build a reliable supplier network and integrate it in their logistic processes.

8.3.2.2 Discussion of links to Chinese context factors

The current findings clearly indicate that the Chinese national context does influence the implementation of Lean. The findings demonstrated several links between the weak supplier performance and the national context (See 7.3.2.4

Influences of the context factors on ‘Weak supplier performance’). Such a detailed analysis of what role the Chinese national context plays within the implementation of Lean has not been done before. Other studies did not evaluate the role of China’s national context on the performance of local suppliers. For example, the studies by Comm and Mathaisel (2005) and Lee (2004) give some indications of the manufacturers’ dependency on overseas imports as a direct consequence of the weak supplier performance in China. However, these studies do not examine the influences of the national context of China. With regard to weak supplier performance, these studies miss out on investigating the mechanisms by which the national context influences the barrier.

The present study was able to provide evidence that China-specific context factors influence the plants’ Lean production system negatively (See 7.3.2.4 Influences of the context factors on ‘Weak supplier performance’). The findings link the plants’ dependency on overseas imports with specific Chinese context factors. For example, a disregard of Guanxi connections with local authorities led to a slower customs clearance procedure when overseas imports were released by customs. Within the literature, an evaluation of the mechanisms between the implementation barriers and the national context is missing. Rarely, studies link supplier performance barriers to the national context. Examples of exceptions are Paolini et al. (2005) and Oliver et al. (1998), who give some indications that the bad performance of suppliers is linked to China’s partly poor infrastructure. Besides highlighting the barrier, they also show a source of the performance gap. However, these studies do not investigate this phenomenon in further depth. The current study also found evidence that China’s infrastructure influences Lean (See 7.2.3.4 Influences of the context factors on ‘Weak supplier performance’). Such detailed evaluations of the influence of the Chinese context on the barriers are widely missing among studies in the field of implementing of Lean in China. The detailed evaluation of the circumstances and the role of the context may help practitioners, for example to avoid delays or damages of delivered components caused by poor infrastructure and unreliable delivery vehicles in certain areas (as shown in the results). With a detailed understanding of the circumstances, companies may be able to overcome the root causes of the problem, for example by adjusting their components packaging or aiming to build up their local suppliers in a close area.

The research results also evaluated the effects of the 'Weak supplier performance' on Lean principles (See 7.2.3.3 Effects of 'Weak supplier performance on Lean'). A comprehensive evaluation of the direct effects of the barrier on the Lean production system has not been done before. The studies which were evaluated in the literature review (Comm and Mathaisel, 2005; Taj, 2005; Oliver et al., 1998; Paolini et al., 2005; Lee, 2004) only mentioned barriers which the industry or a particular company who participated in the authors' research faced when implementing Lean in China. However, these studies did not further evaluate which Lean principles were affected by the barriers. The present findings do show the effects of weak supplier performance on Lean. For example, the findings make the specific link that quality deviation of Chinese local supplier parts not only requires additional inspections of all incoming part deliveries, but also precludes elements of JIT delivery, such as 'Ship to Line' within the production system. This focus of the study on specific mechanisms by which barriers affect Lean contributes to the understanding of why a barrier which seemed to be generic to all types of production systems is in particular a burden for Lean production. The value of examining the effects on Lean in detail will become evident for practitioners when they want to implement Lean in China and know which particular elements are affected by the barrier.

8.3.2.3 The barrier from a socio-technical perspective

The barrier 'Weak supplier performance' is, within the current study, categorised as the only barrier that lies within the technical sub-system of Lean.

The barrier describes problems within the technical sub-system of Lean such as the lack of localisation or conflicts with JIT principles because of the suppliers' use of batch production. However, the study's focus on the influences of the Chinese national context factors reveals that social components of the national context also influenced the barrier. The study indicates, for example, that missing Lean knowledge among employees working for Chinese suppliers was an important reason why Lean was rarely applied within the company's local supplier base. Therefore, the analysis of the context gives some indication that even a barrier within the technical sub-system of Lean is influenced by social components of the production system. The study further thus stresses the importance of considering the social sub-system of Lean.

8.3.3 Market conditions

8.3.3.1 Comparison of the barrier with the literature

The current study findings show strong evidence that the barrier 'Market conditions' hindered the implementation process of Lean at both sites of the firm. The results show multiple agreements of western and Chinese participants on the existence of the barrier. This barrier was not indicated in any of the reviewed literature on Lean in emerging economies and Lean in China. Therefore, the current findings reveal an additional implementation barrier.

A close comparison of the barrier 'Market conditions' with the barriers found in the literature, reveals certain overlaps. Certain elements of the barrier are also indicated by other researchers, but with a different emphasis, thus the classification as a different barrier. For example, the literature describes high inventory levels in the industry as a burden for Lean, which I grouped in the barrier 'poor inventory management' in my literature review (See: 4.1.3 Poor inventory management, 5.1.3 Poor inventory management). The current study reveals that poor inventory management is a barrier to Lean implementation, but only as part of market conditions as the broader barrier.

In the literature, most studies that indicated high inventory levels did not give further explanations of their causes. Most inquiries did not distinguish between internal inventory levels of different firms. In contrast, this study revealed that the firm's high inventory levels were not mainly driven from within the firm, but by the company's interactions with its customers. The in-depth analyses of the plants' circumstances revealed that their customers requested high amounts of the firm's final products in their own consignment warehouses to provide safety buffers for their production. Even though the firm did not have high levels of inventory within their internal warehouses, these consignment warehouses created high inventory levels for the case company. An analysis which examines the inventory levels in such depth was has not previously conducted and most other studies did not differentiate between inventories caused by internal processes and inventories requested by the customers. Oliver's et al.'s (1998) study is the only one which states that car makers in China insisted on several weeks of inventory of finished supplier components but does not give more detail.

The company's enthusiastic focus on implementing all elements of the internal Lean production system to a high level of perfection might be a reason why the market conditions were a major barrier in this case, but not in the cases investigated in the literature. In companies that are willing to compromise on the holistic implementation of Lean principles, the barrier may not be as evident. Companies that do not follow Lean as strictly and therefore do not reduce inventory levels (to constantly challenge the robustness of their production system) may not consider the customers' requests for high inventory levels as such a burden for Lean.

In the same vein, the barrier 'Market conditions' highlighted that Lean is used only rarely among the automotive industry in China. This was also indicated by Oliver et al. (1998) and more recently by Comm and Mathaisel (2005) and Brown and O'Rourke (2007). Comm and Mathaisel (2005) conclude that the manufacturing industry in China needs to become more knowledgeable about

Lean. Brown and O'Rourke (2007) describe the production methods applied in China as a large-scale, top-down controlled version of lean manufacturing and named it 'Lean with Chinese characteristics". Oliver et al.'s (1998) study illustrates the existing levels of Chinese expertise with respect to modern manufacturing methods such as total quality management and just-in-time, with a quote: "The Chinese know the names, but there is nothing behind". This allows for the conclusion that most firms in China are less eager to follow Lean strictly.

Another aspect of the barrier 'Market conditions' was related to the different types of customers the company was dealing with. The findings revealed that small- and medium-sized Chinese customers and the international joint venture customers were requesting products in different quality and prices ranges. It was, however, seen as unrealistic and in conflict with Lean to obey the company internal Lean quality standards and at the same time be able to offer products for a low price as requested by Chinese customers. The literature did not examine this dilemma the case company was facing. Oliver et al. (1998) indicated in their report that the Chinese automotive industry is fragmented, but they did not evaluate problems suppliers might face when serving big joint venture customers and local SMEs at the same time.

Another aspect of the barrier 'Market conditions' was the short notice of purchase orders and order cancellations by Chinese automotive manufacturers. Respondents regarded these rigorous demands by Chinese customers as a burden for the levelling procedure and maintenance of Lean process standards. This is another specific effect on Lean which has not been evaluated by other researchers within the field. The literature review gave no indication that the described behaviour of the local customers led to problems when applying Lean in China.

As previously mentioned, the less eager implementation efforts among other Chinese firms might be an explanation for why the barrier was not evident in other studies, apart from the small number of publications which investigate Lean barriers. Companies which have lower ambitions to decrease their internal inventory levels to a minimum might be less affected by this barrier and employees would consider the customers' request as less problematic. Because the case company was following JIT principles (reduction of inventory to a minimum) that strictly, unpredicted changes lead to overproduction or bottlenecks. These created 'waste' or required 'improvisations', which were a contradiction to strict Lean principles. The effects on the supplier's production system caused by dealing with a 'non-Lean' Chinese manufacturer have not been examined before.

These findings may prepare practitioners to further develop their JIT production capabilities of the production system, e.g. by building up very flexible levelling procedures and tight supply chain coordination which would enable them to cope with the last minute changes by Chinese customers. The described dilemma which the case company was facing, to be Lean (by avoiding safety buffers) or to risk not being Lean (by holding safety inventories) but being able to fulfil the customer demands, may motivate practitioners to find ways to adjust the production system in a way that it can cope with the present market conditions. Another option for practitioners may be to build up a close relationship to the customers and developing robust and consistent schedules both sides can rely on.

8.3.3.2 Discussion of links to Chinese context factors

Again, the current research findings clearly indicate that the Chinese national context influences the implementation barrier 'Market conditions' (See 7.2.4.4). The findings indicate that a lack of industrial experience, China's economic growth, missing Lean knowledge, and lack of quality awareness are the most influential context factors. Because of similar characteristics of the national context of other emerging economies, it is likely that these factors also play a role when implementing Lean in emerging economies. For example, Oliver et al. (1998) also claimed that the absence of an established industry is a common characteristic of other developing countries. They claim that with regard to high inventory levels, the situation in China mirrors the situation in emerging economies such as Mexico. They then deliver data indicating that inventory levels held in Mexican plants were very similar to those of the Chinese plants. It can be speculated that the rapid expansions of the automotive markets in Brazil and India also makes it difficult for Brazilian and Indian automotive manufacturers to estimate order forecasts which might lead to similar difficulties to the ones of the case firm.

Again, the findings elaborate which specific Lean principles were affected by the barriers. For example, the data stresses that the high number of different customers in China lead to a wide range of products. To fulfil various customer orders the assembly lines needs to able to produce several different products every day without wasting much time on setting up the work stations for the next scheduled product. The findings suggest that the circumstances in China require quick tool changes over capabilities of the work station tools and a reliable Kanban delivery system, to ensure parts get delivered to the assembly line in appropriate lot sizes.

These links of barriers to specific elements of Lean provide valuable information for practitioners, enabling them to focus on preparing the specific elements in line with the circumstances given in China. This might be especially important with regard to the barrier market conditions, because it is unlikely that aspects of the market place in China which act as barriers will change in the near future. The parallels found with the Worldwide Manufacturing Competitiveness Study by Oliver et al. (1998) which was conducted a decade ago gives some indication that the aspects highlighted in the barrier market conditions in China will change only slowly over time.

8.3.3.3 The barrier from a socio-technical perspective

The findings indicated that the barrier 'Market conditions' required mainly adjustments of the technical sub-system of Lean, rather than the social sub-system. As previously mentioned, technical adjustments were required to improve the quick tool change over capabilities of the Chinese assembly lines. Moreover, different technical adjustments were requested by the customers within customer audits. The findings did not highlight that the social sub-system of Lean played a major role in the effect of this barrier. However, there is some evidence that when the company spent more effort in establishing closer relationships with customers, technical adjustments could be avoided. For example, when at a supplier a new assembly line or workstation is needed, engineers need to have an accurate demand forecast by their customer orders to estimate how many parts which will be produced in the line. This information is crucial to configure the dimension of the assembly line. Significant changes in the customer's order volumes when the assembly line is already built result in massive redesign efforts on the finished assembly lines. The findings give some indication that close cooperation between the case company (in the role of supplier) and its customer may help to prepare a more accurate demand forecast, which is essential for the supplier to set the dimensions of the assembly line (technical sub-system). However, at the same time, the findings suggest that it may be challenging to improve the social sub-system by building closer customer integration. Participants complained that because of the high number of customers in China, it was difficult to build solid relationships with customers in China. This was different to the market place in Europe where is market is less diverse. There are thus some indications that 'Market conditions' as a barrier was part of the social sub-system of Lean, in terms of relationships with customers. Nevertheless, this barrier has a stronger technical component than the other barriers.

8.3.4 Lack of Lean knowledge

8.3.4.1 Comparison of the barrier with the literature

Studies within the literature on Lean in emerging economies (Seth and Tripathi, 2005; Kenney and Florida, 1994; Mefford and Bruun, 1998; Humprey, 2005) as well as the studies within the literature on implementing Lean in China (Brown and Rouke, 2007; Aminpour and Woetzel, 2006; Oliver et al., 1998; Paolini et al., 2005; Cin and Pun, 2002; Lee, 2004) indicate that the knowledge gap of the local workforce is a major implementation barrier. This is in line with the present findings. The participants at both plants indicated that poor education levels and missing Lean knowledge were major barriers for the implementation of Lean.

However, the Lean literature in emerging economies and China provides only weak evidence of the influence that lack of knowledge has on specific Lean elements. The reviewed studies name mainly the knowledge gap and missing Lean understanding as a barrier, but do not evaluate specifically which Lean elements are affected by the barrier. The present study fills this gap. The data set provides detailed explanations of which Lean elements are affected by the barrier, and in which way. More specifically, lack of lean knowledge affects elimination of waste, production levelling, visualisation, preventive maintenance, single-piece flow, and continuous improvement. Interviewees indicated that the knowledge way affected the production system in different ways such as unnecessary movement of parts, bigger volumes of parts delivered to the line, visualisation sheets just made to fulfil the standard, worn-out parts not replaced in time and the problem solving potential of the operator team not used to its full extent. Therefore the study contributes to the Lean literature by developing the understanding of the mechanisms by which the barrier affects Lean. At the same time, the detailed findings prepare practitioners to be aware of difficulties which might occur when implementing certain Lean elements in China.

8.3.4.2 Discussion of links to Chinese context factors

The findings highlight that China's school and university education system is a cause of the poor basic education among operators and of the missing Lean awareness among engineers (See 7.3.2.4 Influences of the context on 'Lack of Lean specific Knowledge'). Given the well-known shortage of talent in China, (e.g. Melvin, 2001) this is finding is not surprising. The consideration of other national context factors reveals that there are interrelations with other context factors which might make it difficult to overcome the barrier. Most importantly, participants stressed that it was difficult to defeat the knowledge gap by simply offering internal training courses or additional Lean workshops. Other factors, such as the high demand of Lean experts on the labour market and a weak company loyalty among Chinese employees, limited respondents' expectations that the barrier could be overcome by internal education schemes. Internal education aiming to overcome the knowledge gap leads to increased employee turnover because employees got a better qualification, which is then used to get a better job with a competitor (See 7.3.2.4 Influences of the context factors on 'Lack of Lean knowledge' on Lean). Therefore, the detailed consideration of the national context revealed that even when the cause of a barrier is known, it might be difficult to implement countermeasures to overcome the barrier.

8.3.4.3 The barrier from a socio-technical perspective

Again, the results show the importance of the social sub-system of Lean. With regard to the barrier 'Lack of Lean knowledge', this can be seen most clearly in the perceptions of the company's internal Lean implementation team. (See 7.3.2.2 Barrier description). Members of this team stressed that applying Lean required a holistic system thinking which most Chinese colleagues did not have. Even when employees were aware of the technical procedures of certain tools such as 5S, 5W or TPM, they needed to be able to link the tools with each other in order to implement Lean appropriately and utilise its benefits. Conversely, it was stressed that the described holistic system thinking requires a solid knowledge of Lean. These perceptions by the Lean experts show that to utilise fully technical Lean tools, it is crucial that employees understand how to link these tools in a way that benefits the production system. With regard to Lean knowledge, a social sub-system is thus a prerequisite for the functioning of the technical sub-system of Lean.

8.3.5 Intercultural communication

8.3.5.1 Comparison of the barrier with the literature

The current findings indicate that intercultural communication is an internal barrier. Misunderstanding and difficult communication due to language problems and differences in directness inhibited knowledge transfer, e.g. the Gemba leader style, and quick problem solving on the production line. None of the participants were native English speakers, and they all needed to communicate with their colleagues in English. This circumstance augmented the intercultural communication barrier.

General intercultural communication issues have long been shown at the workplace in numerous ways. For example, using a second language creates cognitive strain (e.g. Smith and Bond, 1998), and cultural differences in communication codes, styles, scripts, etc., make cross-cultural communication significantly more demanding than communicating within a single culture, (e.g. Thomas, 2002). The contrast between the Germans' direct and the Chinese indirect communication style mirrors Hall's (1976) classic model of high and low context communication. German and Chinese culture is positioned at the opposite ends of the high-low context continuum in Hall's (1976) model. Therefore, it is not surprising that in this international case setting, participants perceived communication issues as a barrier to collaborating. However, the effect on Lean is less obvious, and it has, to my knowledge, not been shown before.

The contrast between the Chinese and German production systems might explain why German participants perceived communication as such a severe barrier. In the highly automated production in Germany, fewer workers were employed than on the Chinese shop floor. Dealing with many different individuals when working on the Chinese shop floor might be perceived as a burden in itself, because the German engineers were not used to communicating with various people within the production environment. This challenge was further exacerbated by the difficulties of communicating across cultures. Moreover, the high number of western expats working in China, especially in the Changsha plant, made communication issues more present for Chinese participants and might also explain why it was perceived as a difficulty in their daily work.

The literature on Lean in emerging economies and Lean in China did not indicate intercultural communication as a major barrier for Lean. However, a lot of the reviewed studies examined Lean issues within local rather than international organisations. Intercultural communication was, therefore, no issue within the participating organisations. Even when studies collected data from foreign-owned companies or joint ventures, this does not necessarily mean that researchers described this issue. The most likely reason for this is that the majority of authors did not focus on implementation barriers, and therefore did not mention that intercultural communication acted as barrier, even if it did. For example, Taj (2005) looked at the application of Lean assessment tools to evaluate the current state of Chinese hi-tech industries. The Lean assessment questionnaire used in the study focussed on the status of plants according to performance indicators, rather than existing Lean barriers, such as communication. Therefore, even if participants who took part in Taj's (2005) study perceived intercultural communication conflicts, this would not be captured through the questionnaires.

There is, however, some evidence in the Lean literature in China which shows how important communication is for the functioning of Lean. Aoki (2008) stresses that when waste (Muda) is identified, it must be reported to the appropriate people to analyse the root cause and to take countermeasures (Aoki, 2008). He further stresses that, in this process, communication between different functions has a critical role. Communication between the user of the machine, a maintenance person and an equipment engineer is essential to analyse the root causes of a problem. Communication between the people who make work standards and the people who are involved with the analysis is indispensable (Aoki, 2008). However, despite Aoki's (2008) indications that communication plays an important role within Lean, most comments made by participants with regard to communication issues referred to general complaints about the degree of effectiveness of the communication at their work place and were denoted only indirectly as Lean barriers.

8.3.5.2 Discussion of links to Chinese context factors

The findings highlight several Chinese national context factors that influenced the implementation barrier 'Intercultural communication'. These were: worker demographics and origin, lack of industrial experience, education, and elements of Chinese culture (See 7.3.3 Model 'Intercultural communication').

The finding indicated that western expatriates perceived lesser communication barriers when dealing with work colleagues of the younger generation. As revealed by Zimmermann et al. (2003) the findings demonstrate that the younger generation communicated in a more westernised style in comparison to older colleagues. The findings highlight the Chinese school and education system as a source of a lack of English language skills, and differences to the direct western communication style. Participants attributed the improvements by their younger colleagues to the recent reforms in university teaching, with traditional, authoritative methods being replaced by a stronger emphasis on independent thinking (See Zimmermann, 2003).

Traditional hierarchical structures and a high power distance were seen as influential factors of the communication barrier. These cultural factors were seen to be a burden especially when managers were communicating with line operators. The perceived hierarchical distance between operators and western expats, and the expectation of top-down leadership, were regarded as factors that restricted any improvement suggestions from the 'bottom up'. No direct feedback was given by operators. This observation clearly accords with the high score of China on Hofstede's (2001) power distance score. Accordingly, Aoki (2008) highlights that Chinese shop floor workers did not communicate improvement ideas. However, it should be mentioned that besides the hierarchical distance perceived by the operators, the direct communication style (low context) may also have restricted the operators' ability to communicate suggestions for improvements. The direct communication style of the western managers might not leave Chinese operators enough 'space' to express their ideas and suggestions.

The lack of industrial experience among Chinese shop floor workers was also seen as a factor which participants directly related to an effect on Lean. They stressed that their missing experience restricted the operator's ability to communicate suggestions and feedback to managers. This finding can be explained in terms of a missing grounding of the communication between managers and operators. For understanding to occur, the sender and receiver of messages must share a vast amount of common information, called grounding (Clark and Brennan, 1991). Both sender and receiver of the message play an active role in the communication process (Thomas, 2002). People who have extensive common information can communicate very effectively with a minimum of distortion (Thomas, 2002). The current findings reveal that the manager and the operator in the role as either sender or receiver did not have extensive common information, or grounding, and could therefore not communicate in an effective way. Operators were not able to communicate improvement ideas to the managers because they could not communicate what they did not know.

8.3.5.3 The barrier from a socio-technical perspective

The findings indicate that intercultural communication plays an important role in the low-automated shop floor in China, which requires high numbers of employees to be involved within the assembly processes. Therefore, findings stress that in low cost countries such as China it is even more important than in the highly automated western industries that the human interactions, including communication, works well. In other words, the social sub-system of Lean gains even greater importance.

The findings indicate that the lack of an effective communication channel between management and operators had a direct effect of the improvements made within the production. Because operators did not communicate improvements, the technical system could not be improved. To establish the improvement mechanism of the assembly lines, management needs to ensure that operators are able to communicate their improvements suggestions. This direct link between the communication barrier and technical effects within Lean highlights that the social sub-system, in this case communication, has direct influences on the technical sub-system and therefore on Lean performance.

As mentioned in the section on employee turnover, some engineers tried to reduce the ‘human factor’ within the assembly lines. Driven by the high employee turnover on the shop floor, some engineers tried to simplify work tasks and make the operator tasks foolproof. The aim of this was so that even untrained operators would be able to work in the assembly lines, which would reduce the effects of sudden operator loss. As a consequence, however, the badly trained workforce did not contribute to improving the technical facilities. This failed initiative to adjust the technical sub-system in a way to reduce the influence of the social sub-system (which they called the ‘human factor’) indicates that some engineers were not aware of the operator’s improvement potential. Improving the communication channels between operators and management might have helped to achieve this potential more than downsizing the ‘human factor’.

8.3.6 Work styles

8.3.6.1 Comparison of the barrier with the literature

The literature on Lean in emerging economies and Lean in China indicates that work styles are a barrier for the successful implementation of Lean. The findings of the current study mostly confirm the relevance of the work styles that the reviewed authors identified as barriers. The three components of work style barriers described in this thesis, namely ‘Disregard of instructions and procedures’, ‘Lack of maintaining standards’, and ‘Lack of problem solving’, overlap partially with prior research, but contain many new insights.

Participants showed great concerns about the workers’ disregard of instructions and procedures and the lack of maintaining standards. Aoki (2008) also highlights this issue within his study. Aoki (2008) also observed a lack of maintaining standards as a barrier to implementing Kaizen activities in China. Managers in most of Aoki’s cases highlighted how disciplining workers to conform to the company rules, especially work standards or 5s practices, played a critical role when implementing Kaizen activities. Within the present study, interviewees also gave several examples to indicate that procedures which should be accomplished according to a standardised process were not applied appropriately. In addition to Aoki’s study, the present study also evaluates the state of the standard itself. The findings point out that the plants’ internal standards were not yet fully refined and that engineers kept adjusting and changing standards without ensuring process stability. This gives some indication that the operators were not exclusively responsible for the lack of maintaining standards. The analysis of the refinement of the standards also suggests that because of the poorly established standards, problems occurred. Furthermore, the present research revealed that a lack of maintaining standards was not exclusively a problem at the shop floor level (as shown by Aoki, 2008), but also a problem at the engineering level. Western managers complained that the office level did not stick strictly to the standards set by the leadplant, and this loose interpretation of standards led to quality deviations.

Another finding which is rarely indicated within the reviewed Lean literature is the barrier 'Lack of problem solving' as part of work styles. An exception is the study by Aminpour and Woetzel (2006) who addressed a deficit of workers' and managers' problem solving skills. A reason why most studies do not indicate a lack of problem solving as a separate barrier might be its overlap with lack of Lean knowledge. For example, to solve a problem in a systematic manner might not be possible for employees who do not have the knowledge to understand the problem's circumstances or how to use problem solving tools. However, participants stressed the importance of problem solving for Lean and considered it as an important work style characteristic which acted as a barrier itself. Accordingly, the analysis of the barrier reveals the effects of the barrier on specific Lean elements, such as CIP.

There are also differences between the literature and the current findings regarding work styles. Foremost, the high absenteeism among operators in Mexico indicated by Kenny and Florida (2004) and Mefford and Brunn (1998) was not confirmed by the China-related Lean literature and also not by the present study. This might be grounded in China's high number of migrant workers who are willing to work, and are dependent on a daily income. Also, strict company rules to prevent absenteeism may in the case company have led workers to think that absenteeism was not an option.

A major contribution of this study is, again, that it provides detailed explanations of the effects that work styles have on the production system. The findings show how the workers' behaviour leads to problems within the production flow and therefore acts as a barrier to Lean. For example, the workers' disregard of instructions and procedures affected Lean elements such as the effectiveness of single piece flow production and the embedded quality insurance mechanisms. (See section 7.3.4.2.3 Effects of workers' disregard of instructions and procedures on Lean).

8.3.6.2 Discussion of links to Chinese context factors

The reviewed literature on Lean in emerging economies does not provide any indication that particular national context factors influence the three major work styles indicated by the present data set. The reason for this is probably that the authors did not have the intention to evaluate the role of the national context with regard to Lean implementation. When looking at the Lean literature in China, the majority of studies do not analyse whether the indicated work styles are linked to the national context. However, a few studies give some indication that China's country context does influence operators' work styles. For example, Paolini et al. (2005) indicate that Chinese workers within their case study lack the ability to work as a team. The authors then explain these team working deficits by China's one-child policy and the 'spoilt child syndrome'. They argue that most workers within the shop floor have grown up as single children and are therefore not used to working as a team.

The present data did not indicate strong links between a lack of team working and the single child policy. However, participants also named the single child policy and the characteristics of the 'Generation 90' phenomenon as influential, China-specific context factors. For example, participants linked the workers' disregard of instructions and procedures to characteristics of the 'Generation 90'. They perceived a significant difference between employees from the 'Generation 90' and the employees from older generations with regard of how well workers followed orders (See 7.3.4.2.4 Influence of context factors on 'Workers' disregard of instructions and procedures').

As another important context factor with regard to work styles, the study indicates China's recent industrialisation and missing industrial experience among Chinese employees due to China's agricultural past. With regard to workers' discipline, the study suggests that workers who come from rural areas have no clear picture of how to deal with rules within a company and how to position themselves as workers in the organisation.

China's agricultural past and recent industrialisation was also seen as directly linked to the work style of maintaining standards. When implementing Lean tools such as 5S, interviewees were convinced that there was a clear link between the workers agricultural background and workers' tolerance of an untidy and disorganised workplace (See 7.3.4.3.4 Influence of context factors on 'Lack of maintaining standards'). Similarly, a few prior studies (Aoki, 2008; Wong, 2007; Paolini et al., 2005) have indicated that workers' tolerance of untidiness created difficulties when implementing standardisation tools such as 5S.

With regard to problem solving, the data also indicated a number of Chinese context factors which were seen to be influential (lack of industrial experience, institutional education system, economic growth). Surprisingly, the participants also named a number of context factors which can be found in particular in the Chinese cultural context. Several western and Chinese interviewees saw direct links between the lack of problem solving abilities and the concepts of face and Guanxi, high power distance, and Confucian values (See 7.3.4.4.4 Influence of context factors on 'Lack of problem solving').

With regard to the concept of face, the data revealed that in their problem solving activities, Chinese employees tried to avoid confrontation with other staff members. They sometimes avoided blaming somebody who was responsible for the root cause, or concealed a root cause to avoid exposing somebody who might be responsible, in order to avoid the colleague losing face. Therefore, the study indicated that there is a link between safeguarding face and keeping a good relation with an individual and 'cursory fixing'. In the same vein, other Chinese cultural factors, such as high-power distance among Chinese employees, were seen as influential for lack of problem solving. The study showed that Chinese employees avoided escalating a problem to the next management level, because they feared the confrontation with their boss. Similarly, Aminpour and Woetzel (2006) indicated that the hierarchical nature of Chinese organisations hinders the cooperation and joint decision-making up and down the chain of command. Their findings are in line with the present study, and support the argument that due to Chinese cultural factors, problem escalation mechanisms which aim to enable employees to cooperate across departmental boundaries are less effective in China.

Other studies in the field of operations management with focus on Lean implementation did not to the same extent deliver detailed data which highlights direct links of the Chinese context factors and Lean elements. However, in the same vein it needs to be said that the data is based on the perception of the participants and there were no special investigations made by the employees which proves a causal relationship between these named cultural concepts and the Lean elements.

8.3.6.3 The barrier from a socio-technical perspective

The consideration of work styles as a barrier demonstrates again how important it is to consider the interrelations between the social and the technical sub-system of Lean. The results on the barrier 'Lack of maintaining standards' indicated that some production standards were not yet well established. Moreover, the production processes were not reliable and stable enough to run the production smoothly according to the standards. Engineers therefore kept adjusting and changing assembly standards within the production line to stabilise the production process (See 7.3.4.3.2 Barrier description). These production standards can be regarded as elements of the technical sub-system of Lean. Engineers were thus continuously modifying the technical sub-system of Lean. However, by frequently changing the work place standards within the assembly line, there was not enough time for operators to take the new standard in and accomplish their assembly task according to the requirements.

Due to the frequent changes in the technical sub-system of Lean (in the form of changing standards), there was not enough time for the social sub-system (operators) to adjust to the new situation. Hence, the changes of the technical system which were initially meant to achieve an improvement of the production acted as a barrier to Lean production, because the social sub-system (operators) was not able to adjust in time.

This is in parallel to the mistake that was explored by Tavistock researchers in the British coal mines which marked the foundation of the socio-technical systems theory (See 2.2 Historical background of socio-technical systems approach). In the mining experiment, a new, more advanced technology was implemented, but did not lead to higher productivity, because workers did not adjust well to the new system. The researchers of the Tavistock institute stressed that within their socio-technical system approach, changes of the technical system that appear quite rational from a pure engineering perspective can disrupt the existing social system and reduce the expected benefits of the technical change significantly. Hence, the current study provides evidence that the same socio-technical principle still applies in the modern context of Lean manufacturing in the automotive industry.

CHAPTER 9

9 Conclusion

In the last two chapters, I have presented my findings and the Lean implementation model, and I have discussed each barrier with regard to prior research, links to Chinese context factors, and the socio-technical systems perspective. Secondly, I have drawn comparisons between the two case study plants and between Chinese and Western views, and evaluated the influence of participants‘ hierarchy levels. Through this discussion, I hope to have demonstrated the relevance of the Lean implementation model and its value for our understanding of the implementation of Lean across the participating sites in China. I will now draw a number of conclusions from my study, by outlining its contributions to research, suggesting implications for practitioners, and indicating possible limitations along with suggestions for research.

9.1 Contribution to research

9.1.1 The difficulties of implementing Lean in China

As one of the central contributions, the study provides empirical evidence that barriers to Lean do exist in China. Using an in-depth case analysis, the study is the first to systematically describe Lean barriers and the negative effects they have on the production systems' output and profitability. The findings therefore show that Lean was implemented sub-optimally in the host company in China. By examining the effects of the barriers on Lean the study highlighted that the company was having severe difficulties to; reach the targeted quality standards of their products, maintain a constant production flow, decreasing waste levels, maintain low inventory levels, build up a reliable supplier network, applying JIT production, applying Lean tools appropriately and retain experienced workers and Lean knowledge. Moreover, the study suggests that other companies in China face similar barriers when implementing Lean, by singling out barriers external to the host company (high employee turnover, weak supplier performance, market conditions), and barriers of the company's Chinese business partners (suppliers). The study's detailed description of the Lean barriers and related Chinese national context factors allows us to assume that Lean is implemented sub-optimally throughout China. Therefore, the study contributes to international Lean Research by producing empirical data which allow us to picture the current state of Lean implementation in Chinese industry. More than a decade after Oliver et al. (1998) draw a dramatic picture in their comprehensive Lean report 'Inside the Chinese automotive industry' about the state of Lean implementation in China, the present study provides again evidence that Lean has not yet arrived in China on a full scale.

9.1.2 The value of the socio-technical lense

Another major contribution of the study is to apply socio-technical systems theory to this research context. STS theory has not yet been applied when examining the implementation of Lean to another national context. My findings imply, however, that STS theory is highly relevant to Lean.

The study uses a socio-technical perspective when examining the implementation barriers, by distinguishing whether a barrier is grounded in the social- or the technical sub-system of Lean. It was revealed that most of the barriers, and even their root causes, are grounded within the social sub-system of Lean. The study yielded several examples where the technical and social elements did not work together satisfyingly and therefore did not produce positive outcomes, thus creating barriers to Lean. This is in line with socio-technical system theory, because its principle of 'joint optimisation' suggest that social and technical aspects of a system need to work together to allow the system to produce desired outcomes. For the successful implementation of Lean, this means that the implementation of a new production system requires the introduction of new technical processes (technical aspects) alongside new working practices (social aspects). Moreover, the consideration of STS theory helps to strengthen the evidence of the study findings. I demonstrate that barriers were created because engineers did not attend to technical alongside social aspects of the Lean system, and I explain this by applying the STS approach.

By taken on STS lenses when looking at the barriers, the study yielded several examples were the principle of 'joint optimisation' was disregarded. For example, engineers kept modifying the technical sub-system (by changing work standards), which did not leave enough time for the social sub-system (operators) to adjust to the modifications. Instead of a more stable production process, a performance loss was the consequence. Providing a great deal of detail, the study highlights how employees within the host company considered the technical aspects and social aspects as independent bodies, which was not in line with the joint optimisation principles within the STS theory. In this way, the study demonstrates how a lack of attention to the social sub-system and the interrelations between the technical and the social sub-system produce specific barriers to the Lean system. It was not only a new approach to take a STS perspective when looking at Lean barriers, but it also turned out to be very helpful in building our understanding of the implementation process of Lean in China, and therefore an important contribution to Lean research.

By taking on STS lenses when examining implementation barriers the study was able to contribute to a more thorough understanding of the root causes of the barriers and thereby to highlight possible ways to overcome barriers. For example with regard to the barrier high employee turnover, taking the STS lens helped to show that a disregard of the social sub-system of Lean lead to an increase of the barrier rather than a decrease of turnover rates. The analysis revealed that high operator fluctuation was a problem to Lean because it led to incorrect handling of parts by new, inexperienced operators, leading to component damage. By redesigning the technical sub-system towards very simple work tasks, engineers thought that even inexperienced operators could fulfil the assembly task with minor training. However, simplifying the assembly tasks made the work for most of the operators mind-numbing, and as a consequence, fluctuation increased. By looking at this phenomenon from a socio-technical viewpoint, it became evident that the difficulties in the social sub-system, namely the fluctuating workforce, led engineers to try and reduce the effects of the social sub-system, which was not possible, due to the effects on worker motivation. This example illustrates that trying to reduce the influence of the social sub-system harmed another component of it, worker motivation, reiterating the initial problem (high employee turnover) within the social sub-system, and perpetuating the consequent failures in the production. The findings suggest that rather than redesigning the work station (technical sub-system), engineers need to increase their efforts in retaining the operators within assembly lines. By taking on STS lenses, the study highlights why introducing new and more powerful retention schemes for operators will be necessary in order to overcome the indicated problems. Investing in the social sub-system, for example by giving the workers additional training and internal career opportunities, seems to be only option to avoid the negative consequences caused by inexperienced workers.

Other researchers have also looked at the implementation of Lean in China. Aoki (2008) for example has also suggested the reduction of human factor to reduce the effects on high turnover on Lean, however did not examine what the effects this would have on the workers' motivation and consequently on the turnover rates. applying a STS perspective on Lean facilitated the examination of the wider context of the phenomenon and thereby highlighted the negative consequences of those counter measures. Looking at the interrelations of the technical and the social sub-system allowed me to develop an understanding of how barriers emerged and to highlight ways of overcoming the barriers in the long run.

As stressed in Chapter 2, most studies within operations management use STS by taking on the paradigm view where they consider Lean production on the one hand and STS shaped production systems on the other as a separate production paradigms. There are researchers who also consider Lean production as a sociotechnical system (Paez et al., 2004; Genaidy and Kartowski, 2003). However, these studies of Lean as a socio-technical system do not go far enough in assessing the relative importance of the social sub-system of Lean, and in showing how they are created by a mismatch between social and technical elements within the implementation of Lean. The present study expands the previous perspectives by applying socio-technical principles and thereby showing how a failure of 'joint optimisation' leads to certain implementation barriers.

Another major contribution of this study is to emphasise, with the help of the STS perspective, how national context factors play a central role when implementing Lean. When considering that humans and therefore social aspects of a socio-technical system are affected by their context, and more specifically by their national context, it does not come as a surprise that the national context also influenced barriers and therefore Lean. By showing evidence that most barriers are grounded in the social system, and that the social component of Lean cannot easily be downsized, these STS findings underscore the claim that the national context has to be taken into account. Therefore, investigating the barriers from a STS viewpoint helped to corroborate the claim that the national context plays a central role when implementing Lean in China.

Conversely, by showing the applicably of STS theory within the implementation of Lean, the study also contributes to STS research. It highlights a new application area of STS theory, by providing detailed evidence on how STS theory (and the joint optimisation approach in particular) helps to understand and overcome Lean barriers. The findings also reinforce the continuing strength of socio-technical system theory. The study gives examples which mirror the mistakes which were made within the British coal mining industries, described by the Tavistock researchers in the 1950s (Trist et al., 1963). The study uses the STS background to stress that only if systems managers and users consider both social and technical aspects, the implementation can lead to an increase in Lean productivity and employee wellbeing. In China, as in the early Tavistock studies in the UK, there might be the risk that a technological change (implementing a Lean production system) that appears quite rational from a pure engineering perspective can disrupt the existing social system so as to reduce greatly the anticipated benefits of Lean manufacturing. The study showed that because of the higher number of workers within the production in China, it is in China more important to consider social elements than in the nearly fully automated HQ's production. My evidence that a lack of adjustment of the social system on technical changes led to Lean barriers, and a reduction of Lean productivity, shows the applicability of STS theory even to the high tech automotive industry of the twenty-first century.

9.1.3 The Lean barriers

The study provides a comprehensive listing of the main barriers that are evident in China. Whilst prior research only hints at such implementation barriers in a fragmented manner and without sufficient evidence, the study summarises and categorises the barriers found within the case study context into broader barriers. By grouping the barriers systematically into external and internal barriers, it contributes to the international Lean literature, and also facilitates the transfer of Lean to the Chinese in practice.

The identification of main barriers may inspire other researchers who investigate the implementation of Lean in China to examine whether these barriers are also relevant for their research. The empirical evidence given by the data set may provide the basis for building a comprehensive data set which helps researchers gain a better understanding of Lean implementation in the Chinese context.

The China-specific Lean implementation model which resulted from this study allows for a detailed and holistic understanding of the effects that barriers have on the Lean elements. Such a holistic view is important in order to understand why the barriers are a threat for the Lean implementation, and to overcome the barriers. The China-specific implementation model can be regarded as a novel contribution to Lean research because it is the first, and empirically grounded, model which gives a comprehensive listing of the main barrier to Lean in China. Moreover, the sub-models provide details about the effects each of the barriers had on the Lean production system, indicating why each particular barrier was a burden for Lean and which Lean principle was affected. Such a conceptual model is a basis for other researcher to develop more detailed frameworks.

Here it needs to be mentioned that some of the indicated barriers were also named within the Lean literature in China. The study confirmed and thereby strengthens the evidence, however weak, provided in former studies. It needs to be stressed that there were hardly any studies which examine implementation barriers of Lean. The studies which describe implementation barriers in China are mostly consultancy or practitioner reports which lack the empirical evidence. The present study describes the barrier in much more detail than has been done before. The study also highlighted barriers which have not been found by any of the reviewed studies. There are overlaps, as the literature revealed some aspects of the new barriers, but these were never considered part of a more generic barrier. For example, this thesis highlights ‘Market conditions’ as a new barrier, which describes a barrier created through interactions between the host company (as supplier) with business customers. In particular, customers requested that the host company stored high amounts of inventories as safety buffers on their site, which is not in line with JIT principles. Other authors have also indicated high inventory levels among companies operating in China; however, they did not consider this to be a consequence of the larger barrier ‘Market conditions’. The detailed analysis of the firm-external circumstances of the barrier, which has not been done previously, allowed me to reveal that the high inventory levels were not driven mainly from within the firm, but by requests from the company’s customers. In other words, the study identifies the short notice customer requests (which are not in line with Lean) as the main barrier, and inventory levels as a consequence of the barrier, rather than defining high internal inventory levels as a barrier on its own. Overall, by demonstrating previously neglected barriers and categorising other researchers' barriers in a more comprehensive manner, this study contributes to a more holistic understanding of Lean implementation in China.

Even though the study focussed only on the barriers in China, it is likely that the findings also contribute to our understanding of barriers in other emerging economies, given the overlap with the literature on Lean in emerging economies. However, it remains to be examined which of the barriers transfer to other countries, and to what extent.

Most prior studies do not explain why their indicated barriers are specific to Lean. The present study fills this gap, by providing detailed explanations of how certain Lean elements, such as JIT, CIP, and QM were affected by the barriers. Even barriers which might not seem immediately related to the functioning of a production system, such as employee turnover and market conditions, influenced the performance of Lean. I therefore claim that Lean production is likely to be more affected by the barriers than other traditional production systems.

9.1.4 The critical role of the national context

To my knowledge, this piece of research is the first to conduct a detailed analysis of the role of the Chinese national context for the implementation of Lean. Other studies may offer some indications that the national context may be influential; however, most studies miss out on investigating the mechanisms by which the Chinese national context influences the performance of the Lean production system. The in-depth data analysis showed that the Chinese context factors were either seen as root causes of barriers or acted as catalysts of barriers to Lean. The study thus provides evidence that the country context has to be taken into account in order to overcome the barriers to Lean, and to implement Lean successfully. Other studies in the international Lean literature within operations management (e.g.: Wallace, 2004; Chin and Pun, 2002; Taj, 2005; Kenney and Florida, 1994) miss out on examining the mechanisms between factors and barriers in detail, whilst the present study closes that gap. By highlighting the mechanisms it becomes evident how context factors influence certain principles of Lean. By providing these data the study contributes to the understanding of the implementation process of Lean in China and consequently to international Lean research.

As mentioned, the context factors that, in the views of respondents, influenced employee turnover, in particular multiple job opportunities due to economic growth, and a talent shortage, have previously been examined in a different literature stream, namely the literature on international human resource management in China (e.g. Ma and Trigo, 2011; Melvin, 2001). What is new in this study is that it identifies how these context factors influence the implementation of Lean, by reinforcing turnover as a barrier to Lean. This suggests that HR practices designed for improving retention rates can also support the implementation of Lean production systems. Such HR initiatives may thus have an even wider impact within the organisation than expected by HR researchers and practitioners.

Some of the context factors identified in this research accord with context factors which have been demonstrated in other emerging economies, e.g. economic growth and a lack of industrial experience within the workforce. However, the study also demonstrated a number of context factors and mechanisms by which they create barriers, which can be found in particular in the Chinese cultural context. For example, the findings highlighted that China-specific factors, such as Guanxi connections, the concept of face, or China’s single child policy were seen as root causes of barriers.

In particular Guanxi was seen as one of the major root causes for the barriers: ‘High employee turnover’, ‘Weak supplier performance‘, and ‘Lack of problem solving‘. You could now questions the extent to which Guanxi is specific to the national context of China and if it was right to consider Guanxi as China-specific interaction style.

I argue that Guanxi is a China-specific concept and that it differed from the Western concept of networking. Certainly, Western networking and Chinese Guanxi share some common features and there are also China specific elements embedded within Guanxi. This may explain why, within the literature, there is an extensive debate on whether Guanxi is China specific or if these kinds of connections are also evident in other countries. Related studies examine the differences between Western networking and Chinese Guanxi connections. There are authors who consider Guanxi to be to the same as networking in the West (e.g. Wellman et al. 2002). However, a number of prominent scholars maintain the view that Guanxi is a cultural phenomenon and consider Guanxi as a China-specific interaction style (Hung, 2004; Lin 2001; Buttery and Leung, 1998; and Dunning and Kim, 2007). For example Dunning and Kim (2007) argue that Guanxi is deeply involved in Chinese cultural characteristics, power distance and collectivism, with a strong emphasis on harmony and hierarchy, and propose that Guanxi is indigenous to Chinese culture. Luo (1997) compares Guanxi with Western networking. He found out that favour exchanges that take place amongst members of the Guanxi network are not solely commercial, but also social, involving the exchange of social or humanised obligations and giving face or social status in society. In contrast, networking in the Western management literature is a term which is associated with commercial-based corporate-to-corporate relations (Lou, 1997). Chan (2006) supports his view and also argues that the Chinese Guanxi differs from the Western networking based on the fact that networking is impersonal and, to a large extent, at the organisational level. Tung and Worm (2001) conducted an in-depth study of the perception of Guanxi between European managers. In their study, they worked out that there are main differences between the concept of Guanxi and networking. They stress that Guanxi is more pervasive in terms of connecting the amount of people and the aspects of societal functioning. In comparison to Western networking, the Chinese Guanxi is a stronger, more in depth, and more time oriented relationship, which requires a more frequent active commitment of the members, also in times when members do not request favours. Different to networking, Guanxi involves more personal nature rather than networking, which is grounded in a commercial basis.

In view of the evidence of major differences between networking and Guanxi, it can be argued that Guanxi is a China-specific interaction style. When looking at the perception of practitioners, the literature also shows that foreigners living in China consider Guanxi as a China-specific interaction style. Tung and Worm (2001) observed that European managers were aware of these differences of Chinese Guanxi and Western networking, and the significant effect of Guanxi in the Chinese context. The study showed that the European managers were not willing to adapt to the Guanxi policies and practices in China and build such kinds of relationships, even when a lack of Guanxi restrained their potential to achieve greater business success in China. Interviewees in the present study had the same perceptions as shown by Tung and Worm (2001). Interviewees' comments about Guanxi indicated that they also considered Guanxi as unique to the Chinese context. Given the evidence present in the literature and the perception of the participants, Guanxi can be considered to a certain extent as only present in the Chinese context.

Another contribution is that the study demonstrated that certain Chinese context factors seem to be particularly influential when implementing Lean compared to other production systems. For example, a lack of industrial experience and knowledge about modern production methods of migrant workers from central China may be perceived as a burden for traditional mass production systems as well. However, Lean production systems appear to be more affected by these factors, given the importance of highly skilled operators for Lean elements, such as continuous improvement from the bottom up. This suggests again that the Chinese context creates more significant barriers for Lean than for traditional mass production systems, and therefore has more severe negative effects on the Lean system.

Having outlined the critical role of the national context for the study, it is now necessary to discuss whether Lean necessarily brings benefits to the host company in China.

9.1.5 Lean or Lean with a ‘Chinese touch’?

The study investigates which implementation barriers a company faces when implementing its global Lean production system in China. The study does not, however, question whether the use of the Lean production system is the ‘right’ (or best) choice for effective production in China. One could argue that the study misses out on a consideration of whether either adoption or adaption of Lean is the best approach to producing in a Lean manner in China. But it was never the intention of the study to address the question of whether Lean is the best production paradigm for companies who want to produce in China or whether there are better alternatives. For example, the study does not analyse whether the use of a traditional production system or a more humanistic production system causes fewer barriers and would therefore be more beneficial to the company.

In the following, an exploration is given to clarify why it is so important for the host company and other international operating companies to implement Lean production methods in China, even when they are facing implementation barriers as indicated in the present study. In this section, I stress why the adaption of the company’s Lean production system to a Lean system with a ‘Chinese touch’ (China-specific Lean system) is not a targeted aim of the host company. I explain why, even though the host company faced a number of implementation barriers, they were following its intention to implement the same Lean production system in China as in their other subsidiaries, rather than implementing a China-specific adapted version of Lean.

The decision of the host company to stick with their Lean production system in the Chinese subsidiaries despite the severe barriers is not untypical for multinational companies within the automotive industry. Even if headquarters regards a particular practice as technically superior and therefore wants to diffuse it to its subsidiaries worldwide, it does not follow that the practice is efficient in all locations (Netland et al., 2010).

The Lean implementation department at the host company's headquarters is trying to roll out their own Lean production system worldwide. No data was collected which explains the headquarters' motivation to roll out their internal production system globally. However, the literature within operations management gives indications of the benefits multinational companies do have by using a uniformed production system.

Netland et al. (2010) argues that multi-plant improvement programs aim to build isomorphism in the global network where similar practices are institutionalised in the different plants and that the companies' aim is to build a value seeking behaviour based on global conformity. Against a local adaption of the production practices, some authors argue that an adaptation of practices to the subsidiaries' context increases the stickiness of cross-border knowledge transfer significantly, which makes the transfer process more difficult (Jensen and Szulanski, 2004). Zaheer (1995) argues that following the original system might be a more risk-free way than a full adaptation to the local environment, because it might be hard to interpret the local environments rightfully. A popular approach for companies within the manufacturing industry to catch up with world-class standards is to benchmark and adopt organisational practices already proven effective by global market leaders (Yu and Zaheer, 2010).

The history and the sudden emergence of Lean may explain why so many manufacturing firms follow Lean production as their global production system. The publication of the results of the International Motor Vehicle Program in the book “The Machine who had changed the World” by Womack, Roos, and Jones (1990) demonstrated the superiority Lean had over traditional mass production systems. Since the release of the first Lean publications, Lean has prevailed and grasped a foothold as one of the most dominant production paradigms of modern times (Voss, 2005). As a result of this hype, many companies within the manufacturing industry followed the example of Toyota and restructured their production systems in the form of a company-specific production system with Lean as a raw model. Netland et al. (2012) conducted an extensive study on the use of uniform production systems in the automotive industry. They show that most renowned global operating companies within the automotive industry implemented company do apply own Lean production systems which have a tight relationship to the Toyota Production System, e.g.: the Chrysler operating system, Mercedes-Benz Production System, Opel Production System, Audi Production System, Volkswagen Production System, the Ford Production System, and the Hyundai Production System etc.

The recent findings imply that today Lean is the common production standard in the automotive industry. Also, most big automobile manufacturers request their suppliers to become Lean. When deciding to be Lean, global operating companies have to stick with one system to ensure same processes and consequently same quality levels all around the world. Implementing different production systems adjusted to contingencies of the subsidiaries seems not to be the strategy of the headquarters of most international operating firms.

Within the case study, it became clear that the host company wanted to implement their company specific Lean production system worldwide. Despite the barriers common in China, the host company was aiming to implement their company-specific production system also in their plants in China. The host company had even established an own Lean implementation department for all plants, which demonstrates their will to produce according to the same production system worldwide.

The question of what the better strategy for multinational companies is, to adapt the production system to other contexts or to adopt the HQ's original production system, may still be unanswered. Researchers have tried to answer this question theoretically in terms of the 'Lean adoption vs. Lean adaption debate' within operations management (e.g.: Sandberg, 2007, Jürgens, 2003; Cooney, 2002; Berggren and Rehder, 1994; Berggren, 1992). However, they have not come to a final conclusion on which approach is the best for multinational companies. The recent case study by Netland et al. (2012) pictures the recent development of multinational companies to roll out their Lean production system without major adjustments within their subsidiaries. The actual development of multinational companies towards a single global company-specific Lean production system and the request of many automobile manufacturers that their suppliers also manufacture according to Lean principles leave the subsidiaries little space to use adapted methods which may suit the local environment better.

Knowing that it is common practice in the industry it becomes clear that the host company conducted a great deal of effort to implement their Lean production system in China. This shows why it is so important for the host company to fully understand the implementation barriers and find ways of overcoming them. The findings of the present study may help to gain a better understanding of the implementation barriers in China and may finding ways of dealing with them. Future research may investigate how companies teach best their country specific Lean system to the employees in the subsidiaries or how this knowledge can be best transferred.

9.2 Practical implications of the study

My study has a number of direct implications for practitioners working in companies who implement Lean production in China. The presented Lean implementation model can be seen as a guideline for practitioners on what to expect when implementing Lean in China. It suggests which barriers and context factors have to be taken into account in order to implement Lean in China successfully. It prepares practitioners for what barriers are likely to emerge when implementing Lean. The mechanisms described in the model can also give practitioners new ideas on how to overcome barriers they encounter in their companies. The model should make practitioners aware that issues within the social sub-system and national context can be major root causes of specific Lean barriers; it also explains how this effect takes place. These insights should encourage practitioners to try a broader scope of different, new approaches to overcoming the barriers. One needs to keep in mind that the model is specific to the contexts examined in this study. Nevertheless, the major elements may be transferable to other companies in China. In what follows, I shall outline the specific practical implications of each barrier**.**

9.2.1 Practical implication with regard to employee turnover

The study indicated high employee turnover as a central barrier. Certainly, most companies in China face or will face this barrier when setting up a production plant in China. Employee turnover is an external barrier that is not entirely under companies' control. Firms in China will not be able to decrease the fluctuation rates to the level of Japan or developed western industrial countries. The economic situation and the sheer endless job opportunities will remain influential context factors, especially with regard to operator turnover. However, companies need to try their best to decrease turnover rates to acceptable levels. Managers and engineers need to change their current belief that it is not 'worth' investing in operators because there may be a threat of losing them after investing in training and time. Engineers need to give up their focus on technical improvements, and their mistaken belief that reducing the ‘human factor’ will eliminate the effects of employee fluctuation. The study showed that engineers’ focus on adjusting the technical sub-system of Lean did not succeed, and as a result, turnover increased because operators felt bored at work. Companies need to make engineers aware that the social sub-system plays a crucial role for Lean. An awareness of context factors will help engineers and managers to understand the operators’ needs, and to provide them with working conditions which will make them reconsider changing their employers so frequently. For example, supplying on-plant accommodation for migrant workers can help them to achieve their major goal to save as much money as possible before moving back home. They would then be less likely to leave the company for minor differences in their salary. The case company did not offer on-plant accommodation because it was not in line with the global production strategy. Production engineers complained that they did not have the chance to convince the management to offer on-plant accommodation for their workers. Even when these decisions are not common practice in other countries and not in line with global standards of multinational companies, executives should consider to find ways how to bypass these standards, e.g. by renting accommodation buildings nearby. Even when those actions seems to be a distracting for companies from their core manufacturing business, the additional efforts will be beneficial for the production.

With regard to employee turnover among office level employees, the study stressed how important it is to consider Chinese cultural factors such as the loyalty to the leader. Expatriates in leading positions suggested that international companies need to rethink their expatriate programmes. They explained that when an expatriate is in a managerial position and returns home, there is the risk that subordinates leave the company, too. In their opinion positioning expatriates within the departmental hierarchy as technical support staff as assistants to a Chinese department head may be a way to reduce these factors. However, recent research shows that in China also, relationships to other employees increase and may prevent employees leaving the company (e.g.: Homa and Ziao, 2011; Wong, 2008). For example, Homa and Ziao (2011) suggest companies should increase social ties in order to foster loyalty. They stress that relationships with technical staff matter as well. Therefore, companies should not exclusively focus on loyalty to the leader issues. Instead, companies need to make more effort to build up company loyalty by investing in group building events among employees to increase social ties.

Thus, employee turnover is not a barrier which can be eradicated in the near future, but because of the important role of the workforce for Lean, companies need to find more innovative ways to retain their work force.

9.2.2 Practical implication with regard lack of supplier performance

The findings draw attention to barriers within the supply chain which are likely to emerge when implementing Lean in China. The illustrated unpopularity of Lean production among local SMEs in China will challenge manufacturers using Lean to source components in accordance with JIT principles. The model can prepare practitioners for the problems that unreliable suppliers may cause. Knowing about the difficulties, companies who are aiming to set up a new production plant in China should chose their suppliers carefully. Visits to the suppliers' production floor should be conducted in advance of committing to business, to see whether their production may in the future be able to fulfil the high requirements set by Lean in terms of quality standards and JIT delivery performance. As highlighted, practitioners should be prepared for quality deviations and carefully check whether the suppliers' production is reliable enough to implement Lean elements, such a ship-to-line or tight-levelling schedules. It is also necessary to consider China-specific context factors, such as the important role of the company owner as a trigger to achieve commitment to fulfil the requirements set by Lean. Social factors, such as building up a good relationship with the supplier’s owner need to be considered. Even if it is uncommon to do this in western business culture, international companies need to allocate time and resources to consider the importance of these social factors within China in order to improve Lean implementation in China. The importance of relationships in the Chinese business world has been discussed a lot in the literature. But as the study showed, especially because of the manufacturers’ dependency on reliable JIT delivery, close cooperation and a good relationship need to be maintained before the price negotiations meetings with the suppliers.

9.2.3 Practical implication with regard to market conditions

Giving recommendations for overcoming the barrier ‘Market conditions’ is problematic. Companies who act as product suppliers have very limited chances to change customs within the Chinese market place in general and their customers in particular. However, suppliers may have the chance to overcome some issues. For example, the last minute changes of requested products by the customers may be avoided when suppliers work closely with Chinese manufacturers. Lean suppliers need to offer their support and Lean knowhow to help the manufacturer make his demand forecasts more reliable. Time and potential knowledge loss may be threats to the supplier’s face. However, synchronising the suppliers’ production system with the customer’s will bring benefits to both parties. Moreover, convincing the customer to become Lean may give the Lean supplier an advantage over local suppliers who do not use Lean principles.

Certain barriers caused by synchronisation difficulties when the supplier uses Lean and the customers do not follow Lean principles may remain, however, because suppliers have very limited chances to dictate their customers what production system they should use. However, close cooperation with Chinese customers may be beneficial in order to actively convince the customers that restructuring their production system towards Lean brings significant benefits to them. A close cooperation may allow suppliers to show the advantages within their production system achieved by Lean principles. Showing their own success stories based on Lean might be a way to convince the Chinese manufacturer to follow Lean. However, it is not likely that manufacturers will give up their required safety buffers of supplier parts and close their consignment warehouses. The supplier must, step by step, try to build up the trust that a production without high inventory levels strengthens the reliability of the production system and will consequently gain benefits for both parties.

9.2.4 Practical implication with regard to lack of Lean knowledge

Overcoming the knowledge gap is a major challenge for companies in China. There is no question that Lean experts are needed when companies want to implement Lean. This raises the question how companies can get these experts. Recruiting Lean experts from overseas is an option, but creates problems. As shown in the study, besides the high costs, foreigners may have disadvantages when communicating their skills, and they are less aware of cultural issues. Chinese employees do have the advantage that they know how things are done in China traditionally. In view of how important the national context is for Lean implementation, this is an important skill.

An alternative option is to overcome the knowledge gap is for companies to establish a 'Lean implementation team' which acts as a departmental, independent Lean task force of foreign experts and Chinese employees. The local employees can here act as experts regarding the cultural context, whilst the expatriates contribute their Lean knowledge. This team structure may be good to support and consult other employees in different departments in terms of Lean expertise, and at the same time consider the role of the national context. The interdepartmental position of team members may help avoid barriers caused by hierarchy and power distance. The interdepartmental nature of the team would also allow the members to gain access to operators, to release the operators’ potential bottom-up improvements within Lean.

When recruiting foreign Lean experts, companies in China may try to recruit Lean experts from Singapore, Taiwan or Korea, who may also be aware of cultural and language issues to some extent. To recruit western experts, companies need to find innovative ways to recruit knowledgeable engineers. For example, HR departments may use the momentum among young western graduates to do an internship in China to build up career opportunities. Considering the economic situation within the southern European Union, engineers from this area may be a willing to take on the China adventure.

9.2.5 Practical implication with regard to intercultural communication

Intercultural communication issues apply mainly to foreign companies in China. However, as highlighted by this study, it is not just difficult for foreigners to get access to operators to communicate Lean knowledge, but management in local firms struggles as well to communicate with shop floor workers, due to the operators’ education gap and missing industrial experience. Moreover, practitioners need to be aware of national context factors such as ‘Generation 90’ which influence young workers. Close cooperation is needed to motivate and retain them. Chinese companies therefore need to find ways of overcoming the Chinese engineers’ attitude not to be responsible for getting involved in the dirty work operators do. Establishing flat hierarchical structures and building up reward system structures which connect engineers’ bonuses tightly with the CIP suggestions and contributions of their line operators may be one way of overcoming certain context factors which are closely interlinked with the barriers.

9.2.6 Practical implication with regard to work styles

To increase commitment of operators to follow instructions, maintain standards, and join in problem solving, it is crucial that companies invest in additional training programs. Even though through the high fluctuation rates there may be a threat of losing intellectual property and investment, building up a Lean understanding among shop floor workers is crucial enrolling bottom-up improvements.

The widely missing skills which are needed in the modern industrial production and missing experience of young workers require additional training. Companies first need to build up basic manufacturing skills such as quality awareness and building up a quality culture. Second, the Lean basics need to be taught in an appropriate manner to make operators aware of how crucial their role for the production system is. To achieve that, companies need to make sure that employees recruited for operator training do not only have a good ability to communicate (preferably in the operators' language), but they are able to provide assistance without showing their status. Foreign managers and other highly ranked individuals need to make sure that operators are not threatened by their positions. For example, German managers stated that by building up a personal relationship (Guanxi) with their subordinates, they were able to achieve the position where the subordinates were no longer shy, suggested improvements, and contributed to problem solving without being concerned about losing face.

When appropriate teaching schemes are adjusted, company executives also need to make sure that their engineers are aware that just by helping operators to develop an understanding of Lean principles, they can make them understand how important it is to follow the instructions given by the management. Engineers need to understand that technical adjustments are often not conducive to overcoming barriers, and that the root cause of the barrier often lies within the social system (operators' work styles).

These recommendations concerning the importance of social elements are not entirely new, of course, but have long been emphasised by the STS literature. However, it has not been pointed out that these components are also of practical relevance for the implementation of Lean in China. This insight provides a new and more fundamental argument for the importance of considering the social sub-system when implementing Lean. Because of the interrelations of the social components within the country context, the findings also underscore the view that it is essential to consider the national context factors when implementing Lean in China.

Regarding the lack of maintaining standards, even though the economic growth of China is fast and business opportunities seem to be of short existence, company executives need to allocate enough time to the shop floor to refine the process standards in the new country context. To roll out Lean with unrefined standards will lead to unreliable production processes and will consequently take more time in the long run.

Moreover, multinational companies which aim to roll out their company internal Lean production system globally need to be aware that certain elements may need to be adjusted to the national context. Within the ramp-up period, headquarters engineers should therefore be prepared for the fact that their assembly lines and production concepts, which were carefully designed and built within their home country, may need to be adjusted and party redesigned. Also, the technical support staff sent out from headquarters should work closely together with local engineers, to obtain insider information on how to make Lean standards work better in China. Support staff and local employees need to find a fine balance between adjusting the production system to the situation in China and retaining the global production standards set by headquarters.

9.3 *Limitations of the study and suggestions for future research*

Having outlined the implications of the study for practitioners, it is now necessary to highlight some of its limitations and offer suggestions for future research.

9.3.1 Transferability

The study relies on a qualitative case study methodology, which was dictated by its interpretivist perspective, and appropriate for exploring the under-investigated research questions. Qualitative methods also served to gain an in-depth understanding of the perceived mechanisms by which context factors led to Lean barriers, and of how these barriers affected certain Lean elements. However, results of qualitative case studies have their characteristic limitations regarding generalisability. They rely on future research to examine their transferability (See Lincoln and Guba, 2002). The presented Lean implementation model is based on case study research in two plants at two different locations in China. Therefore, its applicability to the context of other locations in China, other countries, and combinations of foreign firms and host countries is not yet known. Moreover, the applicability to other firms, and other industries apart from manufacturing has yet to be examined.

The study concludes that the geographical location of the two participating plants in China has no major influence on the implementation model. However, future research in different Chinese locations is required in order to investigate whether the model is applicable only across these two regions, or also in other regions in China. Lean implementation in other major cities, such as Beijing, and other inland, newly-developed industrial areas could be examined. The findings also do not allow for conclusions on their transferability to other countries. The study shows that there are parallels between the context of China and other emerging economies, namely Brazil, Mexico, and India, and that it is likely that parts of the model are transferable to these other countries. However, the study cannot provide evidence on whether the model is applicable to other countries or not. Future research in Brazil, Mexico, and India, as well as emerging economies such as Russia and the Ukraine should be conducted to examine which barriers and factors are of a generic nature and therefore also evident in other emerging economies, and which barriers are specific to the Chinese context. Moreover, a range of firm nationalities could be investigated. Rather than focussing only on a German firm, future research could investigate the model's transferability to firms headquartered in other highly industrialised nations including European countries, the US, or Japan.

Even when considering a similar geographical and national context, the applicability of the model to other types of firms is still in question. The case company was a multinational parts supplier within the automotive industry. If the research had been conducted at a big automotive (end) customer instead of a parts supplier, different barriers may have been found, or the same barriers may have been present in different ways. For example, the barrier 'Market conditions' which describes mainly interactions between the host company as a parts supplier and automotive (end) manufacturers, was in the present case described from the view of a parts supplier. Participants complained that the manufacturers in China requested their suppliers to store high levels of inventory as buffers in the suppliers' warehouses. This was, in the view of the supplier, in conflict with Lean and its JIT principles, because it created high levels of inventory ('waste'). The manufacturers' view on the barrier 'Market conditions' may have been different, because their internal inventory levels remained low and they were able to produce JIT. This example shows that a change of the company context may affect the barriers and consequently the applicability of the model. Future research needs to be conducted to see whether the barriers are transferable to such other company contexts. Different industries could then be included, as well service sectors, such as banking or health care.

9.3.2 Method triangulation

The research design allowed me to acquire detailed information about the influences of the context factors on the barrier. In line with the interpretivist nature of the study, the described mechanisms are based on the participants' perceptions. Most perceptions were also confirmed by other participants, which substantiates the mechanisms of influence between barriers and factors to some extent. It would be informative, however, to broaden this perspective by gathering data on causal relationships between the country context and Lean barriers from an outsider's perspective. Future research could gather external data, such as demographic data on worker characteristics, employee turnover rates and changes within the education system, to examine the mechanisms in more depth.

I chose mainly qualitative interviews, but also observations and documentation as data collection methods. This does not mean that quantitative measures have to be excluded from studies on this topic. The main variables that are part of the model, i.e. the context factors and barriers, and Lean elements, could be operationalised in a quantitative manner. Quantitative surveys could be applied at a later stage and would create a broader scope of data acquisition. Quantitative methods would also be beneficial because the time limitation of the interviews did not allow me to ask respondents whether, in their view, the barriers also apply to different contexts. Quantitative survey methods could further serve to investigate whether the mechanics by which context factors influence barriers are also perceived by different practitioners in different settings. It needs to be mentioned that quantitative data alone would not be sufficient for capturing the role of the national context in Lean implementation. For example, it is likely that in an expanded analysis, other context factors will be seen as influential. Qualitative methods then have to be applied to be flexible enough to examine new explanations and analyse the role of the newly-emerged factors in depth.

Future research could also benefit from extending the data collection methods through field observations. Due to industrial spying restrictions of the host company, and restrictions of time, I had to abandon the initial plan to conduct detailed observations in the company. Such observations would, however, allow for a more in-depth insight into some of the mechanisms by which context factors affect the barriers. For example, observations would allow for insights into workers' behaviour in the assembly lines. This would help, to deepen our understanding of how the operators change their behaviour when a hierarchically higher positioned person is present in the assembly line. Researchers may investigate whether the presence of managers prevent operators from indicating problems by using the Andon lights, for instance, if they are inhibited to indicate a mistake which they have made. Observations may thus be a way to further develop our understanding of barriers related to the behaviour of shop floor workers.

9.3.3 Research on operators' perspectives

The biggest part of interviews was conducted with employees from the middle management. To examine the implementation process in both cases even more closely, a high number of shop floor interviewees should ideally also be part of the sample. Several authors have stressed the importance of this employee group for Lean. For example, Aoki (2008), in his study of transfer of Kaizen to China, showed the importance of shop floor employees for a successful implementation of Lean principles. With regard to implementing Lean in emerging economies, Jun et al.'s (2006) study of TQM transfer to Mexican maquiladoras also stresses the importance of blue-collar workers within Lean. Interviewing shop floor employees would therefore help to acquire valuable data for my study.

As mentioned in the methods section (See 6.6.1), I was not able to conduct interviews with operators within working hours, because they followed a tight working schedule with one short lunch break in between. Moreover, operators lived off-site and were brought in and returned home by company buses straight after their shifts. I still managed to get slots booked with a few shop floor workers, but could not obtain usable data from these meetings, primarily due to the language barrier. Moreover, even with the help of a translator, the interviews undertaken were not successful. I had the impression that the operators felt intimidated and feared that they would lose their job if they mentioned barriers within the production.

Omitting shop floor worker as a sample restricted me in obtaining an inside view on barriers within the shop floor. Chinese language interviews are needed to get access to this employee group. By speaking Chinese, native Chinese researchers may have the chance to get first hand information from the operators. They should be researchers from an outside institution, and would need to avoid their hierarchical status giving concerns to operators. This may stimulate a greater degree of openness.

It needs to be mentioned that language barriers were not exclusively evident among shop floor workers, but also at the office level. Some Chinese participants had significant difficulties in speaking English. By adjusting the wording of the questions, and with the help of Chinese speakers, I was nevertheless able to make sense of their responses. However, it was difficult and at times impossible to gather the culturally-specific meanings of their replies. Many facets of the views on which role the cultural context plays may therefore not have been captured within my analysis. It was still possible to come to an overall view of office level employees' perceptions, but the language difficulties may have affected the depth of these findings. To overcome these issues, it would again be necessary to employ a Chinese speaker for conducting these interviews.

9.3.4 Longitudinal research

The majority of data was collected within a single research trip. It can be argued that some effects may have been overseen because the cases were not investigated longitudinally. Especially in cases when the message of the participants seemed to be ambiguous, a second data collection stage would have allowed me to question respondents more directly on emerging themes. Moreover, after the first interview stage, participants may remember the researcher's interest and become more sensitive towards barriers and the role of the national context. At the second interview stage, participants may, then, better remember personal experiences which they made in situations where barriers emerged, or the national context was seen as influential.

A longitudinal design would allow for re-investigating the respondents' perception on barriers and the national context after a certain time interval. If participants confirm their views again, this would strengthen the study results. Through a longitudinal approach, it would also be possible to observe transformations within the two companies and see how changes in the national context of China affected the Lean implementation over time.

The study also misses out a detailed exploration to which extent the national context of China is undergoing change. By conducting a case study with a single field trip where data were collected over a time period of two month the present study has clearly limitations to capture the change and direction of change of the national context of China and future development of the barriers as a consequence of that change. For example, collecting data which allow concluding if certain national context factors are getting more or less important in China over time is very limited when collecting data in a single field trip.

Despite the single data collection stage, it was still possible to pinpoint some changes that happened over time. Because of the differences in maturity of the two plants, it was possible to draw conclusions concerning the development of the less mature plant within the next years. By investigating very similar plants of the same host company, it was possible to compare a more mature plant to a less mature plant, and thereby patterns of development over time.

With regard to the barriers, some interviews indicated a tendency of the development of the certain barriers. Interviewees, who had worked for the host company for several years gave valuable insights into the development of the barriers and factors over the last couple of years. For example in the consideration of the barrier intercultural communication (Sub-chapter 7.3.3.2), interviewees stressed that communication difficulties were less evident when working with office level colleagues who were in their twenties or early thirties. They stressed that generally, their English language skills were better than those of older colleagues. Also, they found that the communication style of the younger generation was already more westernised which made inter-cultural communication easier. These comments may suggest that in the future, communication difficulties will become less evident. Another example was given in the consideration of the barrier work styles (Sub-chapter 7.3.4.2). Mature interviewees with several years of work experience pointed out that there are significant differences between worker behaviour of the recent generation and workers of the same age group several years ago. In the perception of some participants, there was a significant difference between the generation 70, 80 and 90 with regard to following orders and work motivation. They argued that most members of the 'Generation 90' grew up in a wealthier environment than the generations before them, which made them more reluctant to work hard. However, from participants' accounts like this, it is not possible to make assumptions about the work styles that future generations may show. Comparing the recent generation with the ones before does not mean that the behaviour of the next generation is predictable. Therefore, this example cannot be used to explore change over time with regard to the workers' behaviour. Moreover, these examples are only stated by certain individuals and may be not credible enough to allow for predictions of changes. By conducting a single case study, the possibilities to examine undergoing change and direction of the change within the national context are very limited. Moreover, the study does not collect data in a longitudinal design and therefore lacks empirical data which describe context factors or barriers over time. Therefore, a systematic exploration which provided details of change over time was not possible.

At the present stage, I hope that the study has had its value for examining barriers to implementing Lean production in China, for analysing the role of the national context, and contributing to the Lean literature. I have shown that research in this field is needed, and I have demonstrated how the developed implementation model China contributes to the gaps in the literature and the understanding of Lean barriers in the international context. It has yet to be examined whether the Lean implementation model can be applied in other contexts, and whether it should be extended or modified.

10 References

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11 Appendices

List of Appendices:

Appendix A

Appendix A - Interview guide (Early Version)

Introduction

Confidentiality, Research project of Loughborough University, Aims to find out what are barriers when implementing Lean in China. Can these barriers be explained by national context factors?

Permission to tape, Information will just use for the research. No names will be used. No transcriptions will be handed to the host company.

Feedback, you will get a feedback report of the findings of the main study.

Start of the Interview

"Face-sheet" question to contextualize data:

Name:

Place:

Number of years working with XXXX:

Number of year working in cooperation with China:

Time spent in China:

Position within the Company: Area:

Age:

How would you rate your knowledge about the principles of Lean production? (Training, work shop)

End notes:

Appendix A

Question 1:

"What are the main barriers when implementing the company's Lean production system?"

(How well does Lean work in China, compared to Germany?)

Can you give some examples of problems you had to face?

Probes regarding barriers:

Did you experience any problems regarding **XXXXXXX**?

Supply chain

Quality

Time planning

Inventory levels

Interaction styles

Work styles

Employee turnover

Education background

Management styles of Chinese or German managers

HRM resource practices

Question 2:

“Can you explain those barriers by the national context of China?”

How does the national context influence the barriers?

[Or: Do you think this problem has anything to do with the fact that the production takes place in China?}]

You mentioned that **XXXXXX** was a problem in China. Do you think this problem has anything to do with Chinese national context factors?

Communication (High & low context, Monochronic and polychronic)

Lack of technical experience

Guanxi , face

Work styles

Team work

Importance of titles

Economic factors

Central planned background

Agricultural background

Employee turnover

Ending

What has not been covered in the interview? Is there anything you want to mention?

Appendix B - Interview guide (Advanced Version)

Introduction

Confidentiality, Research project of Loughborough University, Aims to find out what are barriers when implementing Lean in China. Can these barriers be explained by national context factors.

Permission to tape, Information will just use for the research. No names will be used. No transcriptions will be handed to the host company.

Feedback, you will get a feedback report of the findings of the main study.

Start of the Interview

"Face-sheet" question to contextualize data:

Name:

Place:

Number of years working with XXXX:

Number of year working in cooperation with China:

Time spent in China:

Position within the Company: Area:

Age:

How would you rate your knowledge about the principles of Lean production? (Training, work shop)

End notes:

Appendix B

Question 1:

”What are the main barriers when implementing the company’s Lean production system?”

(How well does Lean work in china, compared to Germany?)

Can you give some examples of problems you had to face?

Probes regarding barriers:

Did you experience any problems regarding **XXXXXXX**?

Supply chain

- Supplier performance (reliability and predictable delivery),
- Local suppliers or overseas imports,
- Overseas delivery a problem?,
- Tax clearance procedures,
- Poor infrastructure,

Quality

- Quality same as in Germany?, Same rework rates & defect rates?
- Reasons for quality problems?
- Quality awareness? Lack of quality control?

Time planning

- Short term orientation,
- Rushed implementation (lack of time to refine production processes),
- Fighting fires rather than implementing Lean?
- How were deadlines treated,
- Delays (supplier side and internal)

Inventory levels

- JIT/batch production,
- Lack of JIT understanding,

Appendix B

Interaction styles

- Importance of interpersonal relationships (Guanxi network-building),
- The concept of face
- Communication (high low context / monochronic and polychronic)

Work style

- Monochronic and polychronic - how they perceive and manage time,
- Self-initiative (education system),
- Participation to improvements (Hierarchy),
- Team work (One Child policy, spoiled child syndrome),
- Project ownership / Responsibility (Company loyalty), Tolerance of untidiness,

Employee turnover

- Employee turnover
- Job change or Layoffs?
- Company loyalty, economic situation, high competition, iron rice bowl.

Education background

- Lack of general education (management level , operator level)
- Lack Lean specific knowledge (former Lean experience)
- Education system (dual System vs. theoretical education
- Background of operators (former experience with Manufacturing, technical knowhow).

Management styles of Chinese or German managers

- Operator empowerment,
- Hierarchical structure

HRM resource practices

- Poor employee training,
- Inadequate manning levels (Iron rice bowl)
- Inadequate empowered workforce

Appendix B

Question 2:

“Can you explain these barriers by the national context of China?”

How does the national context influences the barriers?

[Or: Do you think this problem has anything to do with the fact that the production takes place in China?] You mentioned that **XXXXXX** was a problem in China. Do you think this problem has anything to do with Chinese national context factors?

Communication (high & low context, monochronic and polychronic)

Tolerance of untidiness (quality issues, 5s)

Lack of technical experience

Role of interpersonal relationships, Guanxi network-building (avoiding to strain relationships, lack of individual empowerment, supplier accountability)

Infrastructure (supplier reliability-inventory, custom issues)

The concept of face

Differences in work styles (project ownership, responsibility)

Group orientation, Lack of team work (intercultural interactions)

Respect to age and authority (power distance)

Leadership or Management structures (hierarchical structures, empowerment)

Influence of the Communist Party

Poor infrastructure

Role of family

Spoiled child syndrome (Team work, missing discipline)

Importance of titles

Economic factors (fast economic growth)

Central planned background (Iron rice bowl, “just good enough” ideology)

Agricultural background (Lack of quality awareness)

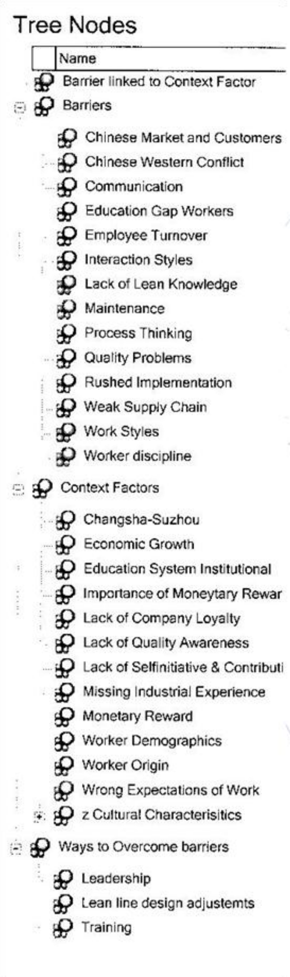
Education System

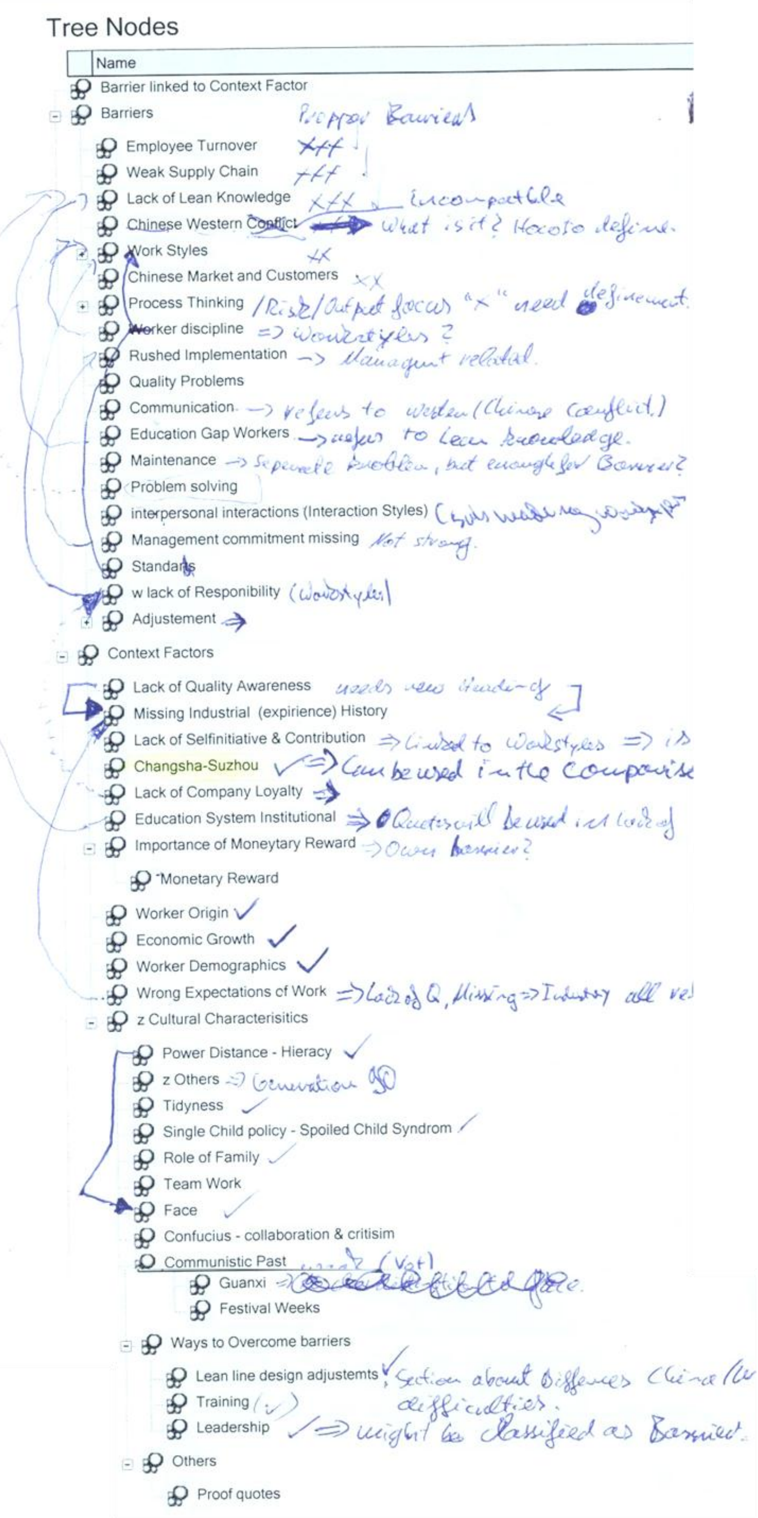
Employee turnover (multiple employment options)

In your opinion, what **works better** in China production plant? Which Chinese context factors were helpful in the implementation process.

Ending: What has not been covered in the interview? Is there anything you want to mention?

Appendix C – Coding tree





Appendix D – Participants list

Interviewe e code	Sex	Nation ality	Plant	Working years	German or Chinese work experience	Position	Responsibility	Lean knowledge	Working area	Personal commen ts
C1SUCD	M	Chines e	Suzhou	4 Years 9 Month	2 years study in Germany (Esslingen) and internship, Short term Customer visits	Team Leader	Test Technology, Sales Special Machinery	Not direct responsible	Machine builder	Deleted
C2SUWA	F	Chines e	Suzhou	6 Years	Occasional visits	Office worker	Expats and Interns Support, Recruitment of Operators, Technicians, Engineers, Office staff, Project managers	Not direct responsible	HR	Deleted
C1SUJX	M	Chines e	Suzhou	5 Years	Previous work in a German machine manufacturer in China, Several Visits to other plants in Germany	Group leader	Sales, Customer solutions, Lean line design, TPM, project calculation	Specialist for Lean line design	Machine builder	Deleted
C2SUTJ	F	Chines e	Suzhou	4 Years	No	Training supervisor (Office worker)	Training and people development (indirect labour)	Involved in Lean training	HR	Deleted
C1SUPJ	M	Chines e	Suzhou	4 (+2) Years	2 Years Work experience in Germany and studied in Germany	Senior Manager	ECU Mechanics Development, Process implementation	No record	Engineering	Deleted
C1SUZJ	M	Chines e	Suzhou	5 Years	No	Project supervisor,	Responsible for new product acquisition	involved in implementing Lean, Lean	Machine builder	Deleted

						(former planner)		guidelines		
C1SUCH	M	Chinese	Suzhou	5 Years	Studied in Germany	HR Director	Expert for employee turnover, investigated fluctuation and countermeasures	Not direct responsible	HR	Deleted
C1SUJK	M	Chinese	Suzhou	2 Years	No	Line leader (Shop floor)	Line support, supervision of operators, Attendance daily continuous improvement meeting	Involved in Lean improvements and problem solving	Shop floor	Deleted
C1SUSCM	M	Chinese	Suzhou	4,5 Years (+0.5 Years internship)	Several month working experience in leadplant in Germany	Supervisor	Electric design and Software management	Attendance of Lean workshops Lean trainings	Machine builder	Deleted
C1SULC	M	Chinese	Suzhou	5 Years	Several trips to leadplant in Germany	Team supervisor	product development, product functionality and fulfilment of customer requirement	Lean knowledge, limited in development applications	Manufacturing	Deleted
C2SULT	F	Chinese	Suzhou	1 Years	Visits to production lines in Germany	Lean line support	Support of Lean projects and problem solving (assembly lines)	Specialist for Lean line support	Manufacturing	Deleted
C2SULP	F	Chinese	Suzhou	3,5 Years	No	Technician	Spare part management	Not direct responsible	Manufacturing	Deleted
C1SUZF	M	Chinese	Suzhou	Not recorded	No (Several trips to Japan)	Technician/ Operator supervision	Ramp up new assembly lines, maintenance, managing operators	Lean knowledge	Manufacturing (internal machine supplier)	Deleted
C1SUZA	M	Chinese	Suzhou	5 Years	Overseas trips (not Germany, worked for	Production Manager/	responsible for new product launch, line set up,	Lean	Manufacturing	Deleted

					Delhi)	Group leader	process set up.	knowledge		
C2SUWP	F	Chinese	Suzhou	10 Years	Worked for 1 Year in the leadplant in Germany	Office worker	Former training coordinator (Expats living adjustment), translations (work instructions)	Not direct responsible	Manufacturing (internal machine supplier)	Deleted
C1SUZH	M	Chinese	Suzhou	2.5 Years	No (Several trips to Japan)	Engineer/ Lean supervision	Involved in standardization, quick changeover, TPM, supplier development	Lean supervisor	Engineering	Deleted
C1SUJB	M	Chinese	Suzhou	5 Years	Several trips to Germany for Lean expert trainings	Lean coordinator (Lean expert)	Responsible for plant wide Lean implementation	Lean expert training	Manufacturing	Deleted
C1SULB	M	Chinese	Suzhou	5 Years	Trips to more than 10 plants in Germany, Spain, France.	Lean Manager (Lean plant coordinator)	Lean trainer/workshop moderator. Lean audits, Lean project coordination	Lean expert training	Manufacturing	Deleted
C1SULJ	M	Chinese	Suzhou	8 Month	Several trips and work experience in North America with former employer	Lean supervisor/ Lean expert	Coordination of Lean activities	Lean expert training	Manufacturing	Deleted
F1SUFL	M	French	Suzhou	10 Years	5 Years working experience in China and Germany	Project Leader	Project Leader for Benchmarking	Lean knowledge	Strategic Management	Deleted
G2CHBG	F	German	Changsha	37 Years	6 Month in China, former trips	Project Leader	Production management, logistics, levelling	Several Lean trainings	Logistics	Deleted

Appendix D

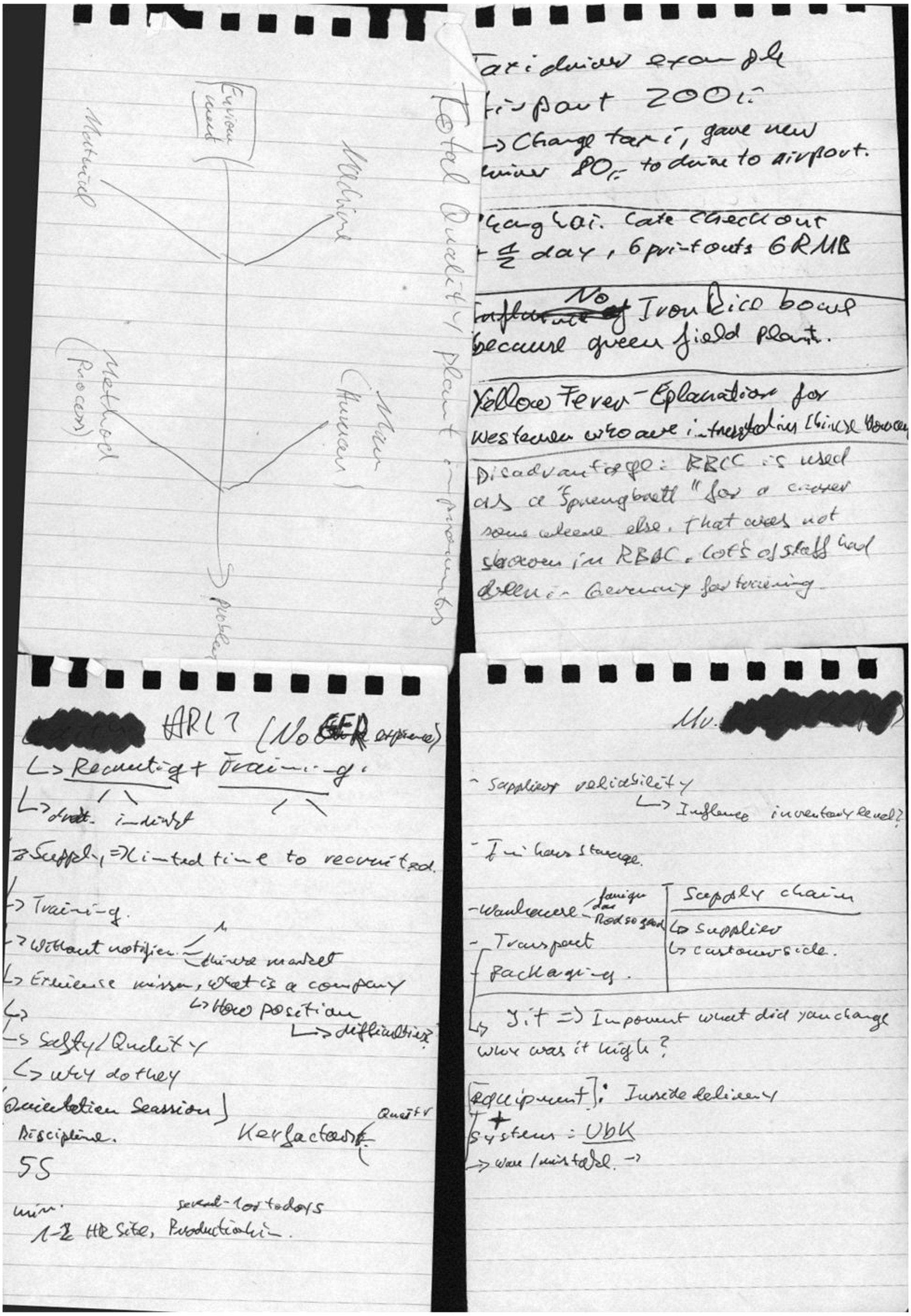
C1SUZN	M	Chinese	Suzhou	5 Years	Trips to Japan and Germany	Planning engineer	Responsible for Lean implementation within the department	Several Lean trainings	Manufacturing	Deleted
G1CHGJ	M	German	Changsha	18 Years	2 Years China, no former trips	Department Manager	Group leader for production processes and quality	Several Lean trainings	Manufacturing	Deleted
C2SUHF	W	Chinese	Suzhou	1 Year 8 month	One trip to the German headquarter	Lean implementation manager	Responsible for Lean implementation within the shop floor (workers)	Several Lean trainings	Manufacturing	Deleted
G1CHBT	M	German	Changsha	24 Years	1,5 Years in China	Division Head	Managers of two major product divisions	Several Lean trainings	Manufacturing	Deleted
G1CHCB	M	German	Changsha	10 Years	3 Years	Department Head	Management and technical support	Several Lean trainings	Manufacturing	Deleted
G1CHDS	M	German	Changsha	7 month	7 month	Intern	Logistic support	Not direct responsible	Logistics	Deleted
G1CHTS	M	German	Changsha	5 Years	2 Years Study, 3+ years work experience in China	Group leader	Cost controlling	Not direct responsible	Purchase	Deleted
G1CHRW	M	German	Changsha	4,5 Years (+0.5 Years internship)	2 Years apprenticeships scheme, 2,5 years work experience in China	Maintenances worker	process controlling, preventive maintenance, general repairs & maintenance	Several Lean trainings	Maintenances	Deleted
C1CHKJ	M	Chinese	Changsha	2 Years	Studied in Germany	Project-Management	Project-Management	trainings	Project-Management	Deleted

Appendix D

G1CHJK	M	German	Changsha	2 Years	2 Years in China, former experience in Korea	Commercial Director	Responsible for all commercial purchase processes	Several Lean trainings	Purchasing	Deleted
G1CHBS	M	German	Changsha	1 Years	1 Year China	Office worker	Controlling-Reporter	Lean training	Controlling	Deleted
C1CHZH	M	Chinese	Changsha	5 Years	Several trips to the Headquarters	Department Head	Technical Management	Several Lean training	Machine builder	Deleted
G1SUNR	M	German	Suzhou	10 Years	3 Years China	Division Head	Technical Management	Several Lean training	Manufacturing	Deleted
G1SUFG	M	German	Suzhou	13 Years	5 Years China	Head Training centre	Technical Education	Several Lean training	Education	Deleted

For confidentiality purposes and restrictions in space some parts and details of the original table are deleted.

Appendix E – Field notes



Total Quality / plant improvements
Environment
Machine
Material
Method (Process)
Man (Human)
problem

Taxidriver example
Airport 200 Y
-> Change taxi, gave new driver 80 Y to drive to airport.

Shanghai. Late checkout
1/2 day, 6 printouts 6RMB

~~Influence of~~ No Iron Rice bowl
because green field plant.

Yellow Fever - Explanation for westerner who are interested in Chinese women

Disadvantage: RBCC is used as a "Sprungbrett" for a career some where else. That was not shown in RBAC. Lot's of staff had been in Germany for training.

[redacted] HRL ? (No ~~Chi~~ EER experience)
-> Recruiting + Training.
-> direct indirect
=> Supply, => limited time to recruited.
-> Training.
-> Without notification - Chinese market
-> Experience mission, what is a company
-> How position
-> difficulties
-> Safety / Quality
-> why do they
[Orientation Seassion]
Discipline.
5S
Kerfactors Quality
min. several-1or todays
1-2 HR Site, Production.

Mr. [redacted]

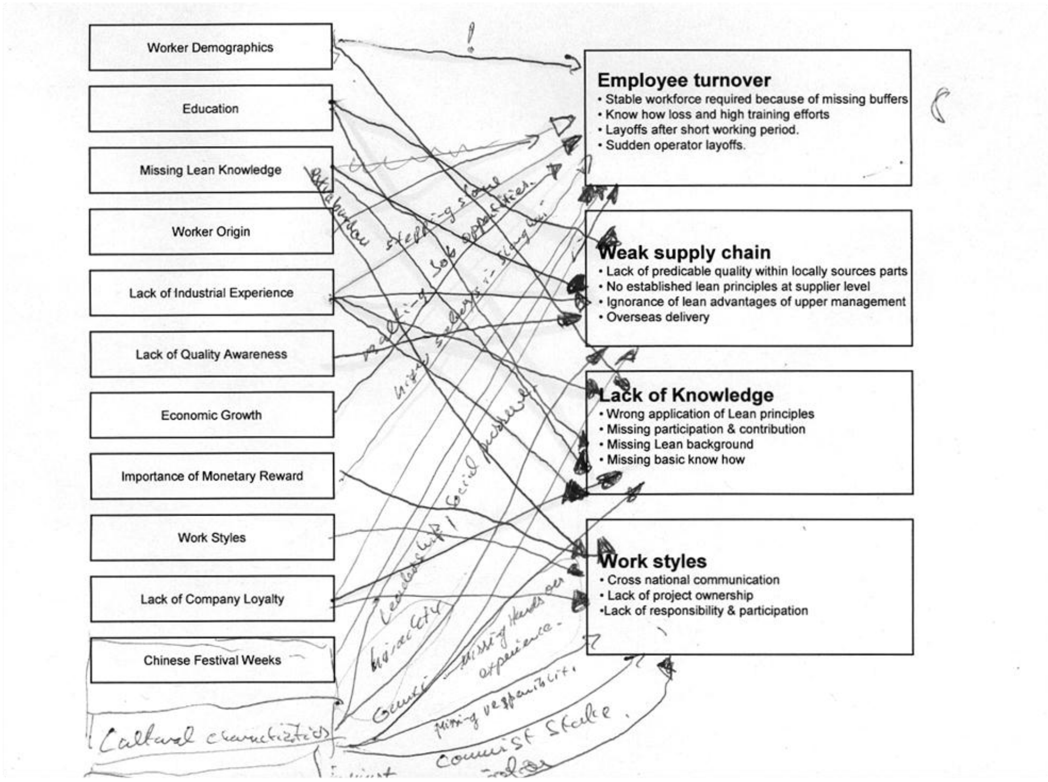
- Supplier reliability
-> Influence inventory level?
- In house storage.
- Warehouse - famique das Rodsogard
- Transport
- Packaging.

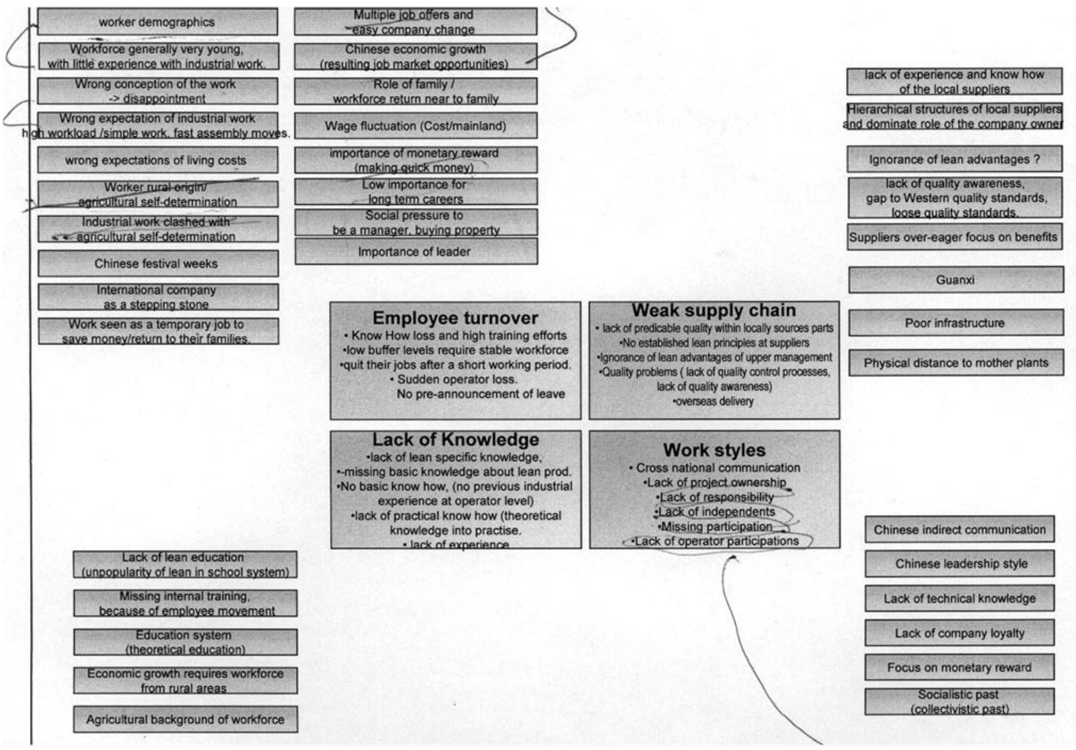
Supply chain
-> Supplier
-> customer side.

-> Jit => Inpowent what did you change why was it high?

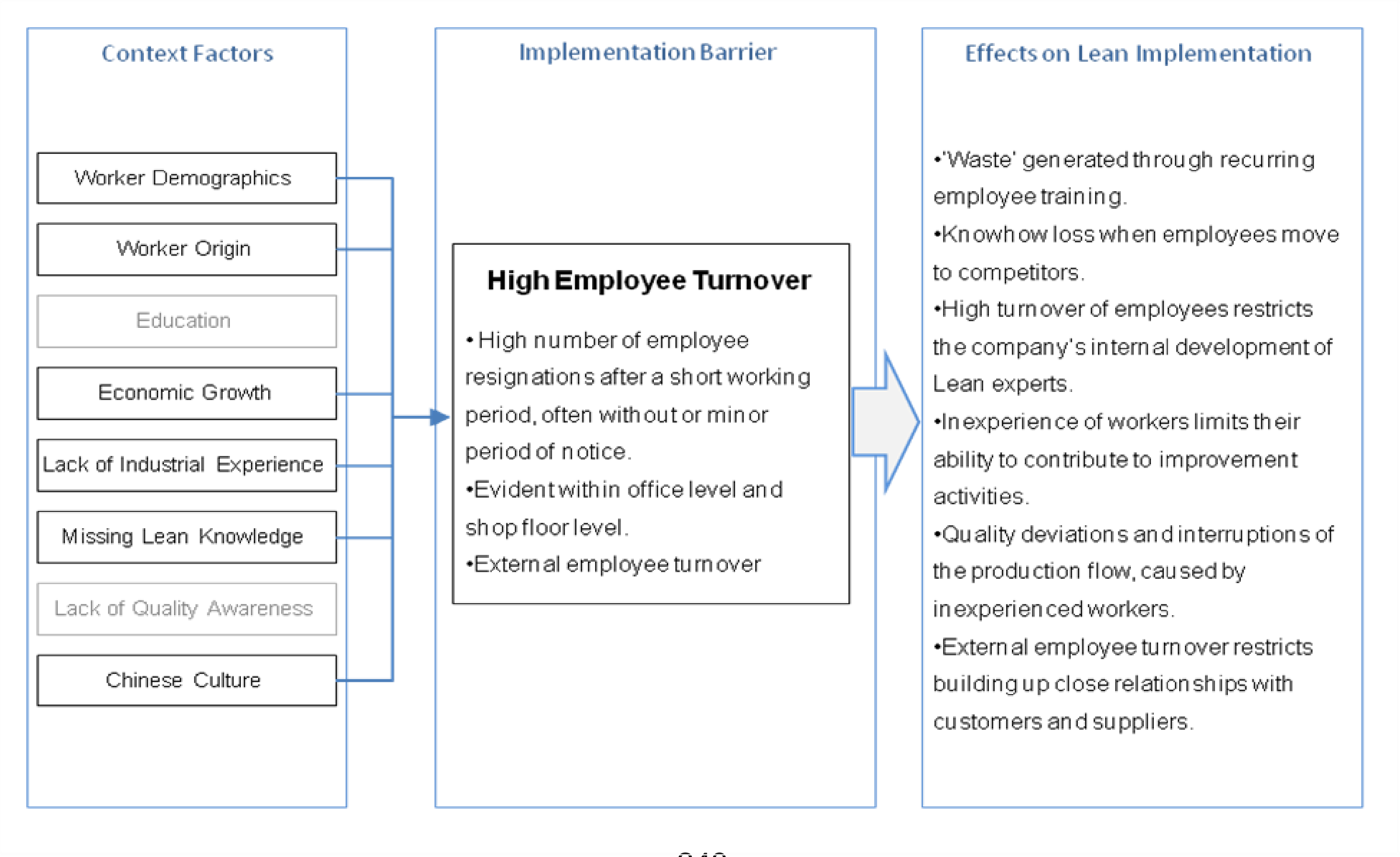
[equipment]: Inside delivery
+
System: UbK
-> was / mistake. ->

Appendix F – Model development

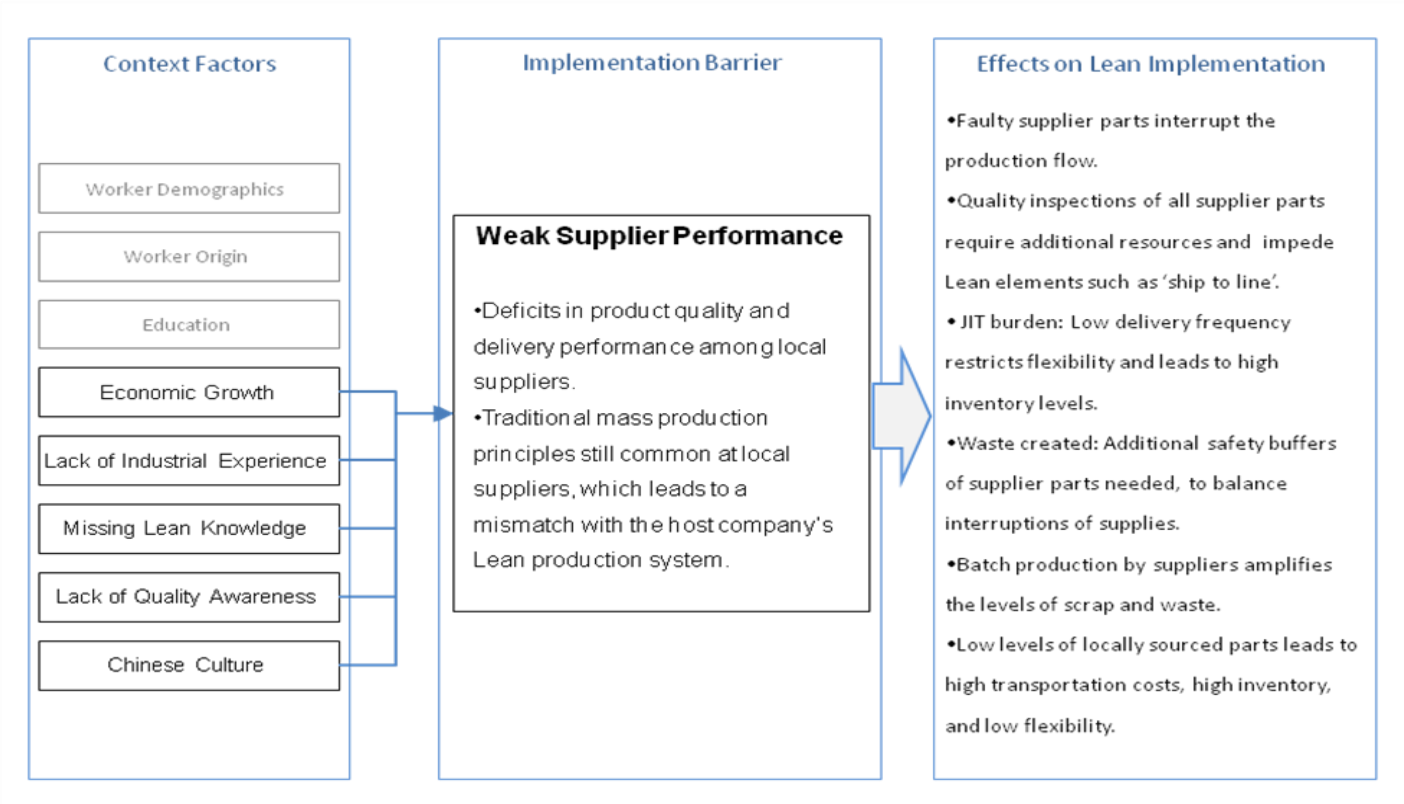




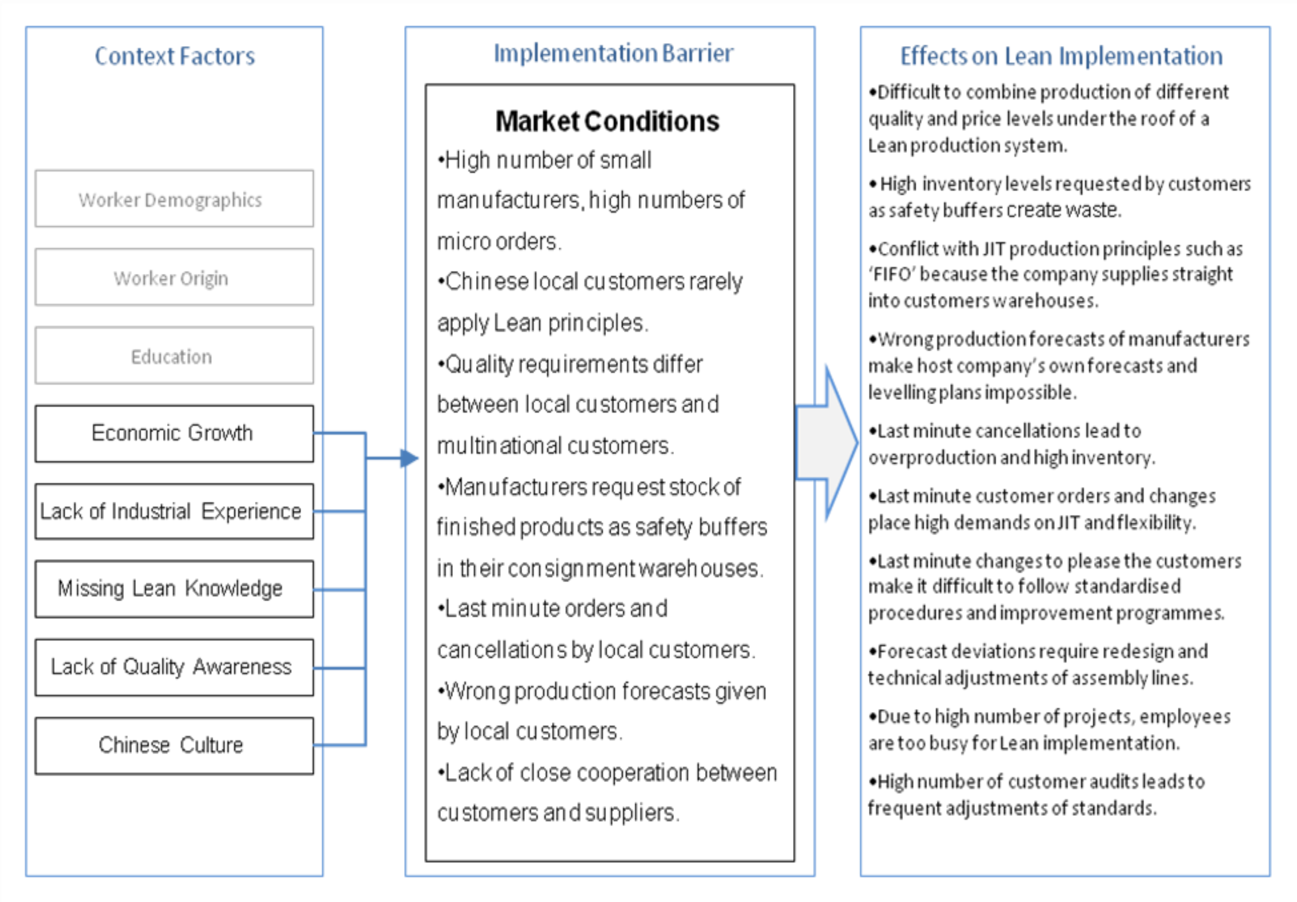
Appendix G – Implementation models (bigger versions)



Appendix G

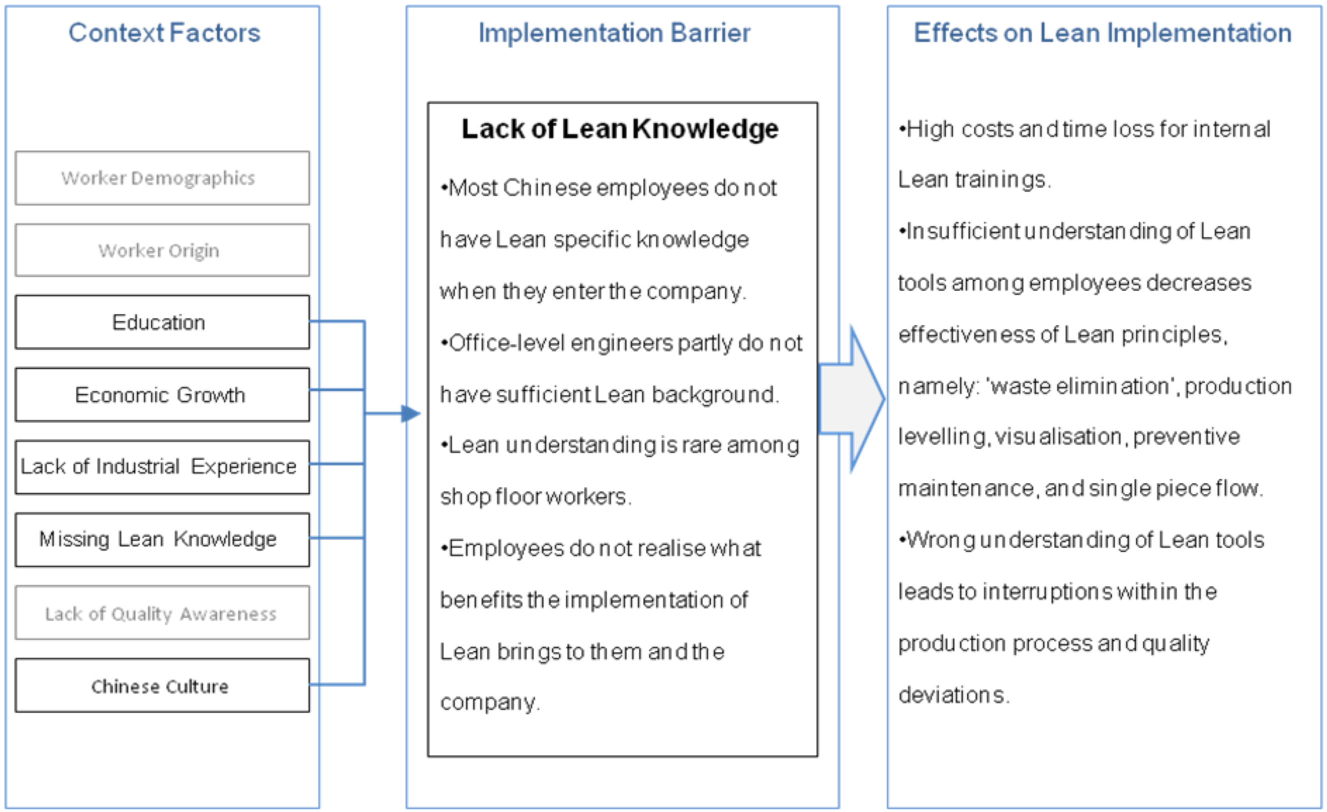

Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Weak Supplier Performance
•Deficits in product quality and delivery performance among local suppliers.
•Traditional mass production principles still common at local suppliers, which leads to a mismatch with the host company's Lean production system.
Effects on Lean Implementation
•Faulty supplier parts interrupt the production flow.
•Quality inspections of all supplier parts require additional resources and impede Lean elements such as 'ship to line'.
• JIT burden: Low delivery frequency restricts flexibility and leads to high inventory levels.
•Waste created: Additional safety buffers of supplier parts needed, to balance interruptions of supplies.
•Batch production by suppliers amplifies the levels of scrap and waste.
•Low levels of locally sourced parts leads to high transportation costs, high inventory, and low flexibility.

Appendix G

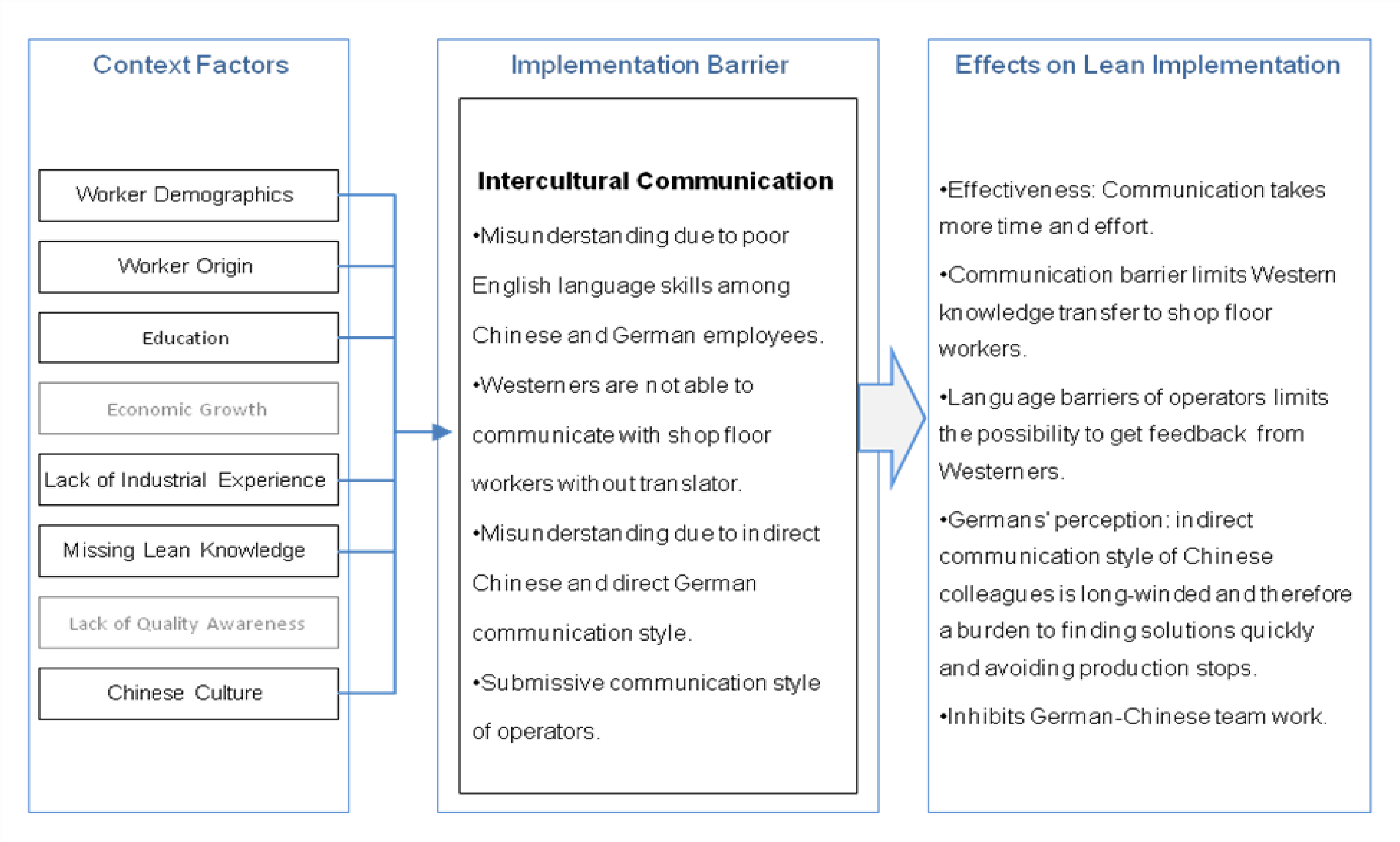


Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Market Conditions
•High number of small manufacturers, high numbers of micro orders.
•Chinese local customers rarely apply Lean principles.
•Quality requirements differ between local customers and multinational customers.
•Manufacturers request stock of finished products as safety buffers in their consignment warehouses.
•Last minute orders and cancellations by local customers.
•Wrong production forecasts given by local customers.
•Lack of close cooperation between customers and suppliers.
Effects on Lean Implementation
•Difficult to combine production of different quality and price levels under the roof of a Lean production system.
•High inventory levels requested by customers as safety buffers create waste.
•Conflict with JIT production principles such as 'FIFO' because the company supplies straight into customers warehouses.
•Wrong production forecasts of manufacturers make host company's own forecasts and levelling plans impossible.
•Last minute cancellations lead to overproduction and high inventory.
•Last minute customer orders and changes place high demands on JIT and flexibility.
•Last minute changes to please the customers make it difficult to follow standardised procedures and improvement programmes.
•Forecast deviations require redesign and technical adjustments of assembly lines.
•Due to high number of projects, employees are too busy for Lean implementation.
•High number of customer audits leads to frequent adjustments of standards.

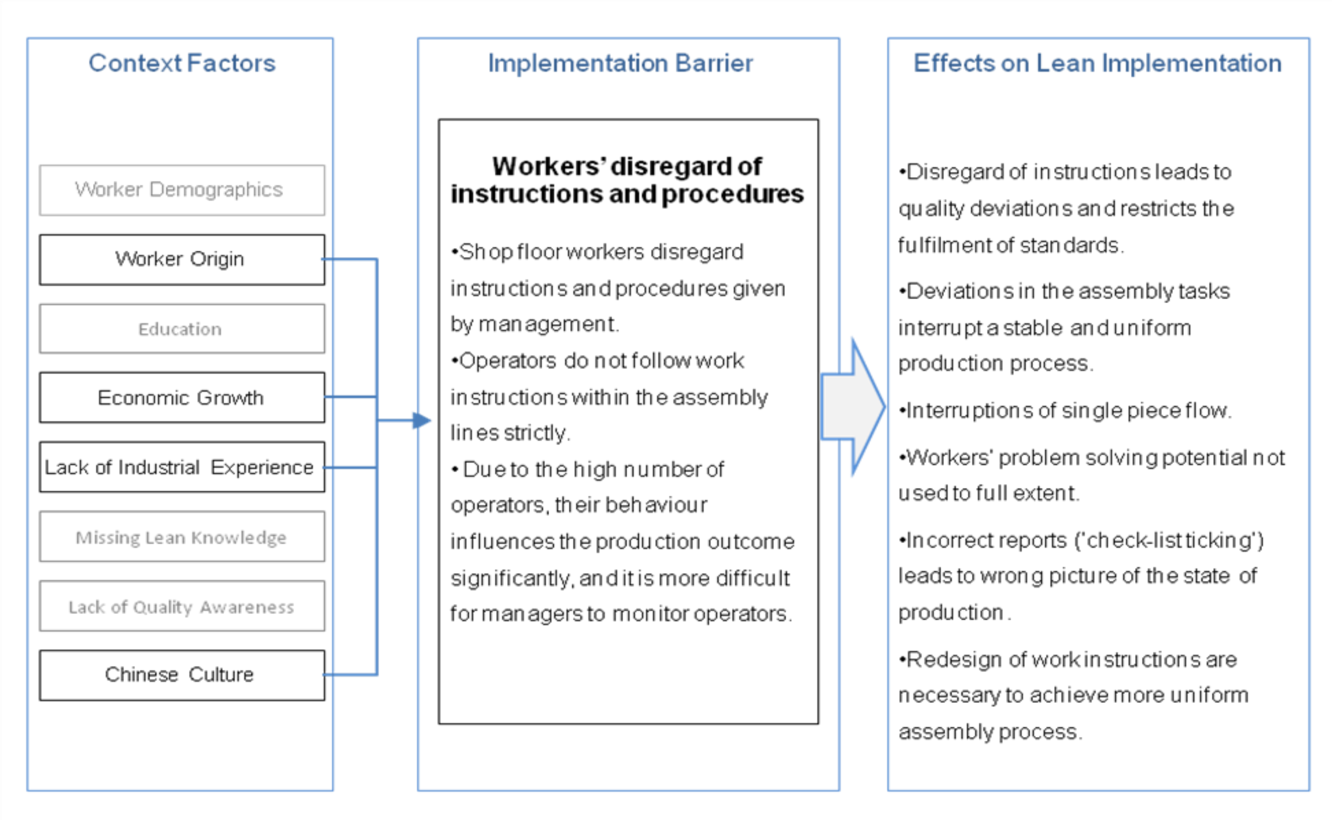
Appendix G


Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Lack of Lean Knowledge
•Most Chinese employees do not have Lean specific knowledge when they enter the company.
•Office-level engineers partly do not have sufficient Lean background.
•Lean understanding is rare among shop floor workers.
•Employees do not realise what benefits the implementation of Lean brings to them and the company.
Effects on Lean Implementation
•High costs and time loss for internal Lean trainings.
•Insufficient understanding of Lean tools among employees decreases effectiveness of Lean principles, namely: 'waste elimination', production levelling, visualisation, preventive maintenance, and single piece flow.
•Wrong understanding of Lean tools leads to interruptions within the production process and quality deviations.

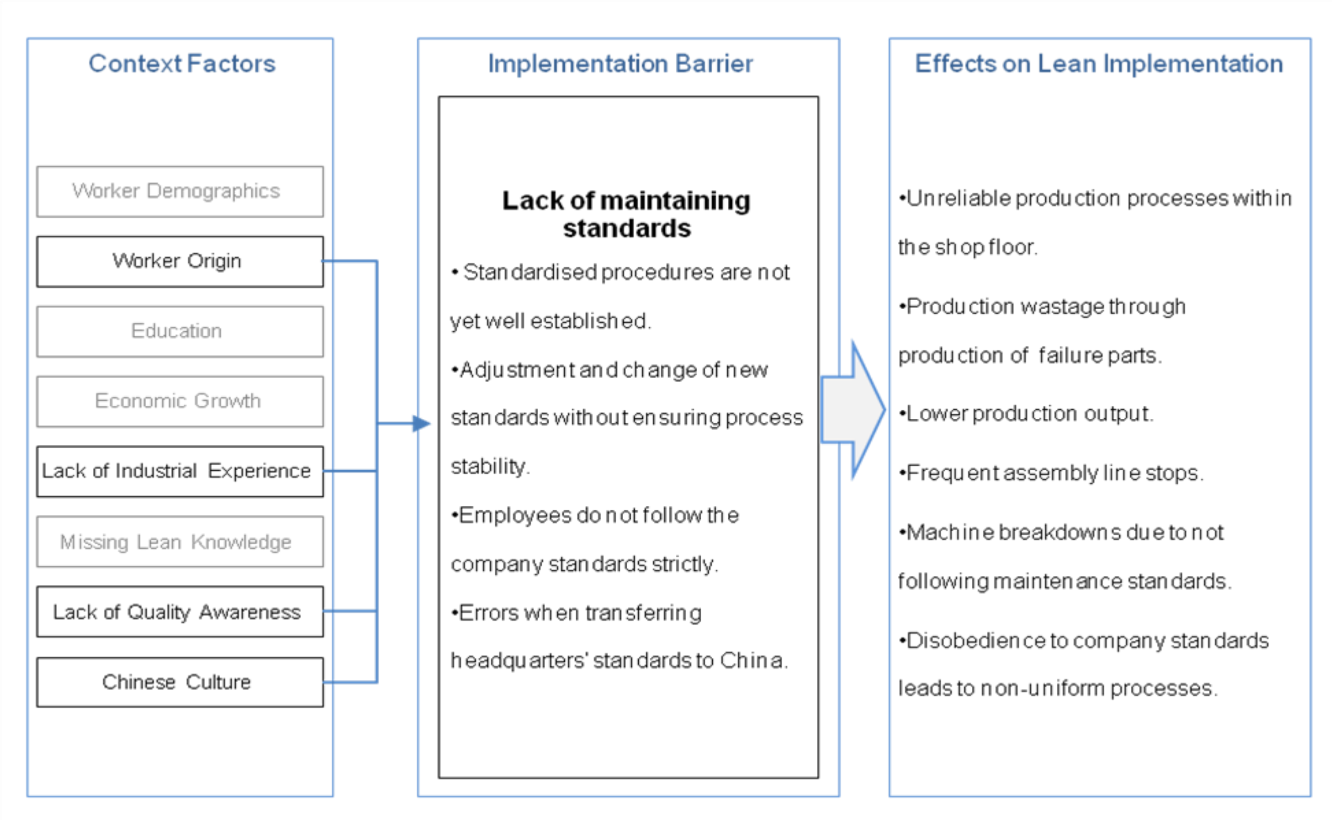
Appendix G


Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Intercultural Communication
•Misunderstanding due to poor English language skills among Chinese and German employees.
•Westerners are not able to communicate with shop floor workers without translator.
•Misunderstanding due to indirect Chinese and direct German communication style.
•Submissive communication style of operators.
Effects on Lean Implementation
•Effectiveness: Communication takes more time and effort.
•Communication barrier limits Western knowledge transfer to shop floor workers.
•Language barriers of operators limits the possibility to get feedback from Westerners.
•Germans' perception: indirect communication style of Chinese colleagues is long-winded and therefore a burden to finding solutions quickly and avoiding production stops.
•Inhibits German-Chinese team work.

Appendix G

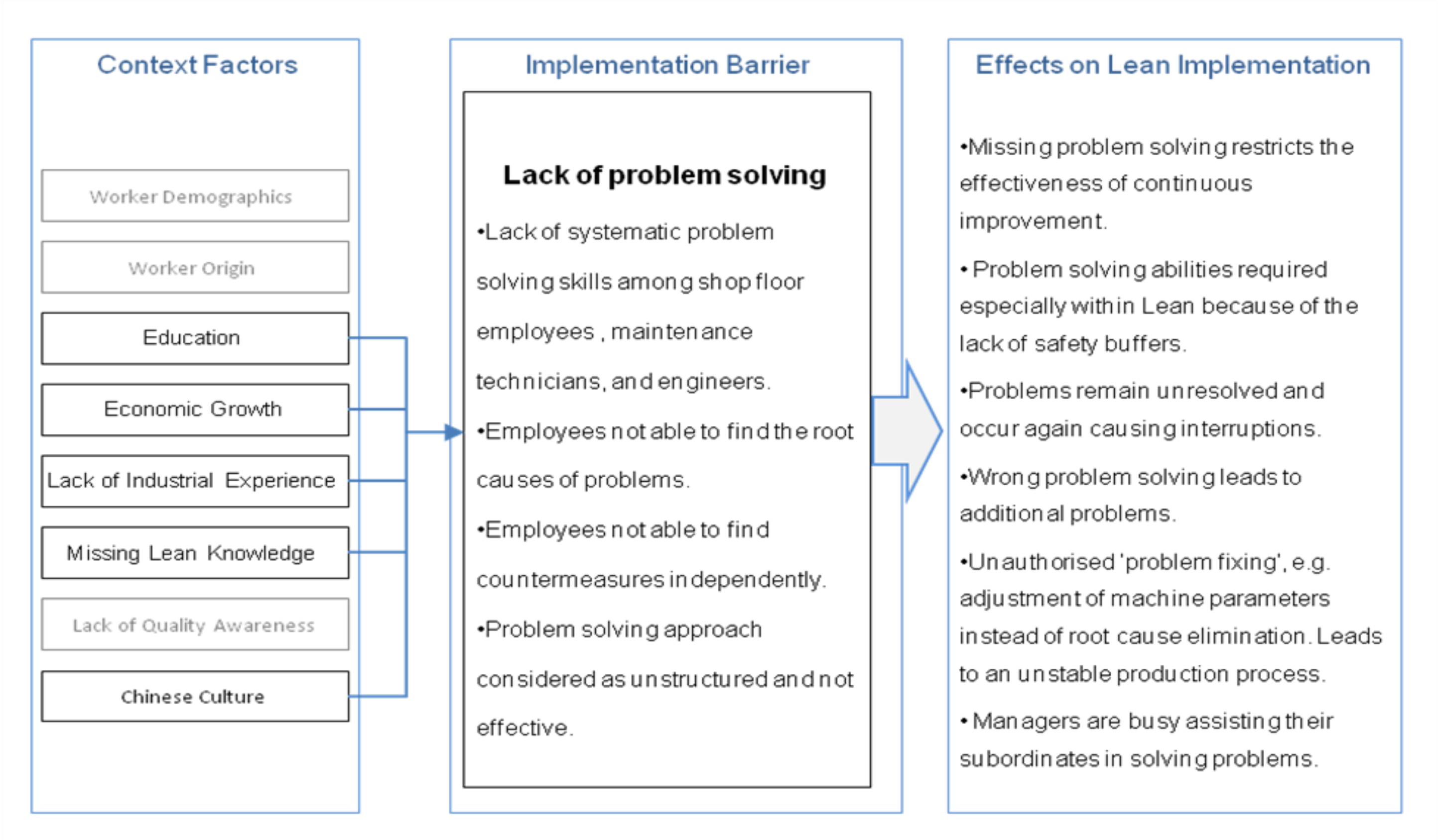

Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Workers' disregard of instructions and procedures
•Shop floor workers disregard instructions and procedures given by management.
•Operators do not follow work instructions within the assembly lines strictly.
• Due to the high number of operators, their behaviour influences the production outcome significantly, and it is more difficult for managers to monitor operators.
Effects on Lean Implementation
•Disregard of instructions leads to quality deviations and restricts the fulfilment of standards.
•Deviations in the assembly tasks interrupt a stable and uniform production process.
•Interruptions of single piece flow.
•Workers' problem solving potential not used to full extent.
•Incorrect reports ('check-list ticking') leads to wrong picture of the state of production.
•Redesign of work instructions are necessary to achieve more uniform assembly process.

Appendix G



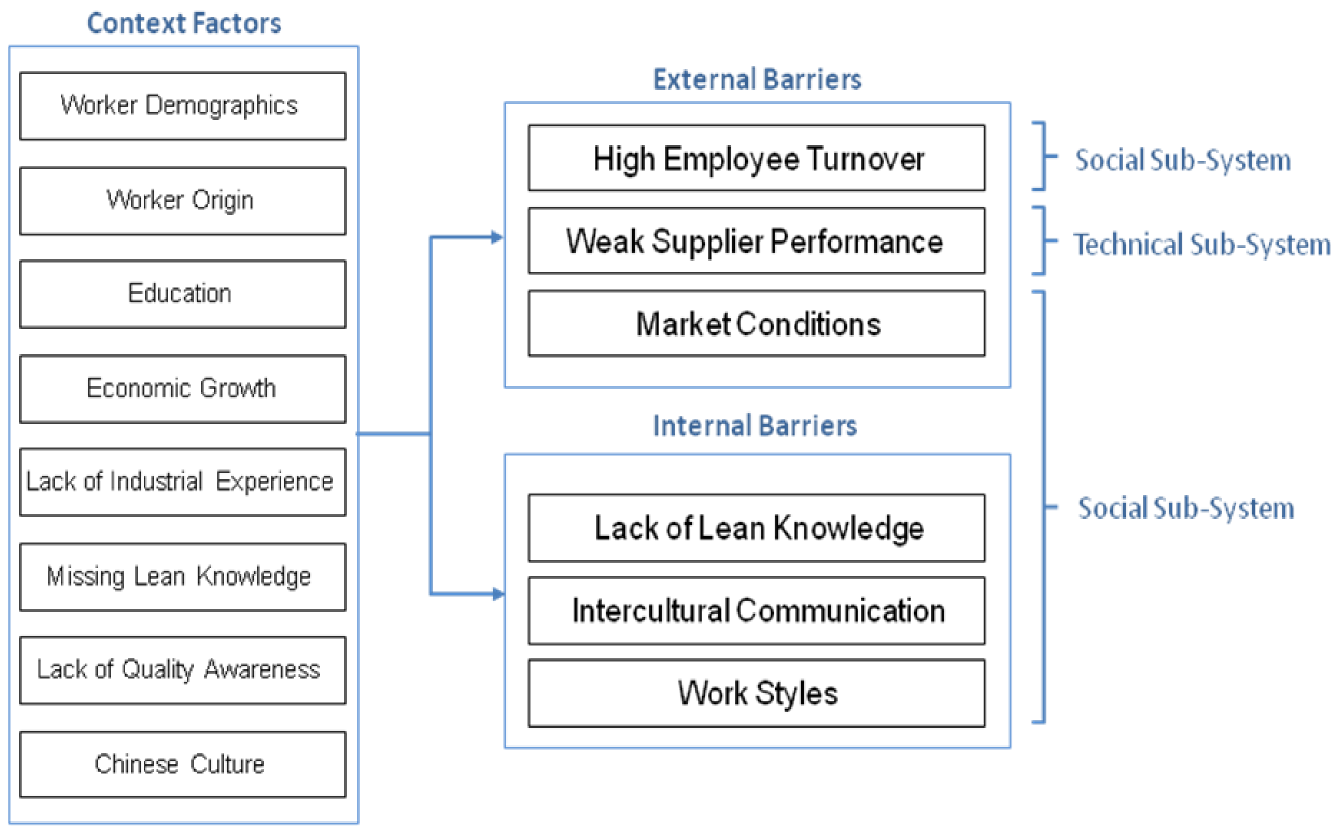
Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Lack of maintaining standards
• Standardised procedures are not yet well established.
•Adjustment and change of new standards without ensuring process stability.
•Employees do not follow the company standards strictly.
•Errors when transferring headquarters' standards to China.
Effects on Lean Implementation
•Unreliable production processes within the shop floor.
•Production wastage through production of failure parts.
•Lower production output.
•Frequent assembly line stops.
•Machine breakdowns due to not following maintenance standards.
•Disobedience to company standards leads to non-uniform processes.

Appendix G



Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
Implementation Barrier
Lack of problem solving
•Lack of systematic problem solving skills among shop floor employees , maintenance technicians, and engineers.
•Employees not able to find the root causes of problems.
•Employees not able to find countermeasures independently.
•Problem solving approach considered as unstructured and not effective.
Effects on Lean Implementation
•Missing problem solving restricts the effectiveness of continuous improvement.
• Problem solving abilities required especially within Lean because of the lack of safety buffers.
•Problems remain unresolved and occur again causing interruptions.
•Wrong problem solving leads to additional problems.
•Unauthorised 'problem fixing', e.g. adjustment of machine parameters instead of root cause elimination. Leads to an unstable production process.
• Managers are busy assisting their subordinates in solving problems.

Appendix G



Context Factors
Worker Demographics
Worker Origin
Education
Economic Growth
Lack of Industrial Experience
Missing Lean Knowledge
Lack of Quality Awareness
Chinese Culture
External Barriers
High Employee Turnover
Weak Supplier Performance
Market Conditions
Internal Barriers
Lack of Lean Knowledge
Intercultural Communication
Work Styles
Social Sub-System
Technical Sub-System
Social Sub-System

End