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Name	Marc Bollbach
Address	6, Radmoor Road, Loughborough LE11 3BS
Email	Bsmfb2@lboro.ac.uk
Institution	Loughborough University
Title of submitted paper	<b>Implementing Lean Manufacturing Techniques in China</b> A consideration of country-specific barriers to implementing lean manufacturing in China
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# **Implementing Lean manufacturing techniques in China**

## **A consideration of country-specific barriers to implementing lean manufacturing in China**

### **Abstract**

**Purpose** – The purpose of this paper is to provide a greater understanding of the implementation process of lean production in China. In particular, it will investigate the main barriers when implementing lean production in China. The aim is to evaluate if implementation barriers can be explained by Chinese national context factors.

**Design/methodology/approach** – Case studies of two auto-parts production plants of a German multinational company in China were used to evaluate lean barriers within China. During a two month research trip to China, sixty interviews with Chinese and Western employees were conducted to evaluate barriers when implementing Lean in China.

**Findings** – Strong evidence is found that Chinese context factors do significantly influence the implementation process of lean in China. The paper proposes the necessity for organisations to consider cultural, socio-political and economic context factors of China when applying lean principles.

**Research limitations** – The paper represents pre-results of the author's field work trip to China in Spring 2010. The research findings are based on selected interviews, field notes, and the author's recent fieldwork impressions. They should not be interpreted as in-depth analysed findings of the entire data set.

**Originality/value** – The fieldwork lead the author to develop a model of barriers which restrain the successful implementation of lean production systems in China. Beside a comprehensive compilation of barriers, the model indicates Chinese cultural, socio- and economic national context factors which may influence the implementation barriers.

## **Introduction**

The current economic crisis, intense competition and rising customer claims place high demands on industry. To meet those demands, global operating companies, and in recent times also many Chinese companies, use the established operational strategy of lean manufacturing, aiming to reduce inventory, enhance process efficiencies, and eliminate waste. Moreover, many companies set up manufacturing facilities in China to connect the manufacturing potential of China with the efficiency of the lean philosophy. This research will focus on the implementation of lean manufacturing in China. In particular, it will investigate the main barriers to implementing the Western approach to lean production in China.

How can lean production systems, that were refined since two decades in Western firms, be established successfully in China? China is an environment 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.

The paper will first give an overview of implementation barriers found in the literature on lean in emerging economies. The findings will be compared with implementation barriers found in the literature on lean in China. This is followed by a consideration of the research methodology. Subsequently, a preliminary model is presented which illustrates the main implementation barriers of the case study and relates them to national context factors. The paper ends with a summary and discussion of the findings.

## **Transfer of lean manufacturing activities to emerging economies**

When investigating the implementation of lean in China, it is important to consider other emerging economies. Besides the Peoples Republic of China, other emerging economies also try to benefit from the flexible and high productive Lean production system. Based on similar country context factors of China compared to other emerging economies, it is likely that there are parallels between barriers when implementing lean manufacturing in emerging economies and China. A comparison of similarities or differences of implementation barriers in China and other emerging economies might help to determine barriers which are country specific.

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

In the review of the literature on Lean implementation in emerging economies, a high number of different barriers were found.

However, the literature lacks detailed descriptions and evaluations of barriers, most authors do not evaluate many of the mentioned barriers in much detail. Only a few

authors explain the cause or the wider background and consequences of these barriers, but without providing strong evidence.

In the following, implementation barriers in Mexico, Brazil and India will be presented. The review provides an overview of the main examined barriers when applying Lean in manufacturing plants in emerging economies. The barriers are divided into barriers within the technical sub-system and barriers within the social subsystem. 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 & Bruun, 1998; Shani et al., 1992). Therefore this distinction is important and helps to focus attention to both parts, the social and the technical subsystem. Both are likely to be influenced by the economic context (e.g. state of technology due to former state owned enterprises), and the socio-political context, (e.g. education of workers) but in different ways. Moreover, the social system is likely to be more strongly influenced by the cultural context, regarding values, beliefs, norms than the technical system.

According to the literature, the main barriers within the technical sub-system include: **(1) Weak Supply Chain**; addressed by studies conducted in Mexico (Kenney & Florida, 2004; Mefford & Bruun, 1998), and Brazil (Wallace, 2004). As major explanations for the weak supply chain, these authors named the lack of qualified local suppliers and the related dependency of assemblers on overseas imports. **(2) Lack of Quality Control**; several authors addressed the inability to produce products within quality requirements of a production plant, including lack of quality awareness, lack of maintaining quality standards, lack of monitoring and ensuring product quality during the production process (Kenney & Florida, 2004 (Mexico); Seth & Tripathi, 2005 (India) ). **(3) Poor Inventory Management** of manufacturing plants was indicated as a further barrier to implementing lean. Several authors reported lacks in terms of how resources are managed and organized. High levels of inventory were reported by Wallace (2004) in Brazil and in Mexico by Kenney and Florida (2004).

Barriers within the social sub-system included: **(1) Education Gaps** within the local workforce; Studies in Brazil (Wallace, 2004; Humphrey, 1995), Mexico (Mefford & Bruun, 1998; Kenney & Florida, 2004; Galperin & Lituchy, 1999) and India (Seth & Tripathi, 2005) reported an enormous gap between education and skill demands of modern production systems. **(2) Employee Turnover**; studies conducted in Brazil (Wallace, 2004; Humphrey, 1995) and Mexico (Kenney & Florida, 2004; Mefford & Bruun, 1998) indicate that high employee turnover acted as a barrier when implementing lean principles. **(3) Work styles**; Mexican case studies, by Kenney & Florida (2004) and Mefford & Bruun (1998) reported high absenteeism and a lack of responsibility and activity of the Mexican workforce as a barrier. It is surprising that not more evidence was found on particular work styles acting as barriers. It is likely that the rural origin and consequently a missing industrial experience of shop floor workers in emerging economies also hinder the implementation process. **(4) Human Resource Practices**; several authors who conducted studies in Latin America and India reported that poor employee training practices restrained the lean implementation (Humphrey, 1995 (Brazil), Kenney & Florida, 2004 (Mexico); Mefford & Bruun, 1998 (Mexico); Dhandapani et al., 2004 (India)). The authors explained HRM barriers by the fact that companies provided little training for those in production jobs.

The review could provide an overview of the main examined barriers when applying lean manufacturing in emerging economies. At a later stage, the findings will be used for a comparison with implementation barriers within China. It may be possible to categorise barriers which are universally significant for emerging economies and barriers which are China specific.

### **Transfer of lean manufacturing to China**

In the following, implementation barriers in China are presented. By reviewing publications regarding barriers that different authors indicated, the review provides an overview of the main barriers to applying Lean in manufacturing plants in China. Like in the literature review on lean in emerging economies, the authors did not evaluate many of the mentioned barriers in much detail.

As main barriers within the technical sub-system, the literature on lean in China provided: **(1) Lack of Quality Control**; several authors addressed poor quality control E.g.: Poor quality control (Aoki, 2008), high defect rates and high repair rates (Aminour and Woetzel, 2006; Paolini et. al, 2005), “output-first mentality” (Oliver et al. 1998), underdeveloped operations management (Lee, 2004). The authors explained the lack of quality control by a lack of quality awareness and “relaxed” internal quality standards. **(2) Weak Supply Chain**, the term describes the lack of supplier performance in the form of predictable quality and predictable delivery. A lack of supplier reliability and the dependency of Chinese assemblers on overseas imports was mentioned by Comm & Mathaisel (2005) Taj, (2005), Oliver et al. (1998); Paolini et. al, (2005) and Lee, (2004). **(3) Inadequate Time Planning**, comprising all barriers related to timing. Several authors mentioned that short term orientation, rushed Lean implementation, and a lack of time to refine operations is in contrast with the long term goals of lean production (Comm & Mathaisel, 2005; Chen & Bo, 2008; Aminour & Woetzel, 2006; Oliver et al. 1998; Paolini et. al, 2005; Chin & Pun 2002). **(4) Poor Inventory Management** was mentioned as a barrier to apply lean manufacturing in Chinese plants. Several authors reported waste in the form of high levels of inventory (Aminour & Woetzel, 2006; Comm & Mathaisel, 2005; Taj, 2005, Oliver et al. 1998; Lee, 2004).

As barriers within the social sub-system, the authors named **(1) Interaction Styles**; in particular, the concept of “Guanxi” was addressed. Authors reported that connections between social relationships and business transactions might act as barriers to lean implementation (Oliver et al.,1998; Paolini et. Al., 2005). **(2) Education Gap**; another main barrier mentioned was the education gap of the Chinese workforce. Several authors named a low level of education, missing experience of the workers, a lack of skills in the local management ranks and deficits in internal trainings as major barriers to lean manufacturing (Brown & Rouke, 2007; Aminour & Woetzel, 2006; Oliver et al. 1998; Paolini et. al, 2005; Cin & Pun, 2002; Lee, 2004). **(3) Work Styles**, as part of the workforce characteristics, play a key role in applying lean manufacturing in China. Several authors addressed the lack of self-initiative and little participation of the workers as a barrier (Taj, 2005; Aoki, 2008; Chen & Bo, 2008; Paolini et. al, 2005; Lee, 2004; Chin & Pun, 2002). **(4) High employee turnover**, as a function of the job market, was reported as a barrier. Several authors reported that because of high recruitment costs and extensive employee training, high employee

turnover is critical for a successful lean implementation (Brown & Rouke, 2007; Taj, 2005; Aoki, 2008; Aminour & Woetzel, 2006; Paolini et. al, 2005).

The review of lean related research conducted in China could provide an overview of the main examined barriers when applying Lean manufacturing in China. It was possible to categorise the barriers found in China in a similar manner as the barriers in emerging economies. Regarding barriers within the technical sub-system the review found evidence for a weak supply chain, lack of quality control, and poor inventory management time planning for all of these countries.

Regarding the consideration of the social sub-system, the review found that, besides the education gap, employee turnover, work styles, and interaction styles act as a barrier in China. Interaction style is a barrier which was mainly China specific. China specific interaction styles such as the concept Guanxi play a significant role when applying lean in China. The importance of Guanxi-connections for empowerment of individuals and maintaining the relationship of an organisation and the state bureaucracy were mentioned as a barrier only in the context of China.

Hence, most of the barriers found in the literature are significant for emerging economies as well as China. This does not come as a surprise, given the similar economy context factors in China and the emerging economies, such as a turbulent macro environment, low education levels and poor labour. However, based on the small number of publications in this field of research, not enough evidence is found to draw country specific conclusions from the literature.

However, the reasons for the barriers are not necessarily identical in China and the other examined emerging economies. For example, high employee turnover might be generally grounded in multiple job opportunities. However, in China, the movement of workers between the commuter belt and the rural regions in the West might also be a reason. This example shows that the root causes of the barriers might be very different. To impose countermeasures to overcome these barriers, it is important to establish whether barriers can be explained by Chinese context factors.

## **Methodology**

A case study methodology was used to examine barriers to implementing lean principles in two plants of a German automotive supplier in China. The study also aimed to examine whether implementation barriers can be explained by Chinese context factors. Multiple-case sampling was used to strengthen the confidence of findings (Miles&Hubermann, 1994).

**Research Setting** - The Research site was a German automotive supplier who has been represented in China for several decades and has set up several plants around China. For a number of years, the firm's headquarters has made an intensive effort to implement the company's own lean production system worldwide. Two sample plants were selected. Both plants produce similar electrical components for automobile manufacturers. The seniority and location of the participating plants are different. One plant was set up around ten years ago and is located in an industrial park in Suzhou, near Shanghai. The second plant was set up around five years ago and is located in Changsha, i.e. inside the mainland around 1000 kilometres away from the coastal commuter belt of China.

We limited the sample to two partly similar production plants of the same multinational company in order to look at similar production systems (e.g assembly line design, employee numbers) and the similar lean-support by headquarters. By keeping the influence of the product and firm stable, we were able to investigate the influences of the different location and seniority of the plants. The fieldwork showed that the mature plant in Suzhou 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. The plant in Changsha had recently set up new production facilities and was still defining its operations.

**Data Collection Method** - The findings are based on the author's two month long fieldwork trip in China in March to May 2010. In the field research, qualitative interviewing was chosen as the main method of data collection. This was based on the following intents:

- The flexibility given by interviews is in line with the study, where no established conceptual or empirically grounded model could be used.
- Qualitative interviewing enabled the author 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.
- Semi-structured interviewing enabled the researcher to draw conclusions when participants were not aware of all barriers or certain context factors. Especially when workers did not have detailed lean knowledge to explain barriers, or if Western interviewees were not aware of certain Chinese context factors.

**Participants** - During his trip to China, the author conducted 60 semi-structured in-depth interviews with 16 Western and 15 Chinese employees in Changsha, and three Western and 26 Chinese employees in Suzhou.

Hierarchical levels included top management (e.g. Plant GMs, heads of plant operations), middle management (e.g.: department heads, line managers), and shop floor employees (e.g.: line leaders, maintenance staff, operators). However, the majority of interviews were conducted with the middle management such as production managers whose work was directly linked to the lean implementation process. Therefore, the majority of interviewees had hands on experience when working with lean principles. The interviews with Chinese participants were conducted in English and those with German employees were conducted in German. The duration of each interview was between 30 and 45 minutes, with an average of 36 minutes.

The interviewees were asked for their own opinion on what the barriers are to implementing the company's own lean production system. In addition, the interviewees were asked if they thought that some barriers are related to the Chinese context.

To assist the researcher, an interview guide was designed which included themes which were likely to emerge. Key words from the guide were brought in when interviewees did not speak about frequently mentioned themes. The guide was continuously adjusted when unexpected themes emerged in subsequent interviews.

**Data Analysis** - The data analysis is based on a cursory review of some selected interviews, important quotes, field notes, and the author's recent fieldwork impressions. From these data, the author summarised the main barriers to lean implementation and linkages of barriers and context factors. The paper presents preliminary results of research trip, a detailed analyses of the interview data will follow at a later stage.

The cursory analysis of the field work findings gave important insights into barriers within the lean implementation process. Findings could be transformed into a broader, preliminary model highlighting implementation barriers in relation to national context factors. This model helps to classify which barriers are country specific. Figure 1 presents the outcome of this process. The model will proceed with the analyses.

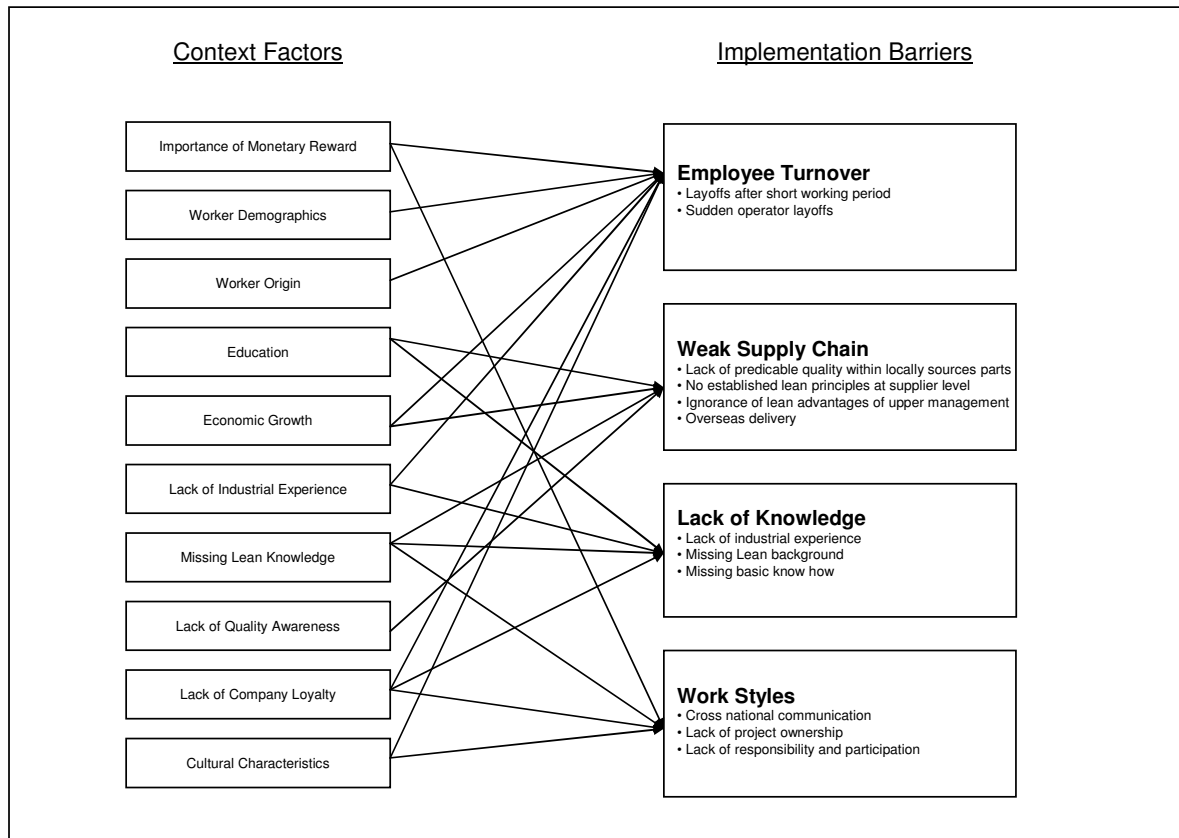


## Lean Implementation Model - China

When asking the interviewees about challenges of implementing Lean in China, the interviewees addressed a variety of barriers. The model shown in Figure 1 illustrates the four main barriers and their relationship to context factors.

**Figure 1**

### Relation between National Context Factors and Implementation Barriers



## Content of the Lean Implementation Model – China

### Employee turnover

Lean production places high demands on the workforce. People need to see waste and solve problems at the root cause (Liker, 2004). Even shop floor workers need to be able to identify minor quality deviation and urgently decide to stop the production. When the production is stopped, low buffer levels require workers who are able to resolve problems immediately and urgently resume production. Multiple skills, technical know how and experience is needed to apply lean principles like continuous improvement.

For companies in China, highly skilled workers who are able to fulfil these task are difficult to replace. A high training effort and time is needed before new recruits are able to start working within a lean production system. In times of Chinese economic growth and resulting job market opportunities, finding sophisticated labour is a

challenge for Chinese companies. Therefore, high employee turnover represents a barrier when successfully implementing lean.

High employee turnover was mentioned by the interviewees as a main implementation barrier. The interviewees named several national context factors which explain the high employee turnover and define the phenomena as China specific. As reasons for the operator turnover, several interviewees named worker demographics. Workers in the Chinese assembly lines are generally very young, with no or very little experience with industrial work. When the Chinese operators start their job, they have a limited conception of what work in a modern production system looks like. Several Western interviewees stated that working in an international company is frequently seen only as a stepping stone for Chinese employees, towards a long term career opportunity in another firm. The wrong expectations of working in modern production by the workers causes disappointment. Besides wrong expectations of modern industrial work, wrong expectations of living costs also played a role. Labour movements are also driven by multiple job opportunities for the workers. Based on China's fast economic growth, there is a high competition for skilled workers within the industry. Higher salaries paid in the costal regions attract many employees from the less developed regions. Manager in Changsha were complaining that some Chinese employees considered companies in rural areas as a stepping stone to find a better paid job in costal areas. By contrast, managers in Suzhou complained that after a short term period employees with rural origins leave the company because they are overwhelmed by the high living costs in the costal regions. Especially operators would complain that they were not able to save enough money. As a result, many workers quit their jobs after a short working period, continued looking for other work opportunities or return back to their homes in rural regions.

Several managers reported that the workers' origin also influenced the implementation of lean. The interviewees stated that there was a relation of worker's rural origin, the traditional Chinese festival weeks and an increased employee turnover. The festival weeks are generally used by workers 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 do not return to their workplaces, without predated notice. According to the participants, the festival activities as well as the journey back home play a major role. Over-crowded trains and buses are used by the employees as a communication pool where the employees get information about other job offers and career opportunities. As a consequence, many employees never return to the same company. The sudden loss of several workers in an assembly line is especially damaging to a production system that relies on small team structures and requires high training efforts for new employees.

The importance of monetary rewards of the workforce is a frequently mentioned context factor which also influenced employee turnover. Chinese and Western interviewees in leading positions frequently mentioned that especially operators, but also management staff's main motivation was "to make quick money" rather than build up long term careers. Monetary rewards as a main motivation within a Lean production system is critical. According to lean principles, every employee should try to eliminate waste on a day by day basis. Consequently, not every minor contribution within the continuous improvement process can be rewarded monetarily. Despite reward systems for improvements, lean production requires a supportive workforce whose operations can be continuously improved. "Making quick money" instead of

building up long term careers was frequently mentioned as an explanation for employee turnover. The participants mentioned that there is a common thought in Chinese society that after a few years time, the job beginner needs to be in a managerial position. According to participants, being a “manager” is seen as important, and if limited career opportunities are given, an employee is willing to leave the company. They mentioned that, if competing firms were paying a salary that is higher by a very few percentages, employees would quit their job and move there, regardless of long term career opportunities or employee benefits of the actual company.

Several Western managers further mentioned the importance of the leader in the Chinese culture would explain certain employee movements. In illustration, they reported that several people of the same department quit their jobs at the same time when the department leader left the company. In both companies, higher managerial positions are still dominated by German expats. Western employees therefore mentioned that there might be a relation between general short term duration of expat managers, and certain employee turnover movements.

### **Weak supply chain**

Based on missing buffers in lean production, defective parts or delayed part deliveries might immediately cause a breakdown of the entire assembly line. A good supplier performance in form of predictable quality and predictable delivery is essential for producing JIT.

Interviewees named a lack of predictable quality within supplier parts as a major barrier. Nearly all participants reported quality problems with the locally sourced parts. The participants explained the lack of supplier performance by most suppliers not applying lean production principles. Chinese suppliers would widely not be aware of advantages of lean. Participants explained this by lack of experience and know how about advantages of modern production systems. An employee who is involved in supplier support stated that it is common that medium sized local suppliers are still managed by the company owner who might not be familiar with lean manufacturing techniques. Internal process engineers from the supplier would struggle to convince the company owner to get resources to redesign the production system. An employee of the purchase department blamed the hierarchical structures and dominant role of the company owner as reasons why lean principles are not applied within the local suppliers.

Several production leaders mentioned that the supplier would not deliver high quality over a long time period. Consequently, a continuous monitoring process of incoming parts of the suppliers would be essential to ensure stable processes. The additional internal quality check represents waste in form of human effort, ware house space and transportation. According to these participants, this hindered the element of JIT in particular.

These participants explained quality deviations on the supplier side by a lack of quality control processes. In spite of cooperation and internal support, the Chinese suppliers were widely not able to produce according to Western quality standards. It was frequently mentioned that a short time after a quality audit, the supplier part quality dropped again. Some participants blamed the over-eager focus on benefits by the Chinese supplier as a reason for such variable quality. Others explained that the suppliers were simply not used to high quality requirements of Western firms.

Based on the lack of local supplier reliability, the Chinese plants still depended on some key assembly parts or machinery spare parts from Western suppliers. Overseas delivery and additional costs and reduce flexibility because parts can not be delivered JIT. Additional warehouse space is required and orders need to be placed in advance. This hinders the continuous flow of parts and therefore represents a barrier.

Participants mentioned additionally that there were delays in the custom clearance procedures. Some interviewees who were responsible for overseas delivery stated that Guanxi had a major impact on how quick parts get released from the customs. Participants mentioned that strict anti-corruption guidelines within the Western firm would make it hard to built up Guanxi relation with authorities.

### **Knowledge gaps**

Knowledge gaps within the work force were named as a further main implementation barrier. The analysis showed that knowledge gaps included a lack of lean specific knowledge, basic know how, lack of practical know how, and a lack of experience.

Lean production is a complex system. Getting an understanding of the interactions between different lean elements and benefits requires detailed lean specific knowledge. For example, using small buffers aim that problems become immediately visible. Workers need to stop the production to resolve problems immediately and urgently. The pressure put on the workers help to solve problems without delay and brings stability to the production. To contribute to the successful implementation, blue and white workers need to understand these interrelations of the lean elements which first might seem contradictory.

Managers generally stated that most of their employees did not have any basic knowledge about lean production when they entered the company. Moreover, university graduates of engineering courses would have a very limited background in lean manufacturing. Interviewees indicated that missing understanding of lean principles would lead to problems. One production managers named as an example that shop floor workers continued working and piling up the produced parts when a workstation further downstream needed to stop because of a problem. Creating buffers of unfinished products does not accord with one-piece-flow principles. The manager reported about errors when production continued and work steps were accidently skipped.

Managers stated that to overcome the knowledge gap by offering training courses is also difficult. Beside the high training costs, employee movement was regarded as a reason. Some managers refused to send employees for training purposes to plants to Europe. They explained that they experienced in the past that the employees would leave the company after the stay. International experience is still seen as a bonus in the Chinese industry and increases the career options.

As another barrier, participants in leading positions mentioned that in their opinion, Chinese employees had difficulties to transfer theoretical knowledge into practice. Western managers stated that Chinese white collar workers lacked hands-on experience. They reported difficulties to solve minor technical problems and missed what they called “eyes to detect waste”. The interviewees widely explained missing practical experience by differences in the education systems between West and East. They explained that in Western education, students were more used to applying the taught knowledge. Others related it to the wider educational background. Missing

hands-on experience was seen by Western engineers as a barrier when applying problem solving and small improvements projects.

Especially at operator level, the lack of knowledge and know how was mentioned as a restricting factor. Lean specific knowledge was barely available at operator level. As a consequence, most improvements were suggested and implemented by white workers. Interviewees attributed this to most operators' aforementioned limited previous industrial experience. They stated that a lack of very basic knowledge of modern production methods would make it hard to apply continuous improvement "bottom-up". Several engineers reported that benefits of the lean principle "quick changeover" would not pay off in China. They stated that stable processes which were taken from assembly lines in Germany would be difficult to implement in China. Several engineers reported examples where careless handling of clamping jaws during the change-over process lead to damages. The result was serious quality problems in the production.

### **Work styles**

Work styles which acted as barriers included the a lack of self-initiative, participation and difficulties in cross national communication. The sense of urgency within the lean production system is based on small buffers requires responses to problems. Workers need to show active participation to resolve problems immediately and urgently to continue production.

Western department managers stated that their Chinese subordinates lacked project ownership and independence. They complained that line leaders and operators did not feel responsible for their assembly lines. They explained that this would cause major difficulties when applying continuous improvement. Improvement tools like 5S-Housekeeping was seen by their Chinese subordinates as an extra burden and was not applied adequately. They stated that every employee working within the production directly or indirectly needed to feel responsible and to actively participate in continuous improvement. A process engineer stated that because of missing participation of operators, inefficient handling of operations could not be improved to a satisfactory level. White collar workers would rely on the operators' participation to get their first-hand knowledge of the assembly process. However, besides the operator level, a lack of commitment within the Chinese middle management was also mentioned. Western managers related the lack of commitment to missing company loyalty and focus on monetary rewards. Some attributed this to the wider historical background and explained it by influences of the former communistic state system. In their opinion, Chinese employees lacked company loyalty and project ownership because of the collectivistic past.

As another work style difficulty, Western and Chinese managers stated that a lack cross national communication lead to difficulties. Several Western managers reported that they felt isolated and did not get interdepartmental information in time. They reported that a lack of communication would restrict lean success. In lean production, workers and managers constantly have to learn new methods and variations of old methods through actual practice on the shop floor. these participants stated that missing communication restricted "best practice" to spread throughout the plant. Most Western managers named the Chinese indirect style of communication, i.e.: Responsiveness of trouble shootings, as a reason for difficulties in cross national communication.

## Summary and Discussion

This paper has presented a preliminary model of the main barriers to implementing Lean in China found in this study. Drawing upon the experiences of Chinese and Western employees in China, a 'Lean success model' is developed that illustrates the relationships between implementation barriers and Chinese context factors.

The analyses identified four main implementation barriers: (1) Employee turnover, (2) Weak supply chain, (3) Knowledge gaps, and (4) Work styles. All barriers influenced the success of lean. All four barriers are also found in the literature survey which considered publications on lean manufacturing within the Chinese manufacturing industry such as automotive-, electronic-, telecommunication-, computer-, and textile industry. The study thus strengthens the formerly weak empirical evidence of these implementation barriers. Moreover, it demonstrates that previous findings and suggestions are transferable to the organisational context of this study, a German automotive supplier producing electronic components in Changsha and Suzhou.

Nevertheless, there are some differences to previous research. Whilst most of the literature explained employee turnover as a result of multiple job opportunities, this study highlights that besides the job market, demographic characteristics of the Chinese workforce play a significant role. Regarding the barrier 'weak supply chain', the findings supported the explanations of the literature that most suppliers do not apply lean production principles. This study explained additionally that continuous monitoring processes of incoming supplier parts are essential for avoiding defects, and this form of waste would be especially critical for JIT principles.

In line with the literature, the study could also allocate that Guanxi plays a role in the supply chain. The findings showed that Guanxi had a major impact on the relationship between customer and supplier as well as how quickly overseas parts get released from the customs. These informal structures make individual empowerment difficult. The 'knowledge gap' barrier has been named as a major barrier in the literature on lean implementation in China before. However, the study could additionally illustrate a direct relationship between missing lean knowledge and errors in the production. Moreover, it also showed that there is a relation between high employee turnover and the knowledge gap, because managers refused to give employees additional training because of the high turnover levels.

Regarding work styles, the study addressed a lack of initiative and little participation of workers as implementation barriers. Continuous improvement tools were not applied satisfactorily, because workers considered these programs as extra burden and resisted it. Additionally, the study demonstrated that a lack of cross national communication acts as a barrier when promoting "best practice" improvements within the company.

As additional implementation barriers, the literature review identified: (1) inadequate time planning, (2) poor inventory management, and (3) interaction styles. Based on the cursory nature of the analysis, it appears that these barriers found in the literature will also emerge during further analyses of the data set.

Despite the number of barriers found in the literature, previous studies on lean implementation in emerging economies and China are lacking of detailed descriptions and evaluations of the barriers, and did not relate barriers to context factors. By contrast, the interviews in the current investigation delivered great detail about barriers and their possible relation to context factors. The qualitative research approach allowed to explain barriers by causes within the wider country context, and consequences of these barriers. Moreover, the study showed that the lean success is

linked to socio-political events which are not directly obvious, such as the relation of traditional festival weeks and increased employee turnover or cultural factors such as hierarchical patterns within the supplier's management, and a weak supply chain.

The interviewees highlighted that social factors play an important role when implementing lean in China, and that these social factors are related to national context factors. To consider the social system and its national context factors when implementing technical systems like lean production is in line with sociotechnical systems theory. Sociotechnical systems theory argues that the social and the technical systems must be developed jointly for a production system to be appropriate in its environment (Shani et. al, 1992). This is particularly relevant when implementing a production system in a country like China where massive cultural, socio-political and economic differences to the Western world exist.

In line with the socio-technical systems view, the findings of the present inquiry suggest that it is possible to implement lean production systems successfully in China, if companies use sociotechnical systems application when implementing lean. This means that they have to take into account not only the technical side of lean, but also the influence of social components on the functioning and success of the technical components of lean. Lean is thereby regarded as a socio-technical system. Moreover, companies have to take into account the context factors that determine the social components, in particular cultural, socio-political and economic differences.

This study demonstrates that the success of lean production is driven by local workers and employees. They will be the ones who can possibly come up with improvements which are likely to be appropriate for the particular social and cultural environment of the plant. To consider country specific knowledge, worker origins and Chinese work styles might help to adapt the technical system to the local social system. For example, the technical component of waste elimination can only be implemented successfully when also considering the social component. Computer based value stream analysis might help to detect major sources of waste. However, to continuously improve the production, workers need to be motivated and trained to see waste and solve problems on a day by day base. This again requires companies to consider the social components of lean production. Moreover, a lack of supplier performance might be based on defects in internal operations of the suppliers. However, social components such as a close relationships to the Chinese company owner can also play an important role in China.

The increasing number of examples of modern manufacturing plants in China proves that lean manufacturing can be transferred to China. Perhaps in the future, adjustment to local conditions will increase the effectiveness of these productions systems. In the future, lean systems in China may have a couple of specific advantages over other developing and industrialized. First, the missing industrial experience of workers from rural areas could also be an advantage. Based on the missing industrial experience of the workforce, managers do not have to overcome entrenched attitudes resulting of many decades of operating under the paradigm of mass production. Principles like single piece flow and minimizing of inventory levels might be principles that are easier to implement than in the West. Second, China with the world's biggest automotive market attracts many Western firms to set up manufacturing plants. It is likely that the Western companies put up the most modern production facilities and

put a lot of effort into implementing lean principles in their new plants, and may manage to adapt to the country-specific social environment.

If the goal is to implement lean production successfully in Chinese firms, the model suggests that national context factors have to be considered. To make employees aware of another nation's cultural context, intercultural training for foreign managers and local employees might help to adjust to the other nation's cultural context. Offering additional training and workshops to shop floor workers may help strengthen their understanding of lean principles and help in achieving effective "bottom up" improvements. High turnover was found to be a central barrier to lean success. Turnover may, however, be tackled by appropriate HRM measures, for example by offering long term work contracts and attractive pensions, convincing Chinese employees to see Western companies as a long term career opportunity. This will require extra resources and cause additional costs. However, if barriers will be overcome and lean production is successfully implemented, these additional costs will be paid off.

As with any research project, this study has its limitations. Due to the field study approach, the researcher's predispositions and bias may have influenced the research findings. The research, however, attempted to reflect the interviewees' intentions as precise as possible by allowing them to focus on topics which they regarded as most important, and by remaining open to new themes. In addition, it needs to be considered that the paper represents pre-results of the author's recent field work trip to China. The findings are based on selected interviews, field notes, and the author's recent fieldwork impressions. They should not be interpreted as findings analysed in-depth from the entire data set. At this stage, the "Lean Implementation Model" should be interpreted as a first draft in order to give a comprehensive compilation of barriers found in China. The detailed analyses of the interview data at a later stage will show whether certain barriers can be explained directly by certain Chinese context factors. As further steps of the research, the full data set will be analysed. All main implementation barriers and important context factors will be extracted from the interview data. The findings will be used to refine the theoretical model.



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