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Lean Six Sigma Implementation in Chinese Manufacturing SMEs

Shuai He
China University of Political Science and Law, Beijing
Shuai.he@cupl.edu.cn

Abstract: The quality crisis directly threats to the China's position of "the world factory". "Made in China" is widely signified to be inferior quality in nowadays. The most of problem products were made by China's manufacturing SMEs. With China's serious product quality safety incidents increasing day by day, improving China's SMEs products quality is a task which brooks no delay. LSS is an effective quality initiative for improving products quality. There are many success case of improving products quality by adopting LSS. Hence, this dissertation aims is to investigate whether China's manufacturing SMEs can improve their products quality by adopting LSS. In order to achieve the aim, the company size effect, the barriers, the critical success factors and the benefits of China's SMEs introducing LSS were identified and analyzed by a survey-based approach and literature review in the dissertation. The analysis result indicated that large-scale implementation of LSS to China's SMEs is unpractical in current China's special circumstances.

Keywords: China, SMEs and Lean Six Sigma

INTRODUCTION

According to the Chinese Provisional Rules of SMEs , the category of SMEs is made up of enterprises whose personnel numbers fall below 2000 persons and which have an annual turnover not exceeding 300 million RMB, and which total asset not more than 400 million RMB. China's economic development for SMEs played a pivotal role. The reason is that China's SMEs has the largest percentage of the all sizes companies in China, accounting for more than 98 percent of the total firms. Moreover, the number of SMEs reached a staggering 50 million in China in 2011. Besides, analysts estimate that SMEs employ more than three-quarters of China's total labor force and provide more than half of economic output, which occupied one third of the country's GDP, according to the data published by the Development Research Center of the State Council in 2011. At present China is titled as "World Factory" because it homes thousands of manufacturing SMEs, making the goods that the rest of the world consumes. Furthermore, in the "Top 100 SMEs Ranking 2011 of all China's SMEs", it can find that China's manufacturing SMEs are still a main force of the country's total SMEs, nearly 30 percent of SMEs in the Ranking are engaged in manufacturing industry.", the Chongqing Business Newspaper said. LSS is a combination of a world renowned statistical improvement system, which is the integration of lean manufacturing principles and six sigma techniques. It can combine the advantages of Lean and Six Sigma to reduce wastes. The practices and tools of Lean emphasize simplify the process, whereas the practices and tools of Six Sigma focus on identification and solution of fundamental problem. Six Sigma implement is positively associated with a Lean practice implementation. Moreover, LSS as a powerful business strategy for reducing wastes, process variability and increasing quality in business processes. Apparently, in manufacturing industry, reducing wastes, process variability and increasing quality means improving market competition and added value. If manufacturing organization want to improve their production process effectively, accurate and timely information is the key. Implementing LSS can help companies to tackle the problem of collecting accurate and timely information that is a best method for process improvement and reformation. Consequently, many manufacturing giants, such as General Electric Co. and Lenovo etc. have seen the benefits, and there has been this great adoption

On one hand, in spite of LSS achieving great success in several large-size manufacturing companies, it exhibits certain limitations to manufacturing SMEs. A series of surveys have shown evidence that six sigma and LSS were not generally popular among SMEs. The majority of SMEs have a lack of enough resources due to the size limitation, therefore SMEs managers think adopting LSS is not realistic. China's government shows partiality to state-owned enterprises and listed companies already well known in the world. Large size enterprises are favored and SMEs are potentially disadvantaged in the market and cannot compete in a fair competition. For example, no matter what preferential policies, financing, taxation and land-use preferential policies, large companies have the priority. Under the background of government-controlled market, without the government's attention, China's SMEs live under harsh conditions, does this make implementing LSS becomes ever more difficult. On the other hand, China has long been known as the

so-called the world's factory. However, a big problem was hidden behind this laurel. “Made in China” always leave a bad impression of quality to people. Especially in China’s manufacturing SMEs’ products, there is a tendency to blindly reducing costs which has the potential to lead to the products quality becoming the notorious problem. Most of China’s SMEs are short-lived with a 3-5 years lifetime or even shorter. The biggest reason is they overly value the advantages of low price and undervalue the importance of quality. The vicious competition of low price makes Chinese manufacturing SMEs produce tainted products. Perceptibly, tainted or poor quality products will damage customer satisfaction. Quality is one of important variable can influence customer satisfaction. Consequently, whether LSS can help China’s SMEs improve their products quality, which becomes an urgent issue to tackle.

LSS as an effective quality management tool that is still in an emergent phase for manufacturing industry which offers an opportunity to China’s SMEs to break the “curse” that most of SMEs only have 3.7 years life maximum in China. Japan is close to China in geography and culture. But what is astonishing is that Japan’s SMEs’ average life can reach 12.5 years. With the development of economic globalization, under this background, China government wants to transform manufacturing industry to technology-intensive ones from labor-intensive ones. However, the Chinese government gambles much of energy on less than 2 percent manufacturing companies and ignores the main force (SMEs) which occupied more than 98 percent by volume of firms. Apparently, the government’s transformation plan should fail because it ignores the main force of GDP. If China government wants to implement the plan successfully, improving SMEs’ products quality is an essential factor. Consequently, the study of whether LSS is the right solution for the problem of SMEs’ products with poor quality has a great research value for China government. According to the theory of Kano Model, basic attributes is the threshold attributes. “If this attribute is overlooked, the product is simply incomplete. If a new product is not examined using the threshold aspects, it may not be possible to enter the market. This is the first and most important characteristic of the Kano model”. Most of China’s SMEs products even cannot reach this criterion for both quality and safety, when they get their products to market. The phenomenon leads to many shocking accidents, for example the shoddy cotton accident, the unsafe milk accident and the toxic toy accident. Colleen Hurley who is a certified kid’s nutrition specialist stated that one third toys in Michigan contained medium to high levels of toxins and the most of the toxic toy comes from China and some development countries. Under the background of China being “the world factory”, improving China SMEs quality is closely relative all over the world people’s quality of life and safety; its importance cannot be under estimated.

FINDINGS

The proportions of small and medium companies according to the feedback of interview. The small sized manufacturing companies was the most common companies in the respondents, which occupied around 89.66 percent (26 companies). On the contrary, the medium sized companies only occupied around 10.34 percent (3 companies). The respondents’ trade covers automotive components, wood products; fitness equipment, glass reinforced plastic, clothes, processing machinery casting, plastic Products, food Production, pharmacy, soft drink, cigarette, paper making, medical cotton manufacturing, microwave communication tower manufacturing, Eggette Manufacturing, watch accessories, washing-up liquid, wine, storage battery, home textiles and packing-case. The most important strategic objective of SMEs respondents by frequency statistics according to the feedback of interview. It can be seen from the statistics that low costs, quality and flexibility are the top three most important factors which the respondents in this study have taken into account while deciding their strategic objectives. The most of respondents (16 respondents) selected lower costs as their most important strategic objective. It is worth noting that all of family-style small factory workshops selected low costs (headcount below 20). The second most popular option was quality which was selected.by 12 respondents. Besides, only one respondent were selected flexibility. The respondent think flexibility can make their production more competitive. Moreover, the options of speed and dependability are no one respondent chose. According to the feedback of interview, around 44.83 percent the SMEs (16 respondents) had quality department and around 55. 17 percent the SMEs (13 respondents) without quality department. The respondents without quality department stated that their business scale is too small. Consequently, they thought their companies need not and should not have quality department. All of the SMEs surveyed indicated that all of employees had received Quality training. However, the most of the quality training are informal training. One respondent gave the reason that formal quality would increase the cost of operation. Another respondent pointed out that the gap of training effectiveness between informal training and formal training is not very big. Only 4 companies’ employees (the three medium companies and one small companies) had a chance of receiving formal quality training. All of the four companies stated that average the 20 percent of employees trained for formal quality and average the 80 percents employees trained for informal quality in the 4 companies. Among SMEs surveyed, 24 SMEs never adopt any quality initiative from past till now. Among these 24 SMEs, there are 5 companies considered to adopting Lean as their quality initiative in the future. It is noteworthy that four fifths in the 5

companies are food processing factories. The all of 4 respondents stated that food is easy to deteriorate, especially in summer. In their daily operation, if the control of storage environment temperature is unsuitable or error prediction lead to glut of inventory, food will corrupt, which will induce economic loss. They considered Just-in-time of Lean can help them to tackle the problem for reducing the loss. However, the remaining 19 SMEs out of the 24 SMEs think TQM that is more suitable for them because of more cheaper than others quality initiative, so they willing to try adopting TQM as their quality initiative in the future. There are 4 SMEs surveyed they never adopt any quality initiative in the past before implementing ISO 9000 or ISO 9001 and TQM as their quality initiatives at present. A quality manager surveyed from one of the 4 SMEs indicated that they adopting ISO 9001 and TQM because of the top management requirement. Moreover, The 4 SMEs with adopting ISO 9000 or ISO 9001 and TQM expressed they would consider implementing Lean in the future.

There is only one company express have an interest in adopting LSS in the future. The company is a supplier which supplies product to three famous state-owned telecommunication operators (China Mobile, China Telecom and China Unicom). In current, Lean, ISO 9000 and TQM are their three quality initiatives. They are planning to introduce LSS to be their new quality initiative and has published recruiting advertisement which attracts talents with LSS Black Belt or Green Belt certification. However, at present, there are no SMEs surveyed adopting LSS or Six Sigma to be their quality initiative. Besides, all of small manufacturers never heard LSS and Six Sigma. On the contrary, the three respondents from the 3 medium manufacturers have some understanding of LSS and they all had received formal training. Through generalizing the interview data the reasons of respondents not adopting Six Sigma or LSS mainly reflects the following aspects (due to open questions, every respondents may gave more than one view)：The cost of introducing LSS is too expensive for SMEs (Frequency: 28); Some respondents states never heard of LSS (Frequency:26); Some respondents never adopting any quality initiative. They doubt quality initiative can help them improving their profits. They want to try the most low-cost option first (TQM). If the effect of TQM let them satisfied, they would choose quality initiative with higher cost (Frequency: 17); some respondents stated low price is more attractive than high quality because their target customer is the low-income common people. They think the low-income groups require minimal in quality. On the contrary, they firmly believe that low price is a key buying factors for the low-income groups in China. For example, some respondents stated that the industry competition is intense. Quality is hard to check how good or bad within a short time. However, low price can quickly grasp the attentions of clients (Frequency: 17); If product is simple in manufacture, for example short operational process and easy control etc, the companies who produce this kind of product are not necessary adopting LSS (Frequency: 8); The current quality initiative(s) can meet their needs. There is no need invest more funding and time in quality (Frequency: 6); The payment of large bonuses as essential to retaining talents SMEs need to give the trained employees higher salary treatment for detaining them, plus SMEs' poor work environment and lower-starting salary means that adopting LSS lead to the cost of the SMEs rocket, yet the crucial LSS talents will not stay (Frequency: 3); LSS is difficult to implement (Frequency: 3); LSS is not suitable for the high-degree customized level product (Frequency: 1); A company in a collapsing industry adopting LSS is a kind of waste (Frequency: 1). The company who gave this view is a honeycomb briquette manufacturer. The head count of the company is only 6 people. Due to fewer and fewer China people using coal stove, honeycomb briquette gradually replaced by piped gas in current China. No matter how good the quality of the product that already was washed out, there would be no market for it. Consequently, he gave this kind of view; they think the quality level only need to meet the basic requirement of customers (only meeting basic attributes of Kano model) (Frequency: 1). According to the above information, the top reasons of SMEs surveyed reject implementing LSS is the high cost of introducing LSS. The second one is SMEs never heard of LSS before. The doubt of LSS performance and underrating the importance of quality both occupied the third place.

Through generalizing the interview data the most troublesome inefficiencies/problems for the SMEs in current are as following: The overall costs increase rapidly year by year (Frequency: 17); Sales fell off dramatically (Frequency: 15); A vicious price competition (Frequency: 15); The uncertainty of market demand forecast lead to High inventory hamper or stock-out (Frequency: 12); Tighter lending standards lead to the shortage of fund and difficulties in financing (Frequency: 7); It is difficult to attract and retain the best talent (Frequency: 6); Product cannot meet the customers' up-rising expectations (Frequency: 4); Core staff job hopping rate is absolutely high , along with a great personnel flow frequency (Frequency: 4); The production plan always change lead to delivery on-time rate is very low (Frequency: 4); Return and exchange rate is very high (Frequency: 4); No inefficiency and problem in current (Frequency: 3); Difficult to entry the middling and high level market (Frequency: 1); The above data shows the overall costs increasing rapidly is the most of problem for SMEs surveyed, followed by sales fell off dramatically and a vicious price competition which tied for second place. The third place belongs to the uncertainty of market demand forecast.

The Case Study: Company A

Company A is a Chinese SME whose main business is manufacturing and selling engineering blender which is a business to business company and has multiple sites. In the period of 2008 to 2009, engineering blender manufacturers faced a long-term decline of the industry margin in the wake of the financial crisis sweeping the world. In order to survive, Company A selected implementing LSS to enhance its competitiveness. Before adopting LSS to be its quality initiative, Company A has many problems in the supply chain management. The first one is raw materials, work in process inventories and finished goods showed high inventory hamper. Besides, on-time delivery rate is low. The company often received complaints from the downstream companies. Moreover, manufacturing sites and plans were chaos. Workers always asked each other the location of tools because most of workers laid tools casually around in manufacturing sites when they have finished using them. Furthermore, Company A is engineering blender manufacturer, so single order production type take up a large proportion of the order book. The variety of products offered leads to Company A complication and difficulty in production planning and controlling. Moreover, Company A also had some procurement problems. For example, raw materials often not supplied timely and the cycle time of procurement is long. The top management of Company A realized the company needed to make some changes to successfully face the financial crisis. Otherwise, the company will struggle to profit in the background of manufacturing industry downturn. William Yu , the president of Greater China for Ingerso II Rand, summarized the ten steps of introducing LSS that according to his many years of management experiences in China companies implementing LSS, which are: Step 1: Top management supporting; Step 2: Using crisis; Step 3: Resource allocation; Step 4: Selecting rational methods; Step 5: Establishing rational sequence; Step 6: Clear separation of duties; Step 7: Selecting rational measurement method; Step 8: Project management; Step 9: Recognition of staff's contributions; Step 10: Success introducing LSS; In the step 2, Yu pointed out that full participation is one of critical success factors for implementing LSS. Companies can seize the opportunity in a crisis to meet the purpose of mobilizing all personnel involved in LSS initiative. For example: Sales have declined by 30 percent approximately in the past 12 months; The profit margin has declined by 50 percent approximately in the past 12 months; In the past six months, the rate of customer complaints rocketed by 200 percent; In the past six months, inventories increased in number threefold;

When Company A is facing a crisis, the top management and staff will fully devote themselves to implementing a new method. The reason is, if left unchanged, the company will fail and staff will lose jobs. Apparently, the top management and staff do not want that to happen. The most of companies in China only when they facing a crisis, the top management and staff will fully devote themselves to implementing a new method. The reason is if left unchanged, company will fail and staff will lose jobs. Apparently, the top management and staff do not want that things happen. Consequently, Company a selected adopting LSS as a solution for facing manufacturing industry downturn. It drew on experiences from a successful precedent Ingersoll Rand which also is a machinery maker. Company A divided implementing LSS into 2 phases. First one is implementing lean manufacturing and the second one is implementing LSS. In the Phase 1, Company A established "lean promotion team". The responsibility of the team is learning and exploring how to introducing LSS. The team collaborated with Ingersoll Rand for guidance and training, especially in lean manufacturing, fulfillment reforming and inventory control. Under the LSS experts of Ingersoll Rand guidance, the team made an appropriate lean introducing plan and schedule. The first step of the plan was conducting a pilot project. Company A chose an assembly room to be a test subject for solving assembly workshops scheduling optimization problems by adopting Lean system. When the pilot project was in effect, the assembly room become a launching pad for lean project to prove its concept, scale-up and replicate in the whole company. Other assembly rooms and departments drew on the experience of the pilot project for duplicating success. The next step was creating the Lean culture in the whole company though Lean training. To achieve this objective, the company made a policy that the bonus is linked to employee performance of implementing Lean. The following is some key works Company A did for introducing Lean (include, but are not limited to the following works): 1. value chain analysis: Company A through value chain analysis diagnosed the non-added value activities and found the problems in the production process. 2, establishing Standardized Work: Company A collected the data of the takt time, precise work sequence and stand WIP. The data can help the "lean promotion team" to find 8 wastes and redesign the content of operating job. The Standardized Work makes the manufacturing process more reasonable. Finally, a relatively well-developed Standardized Work Chart is built up. 3, applying 5S: the team promoted managers and staff to apply 5S in the offices and production plant. The company introduced "pull system": adopting pull system for reducing the inventory. 4, optimizing the workshop layout based on the Standardized Work Chart, pull system and results of value chain analysis. 5, training: the content and method of training was designed in accordance with the current status of Company A. From the end of the Phase 1 of the implementing results, Lean led to enormous progress with many remarkable achievements to Company A. The first achievement is establishing a visualized management system. The second one is setting up a relatively

well-developed Standardized Work Chart. The next one is that the production pattern is changing from batch process to one-piece flow. The fourth one is improving quality, lead-time and capabilities etc to sustain profitable growth. According to the company's internal statistics, by the Phase 1 the production capacity increased 37 percent, 50 percent in the employee utilization rate, and 50 percent in timely delivery rate. Moreover, the inventory levels declined 60 percent and the production cycle time is expected to reduce 65 percent by the end of Phase 2. In the Phase 2, the company 2 repeated the same strategy to introducing Six Sigma and LSS. Company A requested Ingersoll Rand shared Black Belts resource with him and the Black Belts help Company A to training Green Belts and Yellow Belts (Training paid every time, however how much the training fee the respondent refuse to disclose). The Green Belts and Yellow Belts are the same as "lean promotion team". Firstly, they also did a pilot project. When the pilot project had a significant impact on performance, the whole company's staff immediately threw themselves into the LSS project. Through the Phase 2, the company's product defect rate decreased rapidly. However, the specific data of the scale of decrease is still being counted now. In addition to the above information, according to the feedback of the interviewing with Company A, the following information is also useful for analysis: Company A chose quality as the first consideration to design strategy; Company A has the quality department; all employees of Company A are all well trained in quality. The 80 percent employees who trained for informal quality and the 20 percent employees trained for formal quality; Company A has used TQM and ISO9001 before adopting LSS; the biggest issue in the implementing process is that in the initial stage of Phase 1, not all of managers and workers supported LSS.

The analysis of the obstacles of implementing LSS for China SMEs

According to the literature review, the barriers of Lean and Six Sigma have a lot in common. The overlap barriers is well in reflecting the characteristics of manufacturing SMEs internal environment, such as the insufficient sources (funding, time and energy) and poor leadership, internal resistance etc. [1] On the contrary, the different part reveals the characteristics of manufacturing SMEs external environment, such as dangerously under buffered supply chains. The reason for the above phenomenon is the differences between Lean and Six Sigma. JIT is the core content of Lean, which is based on remarkable whole supply chain management. The scope of Lean not only limited to a company internal but whole supply chain. Using an empirical study prove the JIT performance is determined by the ability level of supply chain management. However, the requirement of external supply chain management is not too high for introducing Six Sigma. According to the process of Six Sigma project (DMAIC), all of Six Sigma techniques and activities have no significant relationship with external supply chain [2]. In summary, the barriers of adopting LSS not only come from a company's internal environment such as internal environment but also come from the company's external environment such as dangerously under buffered supply chains.

There are two authors who ranked the barriers of Six Sigma in order of importance and many differences between the two rankings. The possible reason lead to the differences is different subjects of the two studies. The object of Taner's study is Turkey's SMEs and Turkey is a developing country. However the object of Kumar et al. is UK SMEs. It is generally known that UK is a developed country. The UK and US have the world's top educational institutions in all kinds of education rankings. There is no doubt that Turkey's education lag behind UK's. That is to say, UK SMEs are easier to tackle the problem of lack of knowledge of the system to initiate. [3] UK's SMEs can easily get the help from the UK's outstanding business research institution such as some university's business school to tackle the problem. Comparing with Six Sigma, introducing ISO is cheaper than Six Sigma in developing countries. Consequently, on the surface, there are totally different barriers, but they are basically the same thing in fact with analyzing it carefully. If two products have the same price, the customer certainly would be willing to choose the one higher performance. In the same way, if the cost of introducing Six Sigma is the same as the cost of introducing ISO, the SMEs from the developing countries would willing to adopting Six Sigma. The final difference is also superficially different features, but can be viewed as the same thing. The barrier of internal resistance contain people satisfied with the status quo who do not willing to change the quality initiatives they are using. [4]

The respondents of the survey were asked to give the reasons they are not willing to adopt LSS at present or in the future. The high cost of introducing LSS is the biggest impediment in the survey. The possible reason is the special national conditions of the society in China. The most of China's SMEs universal have financing difficult question. China's SMEs getting access to bank loans are extremely difficult because of banks worrying bad loans. The most of China's SMEs are only have a 3-5 years lifetime or less due to poor management [5], plus China government pay no attention to SMEs. Consequently, China's banks raise standards of loans to SMEs for granted. Furthermore, the most of China preferential policies prosperity only can be enjoyed by large size companies. The SMEs cannot get any assist from the government that makes the problem of lack funding more serious. Consequently, the most of SMEs surveyed do not have the enough finding to invest LSS project. Base on the second reason, the

reason of distrusting LSS performance can be explained easily. Because of rarely known LSS, China's SMEs have no confidence in LSS performance. The reason of underrating the importance of quality is China's overly value the advantages of low price and undervalue the importance of quality. According to the Bar Chart 6, the number of SMEs surveyed who select lower cost as the most important strategic objective is more than the number of SMEs surveyed who select quality. Moreover, the most of SMEs surveyed do not have the quality department. Although the content of barriers are similar, the ranking of barriers are different. The most of differences is due to the different environment research objects. The level of nation development, quality of education, the government's policy and attitude are all influence the ranking of barriers. It may be that the barriers change with the variable of economic development or geography, an area for future research. [6]

The analysis of the benefits which LSS can bring to China's manufacturing SMEs

Only Six Sigma can help manufacturing SMEs to reduce warranty claim costs. Although Lean can help SMEs to reduce costs. However, the costs saved are mainly comes from a company's production process, not from reducing warranty claim. The principle of Lean reducing costs is removing the 8 wastes (occur unnecessary costs) and the 8 wastes only occur in a company's internal environment, which is no relationship to external failure costs. Furthermore, another benefit which only Six Sigma can give is defect reduction. There is no doubt that Six Sigma has the ability of reducing defect. "Six Sigma technically means having no more than 3.4 defects per million opportunities in any process, product, or service." That is to say, the main duty of Six Sigma is reducing defect. On the contrary, Lean mainly focus on optimizing process to achieve customer value rather than defect reduction [7]. Not only Six Sigma but Lean also has a unique benefit which only lean can give. The unique benefit is stock reduction. JIT and pull system can help companies to meet stock reduction. However, Six Sigma has no corresponding tool to reduce stock. Moreover, there are many authors stated that Lean and Six Sigma all have abilities of increasing the rate of on time delivery, profit, sales and reducing quality costs. Consequently, Lean also has the power to improve productivity. [8] According to the above analysis, Lean has the benefits of "time delivery (Mean 4.1)", "the reduction of quality costs (Mean 3.9)", "Productivity (Mean 3.6)", "Stock reduction (Mean 2.7)" and "Profit improvement (Mean 2.3)". While not statistical valid, the summing mean of Lean proves a comparison to SIX SIGMA via the following calculation: 4.1+3.9+3.6+2.7+2.3+1.9= 18.5. The summing mean of Six Sigma is: 4.3+4.1+3.9+3.6+2.3+1.9= 22.4. Consequently, Six Sigma is the most important part within LSS, from the standpoint of the Netherlands' manufacturing SMEs' opinion.

Company A as a China Manufacturing SME got the benefits from adopting Lean Manufacturing which is more than the benefits from implementing Six Sigma. Moreover, Lean is more useful than Six Sigma on the demand side in the case of Company A. The reason is that the most inefficiencies and problems are tackle by adopting Lean Manufacturing, not Six Sigma. Furthermore, there are the nine SMEs surveyed are willing to adopting Lean as their quality initiative in the future and the one SMEs is already implementing Lean. [9] On the contrary, the SMEs surveyed have no interest in adopting Six Sigma or LSS. All of China's SMEs surveyed prefer Lean than LSS and Six Sigma. The reasons of the difference can be shown the following point: 1. LSS and Six Sigma are all created in the late 1990s. However, Comparing with Six Sigma and LSS, China has employed lean production a long time ago. The start time of China using Lean Production techniques back to the late 1970s in the automotive industry. It is much earlier than by the most of western countries manufacturers. Due to the around 40 years' experience, China SMEs can easily and cheaply to meet the critical success factors of Lean than some western countries. [10] For example, "Management involvement and organizational commitment" is the most important factor among in Six Sigma, Lean and LSS. Due to China manufacturing industry has a long time history of adopting Lean, the SMEs' top management and employees has a confidence that adopting Lean as quality initiative is feasible and can bring benefits to them, because there are many successful precedents of implementing Lean successful in China. Hence, Lean can easier obtain management involvement and organizational commitment than Six Sigma and LSS. 2, the next reason is the culture difference. The Lean originates in from Japan which is close to China in geography, language and culture. However, Six Sigma is a thoroughly Western creation. Consequently, the abilities of China's SMEs understanding, learning and using Lean is superior to their ability of understanding, learning and using Six Sigma. [11]

The analysis of whether China's manufacturing SMEs adopting LSS is feasible or not.

There are 11 inefficiencies and problems which are mentioned by the SMEs surveyed. The inefficiencies and problems represent the aspirations of China manufacturing SMEs surveyed. The aspirations can be summarized, classified and merged into the seven points. The most longings of SMEs surveyed, LSS can help them to meet. Consequently, the China's manufacturing SMEs has a motivation for adopting LSS. Although LSS can help manufacturing SMEs to overcome their current inefficiencies and problems, large-scale implementation of LSS to China's SMEs still has a long way to go. According to the primary data, the most SMEs surveyed select lower quality as

the most important strategic objective. Hence, the SMEs' first consideration is the cost of introducing when they plan to adopt a new quality initiative. It is very easy to understand why TQM become the most popular quality initiative in the survey. The reason is that adopting TQM is the cheapest among other quality initiatives in China. DUODA MINGSHI is a management training company. Table 24 shows the prices of different quality training courses from DUODA MINGSHI [12]. According to Table 24, the training fee of TQM is much cheaper than other quality initiatives training. The second cheapest one is Lean training that is another reason why some companies surveyed (already adopting TQM) is willing to adopting Lean in the future. The cost of LSS is most barriers for small sized company adopting LSS. The argument also can be used in China. If the whole company staff and managers hold the view of the cheaper the better, introducing LSS is difficult to obtain management involvement and participation which is the biggest critical success factor of implementing LSS. It hard makes the top management and staff to change their view because of the current China government policy. Many western countries SMEs are constrained by sufficient funding that is difficult to adopting LSS [13]. Furthermore, China's SMEs live in more abominable environment comparing than the western countries SMEs that lead to the problem of lack funding become more serious within China. Consequently, in contemporary China's special circumstances, a company's size is important to China's SMEs to adopting LSS. Large-scale implementation of LSS to China's SMEs is unpractical in current. [14]

CONCLUSION

This dissertation has conducted a comprehensive review of the literature, a telephone interview survey, and a case study for exploring whether LSS is appropriate for China's manufacturing SMEs. According to the analysis results, this dissertation provides the following conclusion: 1, Many of authors supported the barriers of Lean, Six Sigma and LSS which are similar in content but different in importance ranking. The reason is their study subjects with different culture and environment. In contemporary China's special circumstances, the top three barriers of obstacles of China's SMEs for implementing LSS are the high cost of introducing LSS, the low popularity of LSS and underrating the importance of quality. 2, According to the case study analysis, the Company a can success introduce LSS because that it achieve the following critical success factors: Leadership and Commitment of top management; Commitment of middle managers; Understanding of LSS methodology; Training a Six Sigma core group cheaply; Organizational infrastructure; Culture change; Communicating success stories and proving that the approach works; Rewarding and recognizing the performers; Institutionalizing the approach; Project management skill; Through conducting a comprehensive review of the literature, it is worth noting that the importance factors of leadership and commitment of top management is may not influenced by SMEs external environment change, such as nation development level, quality of education, the government's policy and attitude. However, others factors will be affected on external environment change. According to the case study analysis, the benefits which LSS can bring to Company A are: The production capacity increasing; the employee utilization rate increasing; the timely delivery rate; the stock reduction; the cycle time reduction; the defect reduction. In contemporary China's special circumstances, a company's size is important to China's SMEs to adopting LSS. Large-scale implementation of LSS to China's SMEs is unpractical at present.

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