Exploring Dynamic Performance improvement in Service SCM: the Lean Six Sigma's perspective

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Abstract

This paper defines the performance evaluation system of Service SCM. As service is intangible and heterogeneous, the paper is to develop a model that illustrates under which conditions Lean Six Sigma is deemed most appropriate according to the type of service delivered. It investigate Lean Six Sigma practice in service supply chain and show how the Lean Six Sigma improve the performance of Service SCM from the statistics perspective. Furthermore, it stresses the CTQ (critical to quality) to the customer and clarifying their demands in terms of value-added requirements.

Keywords: Service Supply Chain Management, Intangible, Lean Six Sigma

1 Introduction

Research in supply chain management (refer to SCM) is approached from different disciplines: logistics, operation management, distribution etc., which related to the physical movement of goods (tangible products) and the related Information flow, Business processes and Capital flow. However, SCM is also relevant for services (intangible products) (Ellram et al., 2004). The notion of Service SCM has garnered increased awareness in SCM field and has been realized the importance within the organization. Servitisation is even predicted as being a future significant research area within operations management (Taylor and Taylor, 2009). SCM in a service context is, like SCM in general, related with designing and managing supply chains, controlling its assets and uncertainties in order to meet the needs of the customers in a cost-effective manner (Ellram et al., 2004).

Service SCM has been defined in a way that differentiates it from a traditional SCM manufacturing centric focus. Ellram et al. (2004) define Service SCM as: "the management of information, processes, capacity, service performance and funds from the earliest supplier to the ultimate customer." An important message in SCM is that a differentiation of tasks should take place. Such a differentiation can, for example, be practiced through different types of relationships with customers, as well as suppliers. The Service SCM framework was normally portrayed to seven service process (Ellram et al., 2004):

(a) Information flow (e.g. collaboration with customers and suppliers and information sharing).

(b) Capacity and skills management (e.g. capability to satisfy the customer, quick response to the market).

(c) Customer relationship management (CRM) (e.g. customer service and opportunity analysis on winning customer).

(d) Supplier relationship management (SRM) (e.g. supplier segmentation, supplier audit, supplier assessment, supplier selection).

(e) Service delivery management (e.g. service coordination on the delivery to customer, enabling service providers).

(f) Cash flow (e.g. flow of payments between parties).

(g) Demand management (e.g. forecasting market requirements).

Currently the functions of Service SCM have been of great strategic extension in the breadth and depth of field, this include the types of Service project, Service objects, and Service area. The difficulty of managing Service Supply Chain has been increased due to the Cross-border diversification regulations, differences individual needs, longer delivery time, increasing transport costs etc., the characteristics of Service SCM are to face a large number of customers, extensive customization requirements, while the fulfilment is mostly reply on external service conditions.

While the pure Services are intangible, and have a quality dimension, which is difficult to evaluate .Service quality evaluation has been critical for the Service SCM. The purpose of this paper is to find out the service assessment index and introduce the Lean Six Sigma practice to improve it in a Service SCM context. More specifically, the paper aims to answer two questions

RQ1. How to define the KPIs in the assessment of Service SCM?

RQ2. How Lean Six Sigma solution to improve the performance of Service SCM?

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2 Performance evaluation system of Service SCM

A. The principles of Service performance evaluation

The quality of Service supply chain is a primary factor to indicate if the organization has the ability to create time and space effectiveness of the scale to customer, to retain existing customers and attract new customers. Hence, another problem is how to measure the quality of Service supply chain. Although the concept of SCM has been developed for more than 30 years and there are many studies on performance evaluation of supply chain, there is lack of definition on Service supply chain. Thus, performance evaluation of Service supply chain is not defined consistently. The content is still incomplete and not systematic. It is an issue worthy of further study (Atkinson, 2004). For the Construction of performance evaluation system of Service supply chain, it should be based on overall strategy of Service SCM and aims to establish balance between short-term and long-term goals, financial and non-financial performance measures and internal and external performance compositions. Moreover, performance evaluation system should follow the principles as below (Youngdah, 2000):

a) Importance

The measures should be divided into different degrees. From measures of each degree, key points of evaluation are selected to analyse key performance evaluation measures.

b) Dynamics

Dynamic evaluation which reflects business process of Service supply chain is adopted and it is not limited to examination of static operating outcome.

c) Completeness

The measures can reflect operation of overall Service supply chain instead of operation of only one node.

d) Immediateness

Immediate evaluation and analysis can demonstrate immediate operation of Service supply chain. It is more valuable than after analysis.

e) General principle

It values evaluation on long-term benefit and long-term potential of Service supply chain.

f) Comparative principle

The evaluation system selected can be compared in terms of time. Moreover, it can horizontally compare different supply chains in the same industry.

g) Quantitative principle

The measures include quantitative and qualitative ones. However, qualitative measures should be quantified for comparison among different supply chains.

h) Economic principle

Scope of evaluation system should be appropriate. With too many measures, the evaluation will be difficult. Few measures will not reflect the performance of supply chain. Moreover, acquisition of measures should be economic and convenient.

B. The KPIs concerned with Service SCM

In literature, three scholars Parasuraman, Zeithaml and Berry (referred to as PZB) made the most representative assessment of service quality, PZB three scholars believe that the customer perception of the "Quality of Service" (Service Quality, abbreviated as SERVICEQAL) by the "expectations of service" and "cognitive services", the difference between the size and direction of the joint decision made by the five services assessed differences in quality of service constitute the general model, that "Tangibility", "Reliability", "Responsiveness", "Assurance", "Empathy" in five areas of service quality assessment table. It is the famous SERVICEQAL scale. In view of above principles and the specifications of Service SCM, the paper list the related KPIs as shown in (table 1, the answer of the RQ1).

TABLE 1 Related kpis in Service SCM

	Evaluate factors	Quantitative index(example)
Tangibility	Distribution process ability	Deal with the special demand (frequency)
	Order receiving	Reject customer order (times and amount)
	Transport capability	Transport speed and cost advantage
	Storage capability	Scrap amount
Reliability	On-time -delivery	OTD%
	Fulfil customer order capability	Satisfy the expedition and postpone requirement (times)
	Good intact rate	Damage %, customer return%
	Delivery error rate	Error %
Responsiveness	Response time	Reply customer within 24hrs
	Fulfil customer order speed	Lead time (purchasing time, production time, transporting time)
	Tracking system consistency	Missing information %
Assurance	Reputation	Industry authority ranking
	satisfaction about Service attitude	3'rd party satisfaction survey
	Employee trust degree	3'rd party satisfaction survey
Empathy	Satisfy the personal demand	Deal with the special demand (types and times)
	Awareness about customer demand	3'rd party satisfaction survey

It is important to improve the efficiency of measurement system as process capability improves; evaluate the use of control measurement systems (e.g., attributes, variables, destructive), and ensure that measurement capability is sufficient to evaluate service system. Performance evaluation system can tell how the overall Service SCM working timely and guide the organization to achieve the business goal.

3 Lean Six Sigma summary

Lean is about eliminating waste and creating customer value and consists of principles that constitute the backbone of the philosophy. The present review of the lean concept has identified that lean is concerned with waste reduction and value creation for ultimate customer. In addition to the diverse conceptualizations of the lean concept, σ is a statistical term for standard deviation, Six

Sigma's strengths is the ability to transfer a practical service problems into a statistical analysis problem, resulting in a statistical solution, then converted back to a practical solution through the DMAIC process that is: D-definition (Define), M-measurement (Measure), A-analysis (Analyse), I-improvement (Improve) and C-control (Control) to improve the existing Service SCM processes. DMAIC is a process cycle which can achieve to serve the customer as the "centre", continue to improve customer satisfaction and link the Service SCM closely to business objectives, it emphasis full use of quantitative analysis and statistical thinking .Six Sigma is a measurement scale upon which improvements can be gauged.

There is supreme advantage that can be gained from integrating Lean with Six Sigma. Lean is primarily about reducing waste and Six Sigma can provide certain problem solving abilities to waste elimination .Lean Six Sigma is an overall methodology, which aim to the continuous improvement. It was always taken into account the service quality during the implementation of Lean Six Sigma project ,as well as the efficiency and effectiveness, it obsolesce the interference rate, to get rid of the waste factors, and move out the Non-value-added process, it conduct a statistical analysis through numerous practical information and data, to dig out and break the outmoded ideas and explain the real changes in the new results, Finally it provide great support for innovative solutions of Service SCM.

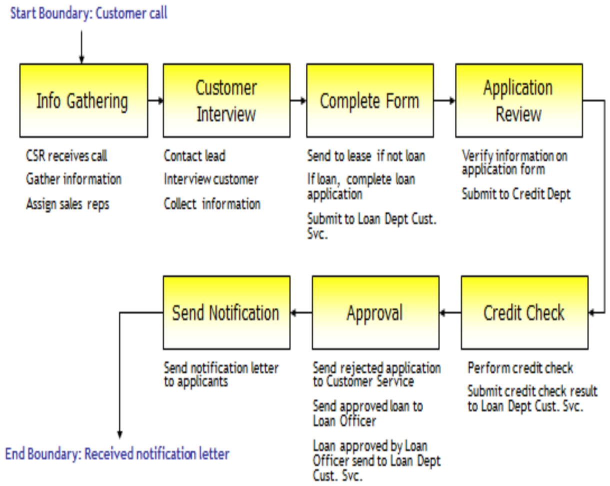
As a result, Lean Six Sigma should be fit well with the Service SCM concept since they are both concerned with creating customer value through cost-effective processes

4 Lean Six Sigma implementation in service supply chain

ABC Savings and Loans Bank is currently the 4th largest bank and plan to be the 2nd largest one in China in coming 2 years. Management studied their markets and determined that cycle time for loans and leases is a key competitive issue in all markets. The target cycle time is 8 days. While current process time is 9.2 days, Management decided to immediately attack this issue to alleviate both customer dissatisfaction and significant financial loss to the company. They made an agreement to introduce Lean Six Sigma to improve this service time.

The Lean Six Sigma team firstly plans to analyse the current application process. The best tool to analyse the process is an "as is" functional deployment map. They started by generating a SIPOC ((Suppliers, Inputs, Process, Outputs, Customers) diagram, followed by a top-down chart and completed the mapping with a functional deployment map for loan and lease processes respectively. It was shown in Table 2

TABLE 2 Top-down chart



With the improved loan process, the team needed to know whether it was feasible to implement the process quickly. Collectively, the team used 5 criteria to determine whether the improved loan process is a "quick win" opportunity. Since the improved loan process is not a "quick win", the team started to work with the "as is" loan process. The next step for the team was to brainstorm and work out the VOC (Voice Of Customer) and VOB (Voice Of Business). This was done to verify ability of current "as is" process in meeting critical customer and business requirements. The team used KANO analysis and C&E matrix to prioritize the CCR (Critical Customer Requirement) and CBR (Critical Business Requirement) obtained from VOC/VOB brainstorming session. The team needed to collect data to determine the baseline cycle time performance of the loan and lease processes.

To be effective, the team wanted to ensure that data for the important input and process indicators was collected simultaneously. They used the SIPOC diagram, fishbone diagram and C&E matrix to establish the relationship between input, process and output indicators.

TABLE 3 Cause & Effect Matrix for Loan Process.

	Notification Cycle Time	Customer Satisfaction	Offer Letter Error Rate	Profit Margin	<<<<Output Indicators
	8	6	10	10	<<<<<<<<Importance
--- Input/Process Indicators ---	------ Correlation of Input to Output ------				------ Total ------
Application form error rate	9	3	9	3	210
Number of customer interview	3	9	0	1	88
Wait for information	9	9	1	3	166
Credit check cycle time	9	3	1	3	130
Approval cycle time	9	3	0	9	180
Number of application used	9	0	0	0	72

SCALE: 0=NONE 1=LOW 3=MODERATE 9=STRONG

After collecting the numerous data about the process time, the team decided that the Pareto chart was selected to start problem identification; the Control chart was used to check for process stability and to identify trends; and Graphical summary was generated to ensure that the team was dealing with not more than one population, and to determine normality of the data distribution.

The team used a scatter plot to view potential correlation between variables. The challenge is how to fix the new process control system, it was created by a team responsible for assuring the quality of a commercial loan process for loans <$1,000,000.

The two customer expectations being tracked were:

Prompt notification of loan approval or non-approval (CCR #1: <24 hrs from submission of application

Timely availability of funds (CCR #2: within 1/2 business day from notification of loan approval)

The duration of various key activities in the loan process are tracked in order to maintain performance at acceptable levels.

Additionally, the team gathers data on incomplete loan applications and rejection reason codes to help in the analysis of loan process cycle time. Outcome Indicator

O1 = loan submission to notify O2 = notification to disbursement

Process Customer Branch & District Commercial Loan Applicants for loans $1,000,000 Critical Customer Requirements:

a) 24 hour (M-S) response time on loan approval

b) Funds dispersed within ½ business day upon approval notification

A process control system organizes relevant information about a process in a meaningful and useable format. The information included in the process control chart may represent the effort of weeks, months and even years of process and customer experience and data collection. Once the right process measures, etc., are validated, a team can gather and organize the information into a process control system in a relatively short amount of time.

The Cycle Time was finally improved to 3.38Ds; Sigma was improved to 3.11 as shown in Figure1

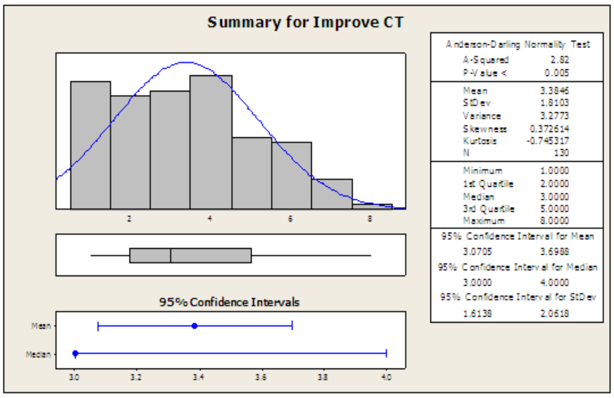


FIGURE 1 Graphical summary post-solution cycle time distribution

And the related whole process control map was shown as FIGURE 2

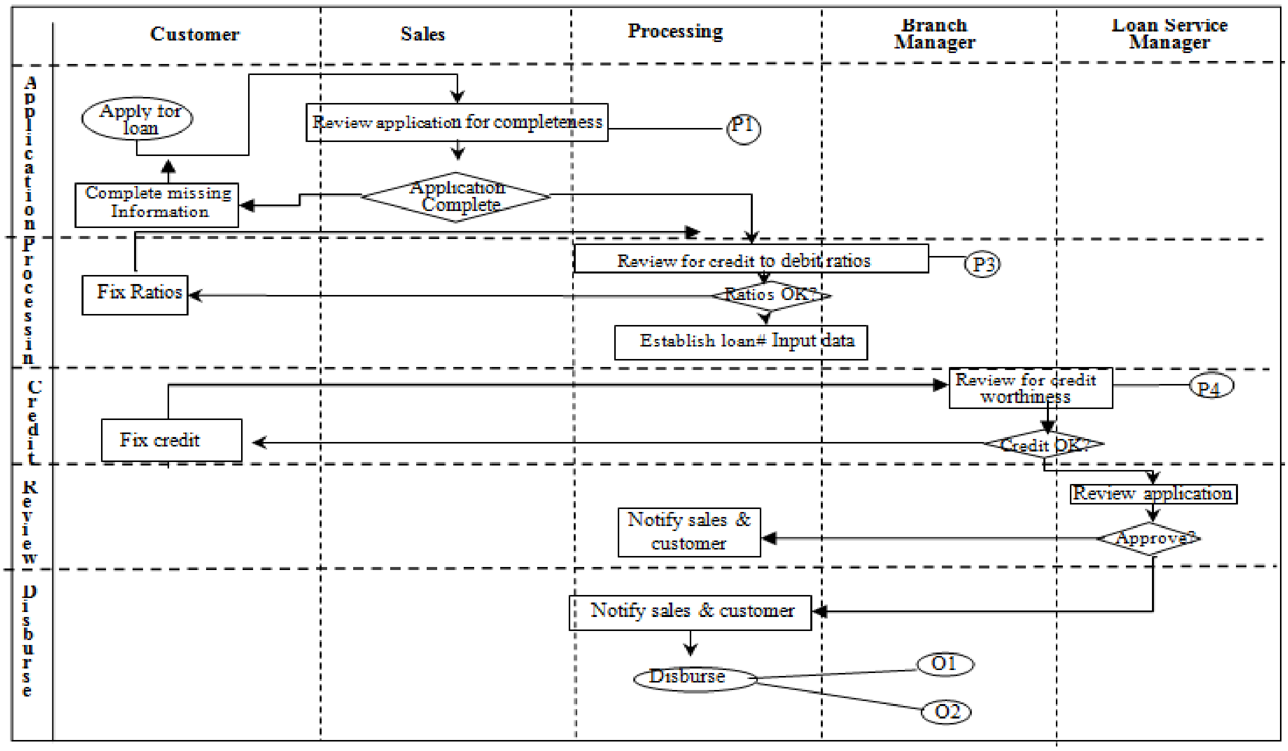


FIGURE 2 Process control map

Using the data collected from 3 sites (Beijing, Shanghai, Guangzhou), the Six Sigma team in Sigma Savings and Loans calculated the DPMO (Defects Per Million Opportunities) and the sigma level using the discrete notification cycle times:

D = 921

N = 2020

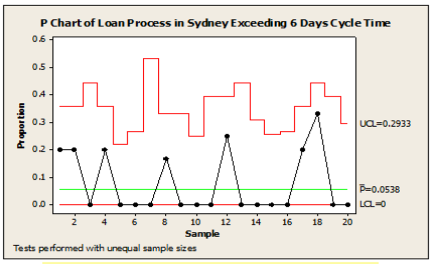
O = 1 (There is only one opportunity for a defect per application. Either the notification is delivered within 8 days or it is a defect.)

DPMO = 921 * $(10)^6$ /2020*1=455,941

Sigma Quality Level is approximately 1.61

The team prioritized potential root causes: Wait for information because no guideline was given for information compilation; Long approval time because managers were busy and not confident that subordinates were capable of evaluating application effectively; Location issue due to IT protocol problems, resulting from different technology platform.

An improvement team recommended the use of criteria that significantly reduced the number of approvals by providing new loan representatives with the same tools that management used for loan application reviews, and the process was finally shorten to around 6days as shown in FIGURE 3



Sigma for improved loan process = 3.11

FIGURE3 Control chart post-solution process performance

The effort has been synthesizing Service SCM and six sigma and developing a unique Lean Six Sigma based methodology to improve service process time. The process control check items were shown as Table 4.

TABLE 4 Process control check items

Indicators	Control Limits and/or specs.	Checking Item	Checking Frequency	Responsibility	Actions	Misc. Information
P1 – activity duration, min.	≤ 5 minutes for all loan types	Time stamp, in and out	All loans on receipt	Branch sales representatives	Call customer Complete and validate applications Items 4,5,6,8 & 9	
P2 - # of incomplete loan applications	N = number of defects	All loans record on travel log	All loans on receipt	Branch sales representative	Call branch sales Reposes for all ratios above 0.8	
P3 – activity duration, hrs	≤ 5 minutes for loans ≥ $100k,\;≤20 minutes for loans > $100k	Time stamp, in and out on log		Processing clerk		See branch policy variations on ratios
P4 – type & reason for application rejection		Reason code sheet and log	All loans record on log	Branch Manager		
O1 – loan submission to notify	≤ 5 minutes for loans > $500k	Time stamp, in and out on log	Only loans > $500k	Loan Service Manager		District centre Service manager only reviews loans > $5600k
O2 – notification to disbursement		Reason code sheet and log		Branch sales representative		

The above case demonstrate the use of Lean Six Sigma mechanisms to improve the process of service supply chain which create value-added to customer, A combined management approach for Lean and Six Sigma will both accelerate the improvements achieved and will make a significant difference to the financial performance of the improvement program and the business.(the answer of the RQ2).

5 Lean Six Sigma to improve the performance of Service SCM

The case has set out to investigate Lean Six Sigma practices in the ABC Savings and Loans Bank through DMAIC method and to elaborate on whether it makes sense to apply the Lean Six Sigma concept in a Service SCM context.

Service SCM has its focus on the objectives of both service improvements and cost reduction with the purpose of providing the customer with the best possible service. The theoretical description of Lean Six Sigma has outlined a number of characteristics for being lean, i.e. customer focus, flow production and standardization of processes.

Lean Six Sigma is analytic tools and a disciplined, standardized methodology for their use.it Integrated approach to leading improvement efforts in Service SCM, Six Sigma is also the principles of leadership and Driving results through engaged teams to improve the whole Service Supply Chain process continuously. The Service process may include: Customer requirements, Process alignment, Analytical rigor, Timely execution and etc. Service SCM aims to deliver the required service in the most cost-effective way. Differentiation is an Important determinant in developing different types of relationships with customers, as well as suppliers, through CRM and SRM. Some customers demand special services requiring a special setup to make tailor-made solutions and to fulfil flexibility and lead-time requirements. Other customers may be satisfied with standard services. On the supply side, there may be arm's length relationships based on market prices for commodity products and more strategic partnerships based on trust with some suppliers in which sensitive information about.

Service SCM is always impacted by the market environment, cultural environment, policy-oriented, intra-industry and etc., the relationship among various factors is complex and uncertainties related to these complex systems of non-linear, this increases the complexity of the Services SCM. The “service-efficient” service strategy is deemed appropriate when the services offered are heterogeneous and thus require customized “production” processes. For example, heterogeneous services are characterized by its unpredictability of demand and time consumption to deliver the service and the actual resource spending.

6 Conclusions

Using the Lean Six Sigma processes, this study found several areas for improvement in the process studied. Bottlenecks and variation in the process were identified through in-depth analysis of the statistical information. Complex processes, no matter how finely tuned, have areas of bottlenecks or consistent delays, which can be identified and resolved through the Six Sigma process.

The resolution of indicated delays will invariably result in a decrease in variation, and ultimately, improved service to customers. The improved service will ultimately translate into improved profitability

Who you serve what services you provide and how you are going to achieve competitive advantage is the mission of Service SCM whose vision is to deliver added-value to its customers. Service SCM is always in a dynamic, complex and rapidly changing market environment, Lean Six Sigma is strategic management tool, which be able to fit in the Service SCM and improve the performance from the basis .Only the "zero error" concept is rooted in the quality of Service SCM, can the organization achieve both its development and sustainability goals.

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