SUPPLIER SELECTION PROCESS OF OUTSOURCED LOGISTICS SERVICES - A LEAN SIX SIGMA APPROACH

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ABSTRACT

This paper focuses on addressing the challenges in the supplier selection process (SSP) for logistical activities. An action research case study approach in a large multinational healthcare technology company was conducted. Lean Six Sigma's DMAIC (Define-Measure-Analyse-Improve-Control) methodology was applied to alleviate bottlenecks and improve the SSP of the case company. Two research questions were raised to address the key challenges faced in the SSP of the case company. The first research question aimed to understand the current state of company A's SSP and identified three possible root causes to this issue. The second research question focused on identifying areas that the Lean Six Sigma can be incorporated to improve the SSP. While the findings and proposed lean six sigma solutions to enhance the SSP in the case company are encouraging, the study is limited in a single case, the proposed approach needs to be further tested and refined in more services purchasing organisations. Research in service procurement and supplier selection rarely link continuous improvement ideology to support strategic selection and procurement of logistics services. This action research contributes to research and practice by explicating the value of lean six sigma as a total quality management framework to drive service improvements in the supplier selection and procurement processes.

Keywords: Action Research, Lean Six Sigma, Procurement, Supplier Selection Process, Logistics Service Providers.

1. INTRODUCTION

Increasing competitiveness in the market today pressures companies to seek for new methods to achieve competitive edge over their business rivals. Besides pressure from the intensified competition, firms are now exposed to market concerns towards issues like economic downturn, deteriorating environmental and sustainability situation (Vasina, 2014). Outsourcing is a common approach for organisation to focus on their core competencies, while transferring of a portion or all of the firm's service functions to external organisations.

According to O'Byrne, 2019, a growing number of 'corporations, medium-sized companies and even small businesses' have a cost base with 90% attributed to supply chain expenditure. At present, many organisations seek to outsource their logistics activities to logistics service providers (LSP) who performs logistics activities as their main business. LSPs have the ability to operate both specific and entire logistics process according to the needs of the organisation.

[1] This paper is based on an applied research project conducted under the Logistics and Supply Chain Management Programme.

Alkhatib (2015) highlighted that global trends are evidently changing and with the emergence of marketplace threats, companies are re-examining their evaluation and selection of external parties, suggesting that there has been shifts in the logistics outsourcing criteria and methods. If an appropriate LSP is selected, firms can benefit in many different aspects such as service improvement, cost reduction, increased flexibility and attention on core competencies. Therefore, the selection and evaluation of a LSP is important as they determine the supply chain performance of a firm which in turns affect the competitiveness of the company.

Besides outsourcing to focus on core competencies, another reason for outsourcing is due to the changing customer demand patterns. In meeting the changing demand, firms are putting greater emphasis to ascertain and ensure the quality of suppliers, distribution channels and all associated activities (Gnanasekaran, et al., 2006). As such, the supplier selection process (SSP), which is the primer to the outsourced activities is extremely critical to a firm as it indirectly impacts the company's profitability and success (Nilesh R. Warea, 2012).

Though extant literature on SSP have provided valuable insights, there remains several gaps that call for a further research and deeper understanding of the SSP. Firstly, most of papers assessed in this literature review provided an unbalanced perspective towards the subject matter. For instance, Alkhatib, et al., 2015 highlighted the need for a SSP to be updated and reflective of the changing environment. However, the author failed to consider the possibility of suppliers falling behind the trends, making them the party who cannot catch up with the fast-changing SSP.

Another gap found in our literature review is there seems to be sparse research that focuses on examining and improving the SSP of healthcare supplies industry. Further, research in service procurement and supplier selection rarely link continuous improvement ideology to support strategic selection and procurement of logistics services. Hence, this research aims to address this gap by examining an empirical case in a healthcare technology company, which seeks to streamline and minimise the lead time of the SSP.

by raising two key research questions:

RQ 1: What are the factors that contributed to the inefficient supplier selection process?

The first research question aims to *understand the current state of Company A's supplier selection process while identifying possible root causes to the issue.*

RQ 2: How can the organisation tackle the inefficiency of the supplier selection process using Lean Six Sigma (DMAIC) approach?

The second research question aims to *find out how DMAIC can be used to improve the inefficiency of supplier selection process*.

2. LITERATURE REVIEW

2.1 Supplier Selection Process of Outsourced Logistics Service Providers

Considering the focus of this study – the SSP of Company A, exploring empirical studies of similar phenomenon aids in our analysis of the subject matter in the later part of the research. Hence, we examined relevant case studies and extant literature by observing the similarities and differences so as to elucidate deepened understanding about the issues and challenges faced by company A, cognizant of the contextual saliencies that are peculiar to our focal case – company A. We focused on examining the recurrent themes and issues in company A and adopted the lean six sigma methodology as the problem solving approach for our analysis.

According to Goodrick (2014), using prior case literature as reference, in comparison to the focal case company allow in-depth analysis to obtain generalizable knowledge about casual questions (Goodrick, 2014). It is typically used when the focus of the research is to answer the 'why', 'what' and 'how' questions raised towards the subject matter (Tiusanen, 2017). In this

case, the research questions cover the 'why', 'what' and 'how' which further justifies the use a comparative case study in this paper. We identified case studies and literature that are closely relevant to the case context and highlighted the learning and value with reference to the research questions in our study.

As shown in the Table 1, the findings from each case literature review were referenced to its respective research objective for analysis. For instance, *Alkhatib (2015)'s* study on the impact of market environment on supplier selection and evaluation process laid a foundation for our understanding towards the subject matter. Each article was critically reviewed to support the analysis of the research objectives and acts as a benchmark for our research. Table 1 summarised the key insights that were identified based on a thematic analysis of our cross-case and within-case analyses, taking each case paper as a stand-alone case.

Table 1. Summary of literature review

RQ	Author	Paper Title	Key Research Results	Value to Research
1	Alkhatib, et al., 2015	Logistics Service Providers (LSPs) evaluation and selection: Literature review and framework development	• Businesses are shifting focus to their supplier base due to the changing trends and market environment • Methods and evaluation criteria are reassessed to determine if they are outdated for the new trend/priority	• Serves as a good foundation for our understanding towards the subject • Aids in our evaluation of Company A's current supplier selection process and evaluation criteria – relevant or outdated for the existing business priorities and market environment
	Ordoobadi & Wang, 2011	A multiple perspectives approach to supplier selection	• Multiple perspectives among stakeholders in selection process • Multiple models can be used to ensure comprehensive research	• Recognising nature of supplier selection process • Identified a potential factor that may hinder the efficiency of Company A's supplier selection process
2	Furlotti, 2014	A model of Best Practices for a Sourcing Process	• Designed a model that incorporates customers touch so that feedbacks can be gathered at specific activities instead of throughout the process	• Gained insight on how process can be streamlined • Identified company that uses the same supplier selection model • Highlighted opportunity for further research for this model

RQ	Author	Paper Title	Key Research Results	Value to Research
	Secundo, et al., 2016	Supporting decision-making in service supplier selection using a hybrid fuzzy extended AHP approach	• Highlighted the limitation of a single model • Emphasised on the need for a model that accounts for ambiguity prevalent in reality • Combined AHP and Fuzzy method for a comprehensive supplier evaluation	• Obtained insights on the importance of designing a supplier selection process that reflects reality • Open up possibilities of merging different models to achieve the best fit for the Company A
3	Vasina, 2014	Analyzing the process of supplier selection. The application of AHP method	• Evaluated popular models from 1970s till present • Designed a model that includes fundamental activities of process	• Guides the study by identifying the fundamental in the activities. The identification allows Company A to apply lean six methodology more effectively
	Haque, et al., 2010	Six-Sigma DMAIC Supplier Selection Process	• Success use of DMAIC for evaluation of case organisation	• Supports the usefulness and applicability of Six Sigma tools in process improvement initiative • Good reference for the final recommendation of this study

2.2 Lean Six Sigma for Process Improvement

This applied research study focused on seeking feasible solution(s) using a structured Lean Six Sigma (LSS) problem solving approach to enhance the current SSP practices for the case organisation. LSS is a well-established and widely used methodology for improving operational efficiency and effectiveness in organizations (George, 2003; Hahn et al, 1999; Pande et al, 2000). It is mostly known because of its stepwise approach to improvement, called DMAIC, which is an acronym for Define, Measure, Analyse, Improve, and Control. The scientific approach to problem solving lays out how a culture of effective and lasting continuous improvement can be realized (Demast et al, 2016). It provides guidelines concerning projects selection as well as deployment, root causes identifications, measurements and analysis, improvement and control strategies. This research focused on examining the recurrent themes and issues in the supplier selection process using the lean six sigma methodology as the problem solving approach to guide in our analysis.

3. RESEARCH METHODOLOGY

This research aimed to conduct an in-depth analysis and holistic understanding of the SSP of a healthcare company so as to highlight potential areas for improvement. In order to deeply engaged in the contextual understanding of the SSP of the healthcare technology company, we conducted our field study using ***action research*** as the guiding research framework. Action research is particularly suited for developing holistic understanding as the project unfolds, recognising complexity of an organisation's dynamic socio-technical systems (Shani, A. B. R. and Coghlan, D., 2019; Coughlan, P. and Coghlan, D., 2002)

We collected both qualitative and quantitative data in the study. These included primary data sources in the form of on-site interviews and surveys, researchers' site observational notes, focused group discussions, archival records, including SAP records and documents on the

standard operating procedures that are relevant to the SSP.

3.1 Case Study – Background of Case Company A

The context of our action research is the SSP of a Multinational Healthcare Technology company, abbreviated as 'Company A', with a primary purpose of enhancing the health of people. The core mission of the firm is to ameliorate people's well-being by extending its coverage to a spectrum of healthcare system, which include 'prevention, diagnosis, treatment and home care'. Examples of products produced by Company A are portable mesh nebuliser, sleep apnea masks and pain relief infrared lamps. Till date, the organisation has emerged as a global influence, establishing its presence in more than 75 countries worldwide. Company A engages LSPs to perform logistics activities like warehouse and distribution for the firm. The selection of LSPs are done through the procurement department as part of procurement operations cycle and supplier selection process before a logistics service contract can be issued for service provision.

Similar to many organisations, Company A outsources its non-core competency to professionals like LSP. To maximise the cost-savings from suppliers, the procurement team is accorded to minimise procurement spending, produce savings, encourage continuous improvement initiatives, decide on whether a product should be made in-house or purchased in order to lower the total cost of ownership.

3.2 Research Design and Data Collection

We have chosen to adopt an ***action research*** case study approach that thoroughly analyses the supplier selection process to identify root causes to the problem, with an ultimate goal of proposing workable solutions to enhance the SSP so as to minimise any potential disruptions to contractual services due to lags in the exisitng SSP. This research aims to make use of Lean Six Sigma methodology to guide the development of workable solutions to address the core issues and challenges that were identified in the case company.

Figure 3 shows the overview of our data collection for this study that included both quantitative and qualitative data that are collected through different personnel and platforms.

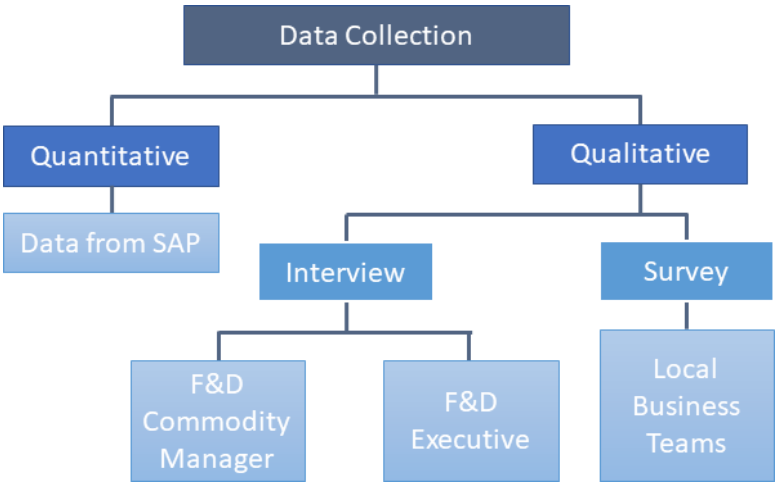

Figure 1. Overview of data collection

Quantitative Data Sources

For quantitative data analysis, raw data from the existing enterprise resource system – SAP were collected and analysed to shed light on the supplier selection issues in Company A. We have taken a longitudinal data analysis approach by analysing the contractual records for the ten-year period from 2008 to 2019. Based on Company A's SAP system, a total of 245 contracts records were negotiated over the ten-year period from 2008 to 2019.

Our rationale for adopting a longitudinal data analysis across the ten-year period from 2008 to 2019 was to mitigate the data skewness due to the wide variations in spending amount and contracting lead time that were accorded for differential product and customers' needs. A substantial quantitative data volume over a ten-year period was so chosen to minimise data skewness that might be more apparent in a shorter time horizon. Furthermore, the ten-year time period from 2008 to 2019 also accounted for three important transitions – (1) sourcing and negotiation, (2) contract drafting and alignment, and (3) contract implementation and expiry in the current SSP. These data include important details like supplier name, contract number, spending and important dates relevant to the SSP. The focus of our data evaluation at this stage was to reveal embedded issues and shed light on the severity of the process inefficiency, with an ultimate aim to identify specific activities that can be tackled to improve the SSP.

Qualitative Data Sources

Besides quantitative data, qualitative data in the form of semi-structured interviews and surveys were collected to shed light on matters relating to human experience, informants' instinct and opinions at the focal case company. This is particularly useful in addressing research questions that pertains to factors that were affecting the processes, approaches or workarounds that were used to tackle issue and challenges in Company A. Since the entire supplier selection process is largely facilitated by human reasoning, qualitative data is needed for us to understand the real issue.

Given that F&D is the main facilitator of the entire SSP, semi-structured interviews were conducted with 2 key parties to obtain more information to encourage discussion and deeper conversations with the interviewee during the interviewing process. The Commodity Manager (CM) oversees the entire project, directs the other stakeholders and make decisions on behalf of the company. Considering the direct involvement of the CM in the SSP from beginning till the end, he is a key informant in our interview process for specific knowledge and detailed information concerning the SSP.

On the other hand, the F&D executive is responsible for supporting the projects of the commodity manager. In most cases, the executive is the most frequent contact point for all stakeholders as he plays the role of a project leader while the commodity manager plays the role of a project advisor. Since the executive is the main facilitator of all activities of the project, valuable insights can be obtained through an interview from his experience working with all stakeholders on the ground level. Furthermore, it allows the interviewer to clarify issues immediately when in doubt. In all, two separate interviews were conducted with the key informants who were experienced and knowledgeable about the end to end SSP.

Besides the F&D team, the other key stakeholder is the local business team of Company A. A survey was chosen due to two reasons. Firstly, considering that all business teams are located in various cities across ASEAN and India, geographical boundary is one of the reasons for a survey instead of interview. Secondly, although the business teams are the users of the contracts negotiated, they do not have the full perspective of the entire SSP. Hence, a survey would be sufficient to gather their insights. In this case, the survey was restricted to those in direct contact with the LSP selection process so that the results are representative of the boundaries of this study.

The survey was sent to a total of 17 respondents, out of which, a total of 11 responded. Although the sample size may seem small, 17 is already representative of all ASEAN business stakeholders directly involved in the LSP selection process. Hence, the survey results are considered representative of the ASEAN business team.

4. FINDINGS

The first stage analysis of the multiple data sources, including semi-structured interviews, surveys, corroborated with SAP data. The second stage analysis involved a deeper evaluation of the first stage analysis and the deployment of various DMAIC tools to improve the as-is process.

4.1 Current State of the Supplier Selection Process of Company A

In the case of Company A, growth in its global influence was observed in the past few years. With an extension of its global influence, supply chain networks are inevitably expanded as well, with increasing number of of outsource contracts that the firm has with LSPs worldwide. The supplier selection process (SSP) is typically triggered in 3 circumstances as shown Figure 1.

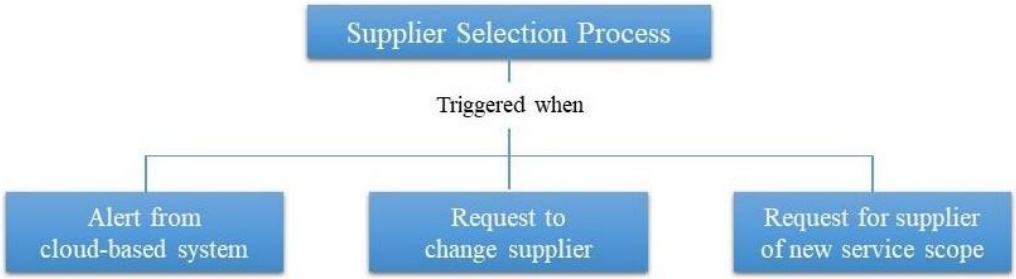

Figure 2. Supplier selection process

Firstly, the SSP is triggered when the SAP Enterprise Resource Planning system alerts the ***Freight and Distribution team (F&D)*** of an expiring logistics service contract. This system is customised for Company A primarily for contract filing purposes. To ensure efficiency and visibility in the procurement team, functions such as e-approval, e-signature and documents sorting are incorporated into the system. It allows authorised personnel to have access to all contracts and ongoing processes including expiring, expired and outdated contracts.

Secondly, F&D is alerted when the local business team requests for a change of supplier. This usually occurs when the incumbent LSP is underperforming or requesting for increase in rates. In such cases, F&D will be activated to facilitate the sourcing of a new supplier.

Thirdly, the process is triggered when the organisation's business team request for a supplier for a new service scope. This arises when there are new products that require additional storage space and distribution services. Although it is convenient for the organisation to engage the incumbent supplier, F&D would still need to conduct a proper sourcing to ensure the best rate and quality are obtained. With reference to Figure 2, the SSP is considered completed when the contract is signed and implemented. Every contract in Company A's SAP system requires a supplier selection process to be executed.

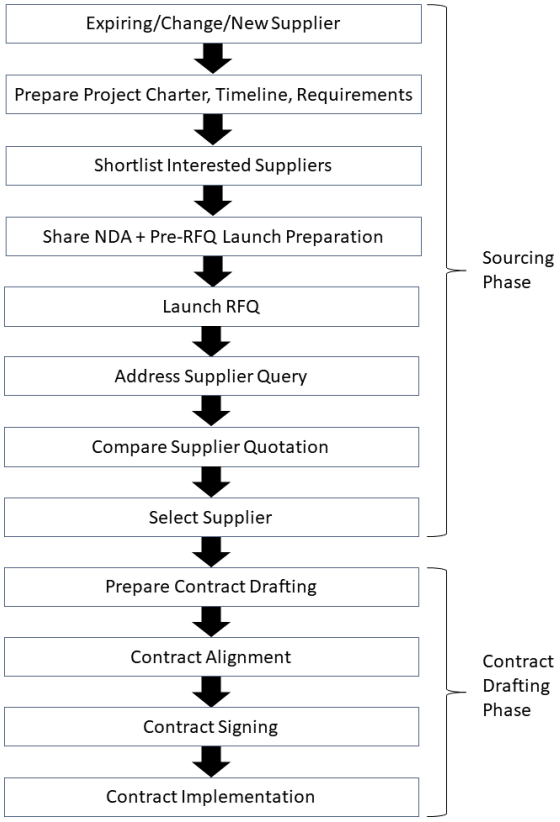

Figure 3. Company A's current supplier selection process

With the rising number of contracts, there had been increasing pressure on F&D to complete each process efficiently. Although the most ideal scenario is for F&D to complete each process within a short lead time to prevent a snowballing effect, this is not actualised most of the time in reality.

The large supplier base together with shortage of manpower impedes F&D from completing each SSP efficiently. According to the Company A's SAP report (2008 – 2019), approximately 52.2 percent of contracts were signed after the effective date of the contract. The difference in duration between the effective date and late date of signature widely ranges at an alarming span of 3 days to 1.5 years.

4.2 Applying Lean Six Sigma for improving Supplier Selection Process

We applied several Lean Six Sigma tools in our analyses of Company A' SSP. Instead of a complete adoption of the DMAIC approach, we will be focusing on the tools and techniques used in the Define, Analyse, Improve and Control phase. The DMAIC tools and techniques that were used to address the research questions are summarised in Table 2.

Table 2. Lean six sigma tools and techniques employed in the study

Define:	Project Charter, SIPOC Map, Stakeholder Analysis, Process Map	RQ1,2
Analyse:	5W2H, Cause-and-Effect Diagram, FMEA, ANOVA	RQ1
Improve:	Mistake-Proofing, Pilot Checklist, Brainstorming	RQ2

Control:	Team Feedback Session, Communication Plan	RQ2

SIPOC Diagram

To begin, a review on all relevant components of Company A's SSP was conducted using the SIPOC diagram. A SIPOC diagram is a Six Sigma tool that identifies all aspects of a process before work begins. It follows the abbreviation of the five categories in a process – suppliers, inputs, processes, output and customers and is useful for defining complicated processes that are not well-scoped.

Table 3. SIPOC Diagram of Company A

SUPPLIERS	INPUTS	PROCESSES	OUTPUT	CUSTOMERS
Provider of necessary inputs that directly contribute to the output creation	*Materials, information, data, or resources required to execute the process*	*A structured set of sequenced activities that transforms the input into specific, value-adding output to identified customers*	*Product(s) of the process that transforms the input*	*The recipient of the output(s)*
• Procurement (F&D) • Business • Legal • Logistics Service Provider (LSP) • Insurance and Risk Management (IRMD) • Quality Agreement (QA)	• Reason for sourcing • Scope of service • Incumbent LSP • Spending • Business Budget • Timeline • Target • Documents needed • Evaluation Criteria	Expiring/Change/New Supplier ↓ Prepare Project Charter, Timeline, Requirements ↓ Shortlist Interested Suppliers ↓ Share NDA + Pre-RFQ Launch Preparation ↓ Launch RFQ ↓ Address Supplier Query ↓ Compare Supplier Quotation ↓ Select Supplier ↓ Prepare Contract Drafting ↓ Contract Alignment ↓ Contract Signing ↓ Contract Implementation	• Chosen supplier • Signed contract	• Logistics Service Provider (Profit) • Business (Operations) • Procurement (Savings) • End customers (Goods)

Table 3. effectively illustrated a systematic process flow of Company A's SSP from the identification of key stakeholders to end beneficiaries of the final product.

Table 4. provides the specific roles and responsibilities of the six key stakeholders that are involved in the process. Of the six stakeholders stated, F&D, Business, Legal and LSP are the main players of the process with IRMD and QA playing the supporting role.

Table 4. Roles and responsibilities of the six key stakeholders involved in the SSP of Company A

Stakeholders	Procurement (F&D)	Business	Legal	Logistics Service Provider (LSP)	Insurance and Risk Management (IRMD)	Quality Assurance (QA)
Roles, Responsibilities and Functions	Leader/Main facilitator of the entire process	Users of the contract	Legal advisor of contracts	Users of the contract	Risk advisor of contracts	Quality advisor of suppliers
	Responsible for sourcing and recommending LSP	Responsible for providing insights on the market	Responsible for the obligations and wordings in the contract	Responsible for performing its obligations as stated in the contract	Responsible for liabilities coverage and protection of goods	Responsible for the quality of suppliers – certification, audit, quality requirements
	Most familiar with company requirements like payment terms	Most familiar with LSP performance and billing matters	Most familiar with legal requirements of different cities	Most familiar with warehouse and trucking operation matters	Most familiar with company insurance coverage, liabilities and safety requirements	
	Represents the firm in negotiation for rates/continuous improvements	Primary decision-maker of operations-related matters	Primary decision-maker of legal clauses and final approval of contract		Primary decision-maker of liabilities-related clauses	

Challenges in Company A's Supplier Selection Process

As we examine the SSP of Company A shown in Figure 2, the process is categorised into two phases with the first eight activities in the sourcing phase and the last four in the contract drafting phase.

Late contracts

As the contract implementation is the last step of the entire SSP, the date in which the contract is signed determines the completion of the process. For company A, a contract is considered late if it is signed and actualised after the effective date of its indicated contractual period.

Our analysis of the SAP records of 245 contracts negotiated from 2008 to 2019, close to 75 percent of the contracts were considered late. Of the late contracts, 52.6 percent of them had the contracting phase as the bulk of its total lead time while the remaining 47.4 percent had the

sourcing phase as the greatest contributor of its total lead time. This suggests that the ***contracting phase*** generally took a longer time in comparison to the sourcing phase and seemed to be a major contributor to the late contracts.

Factors contributing to the inefficient supplier selection process

This section addresses the first research question to understand the current state of Company A's SSP while identifying possible root causes to the issue. Tools that will be employed includes cause-end-effect diagram as well as interrelationship diagram.

Analysis of the contracting phase

To tackle the contracting phase, we first need to identify the contributors to the inefficiency. Using the data obtained from Company A's SAP system, we identified that approximately 90.36 percent of the total contracting lead time were attributed to back-and-forth communication.

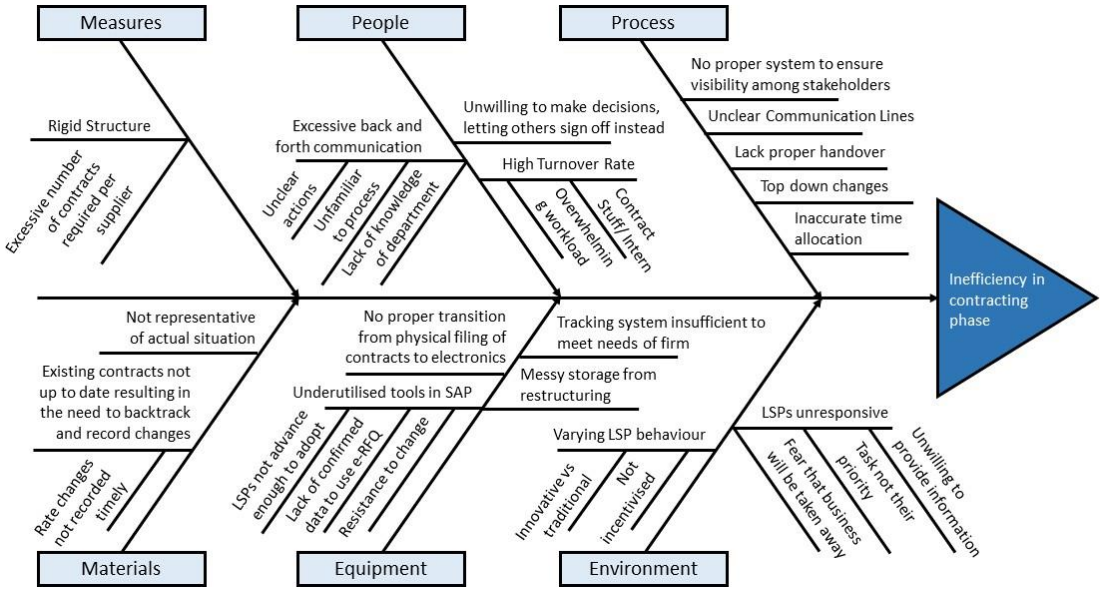

Figure 4. Cause-and-Effect Diagram

To further tackle this issue, a root cause analysis using the cause-and-effect diagram is conducted. The cause-and-effect diagram also known as the fishbone diagram is a lean six sigma tool that seeks to identify the root cause to a problem. Besides indicating the problem statement at the 'head of the fishbone', another important step is to create categories for the causes. There are two commonly adopted categories – the 4 Ps (Policies, Procedures, People, Plant) and 6 Ms (Machines, Methods, Materials, Measurements, Mother Nature, Manpower). In this case, we used a combination of both groupings as seen in Figure 5 to better reflect the SSP of Company A.

The root causes indicated in Figure 5 were established through the quantitative and qualitative data (Appendices) gathered as well as references to the literature reviews. For easier reference, a summary of the root causes and its sources are listed in the Table 5 below.

Table 5. Summary of root causes and its sources

Root Cause	Source
Rigid Structure	Interview with Commodity Manager, Survey
Excessive back and forth communication	Interview with F&D Executive. Survey
Unwillingness to make decisions, letting others sign off instead	Interview with F&D Executive, Survey
High Turnover Rate	Interview with Commodity Manager
No proper system to ensure visibility among stakeholders	Interview with Commodity Manager, F&D Executive
Unclear Communication Lines	Interview with Commodity Manager, F&D Executive
Lack proper handover	Interview with F&D Executive
Top down changes	Interview with F&D Executive, Survey
Inaccurate time allocation	Interview with Commodity Manager
Not representative of actual situation	Interview with Commodity Manager, Survey
Existing contracts not up to date resulting in the need to backtrack and record changes	Interview with F&D Executive
No proper transition from physical filing of contracts to electronic	Interview with F&D Executive
Underutilised tools in SAP	Interview with Commodity Manager, Survey
Tracking system insufficient to meet needs of firm	Interview with F&D Executive
Messy storage from restructuring	Interview with F&D Executive
Varying LSP behaviour	Interview with Commodity Manager
LSPs unresponsive	Interview with Commodity Manager, F&D Executive

Interrelationship Diagram

Although the cause-and-effect diagram is useful in organising the potential root causes of the problem, limitations are undeniably present. Graphically, all possible root causes presented in diagram look equally important, thereby making it difficult for the users of the diagram to rule out the actual root cause of the problem. Hence, an interrelationship diagram is used to counter the constraints of the model.

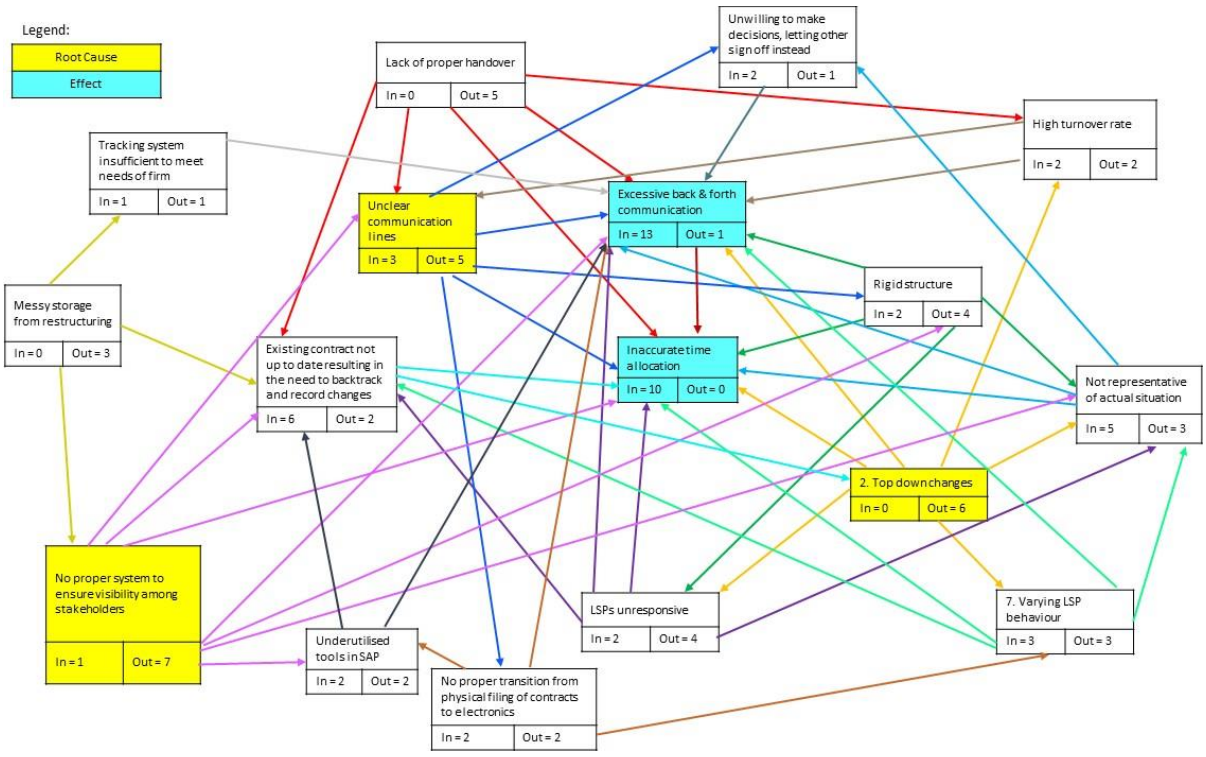

Figure 5. Interrelationship Diagram

The interrelationship diagram in Figure 6 consists of the potential root causes that were identified in the cause-and-effect diagram previously. When the arrow points away from root cause, it indicates that it is the cause while the other that is pointed to is an effect. For instance, unresponsiveness from LSPs can lead to inaccurate time allocation. Hence, the arrow points from 'LSPs unresponsive' to 'Inaccurate time allocation'. Through the analysis done in Figure 6, two effects and three root causes were identified.

Root Cause 1 – No proper system to ensure visibility among stakeholders

Ordoobadi & Wang (2011) highlighted the importance of communication and knowledge-sharing in a multi-perspective supplier selection environment. She mentioned that it is crucial for parties to 'learn the rationale of their colleagues' concerning every aspect of the supplier evaluation process in order for a quality decision to be made. Unfortunately, Company A lacks both effective communication and knowledge-sharing which evidently hindered the efficiency of the process. The absence of a proper platform that encourages interaction, prohibits stakeholders from sharing their expertise such as knowledge on market environment and top-down requirements which are value-adding to the efficiency of the process. This is also supported by F&D executive who stated that the lack of understanding and familiarity towards the business and processes hinders the selection process as parties fail to take into consideration every aspect.

One of the questions asked in the survey done among the business team was regarding the factors that influence the efficiency of the SSP.

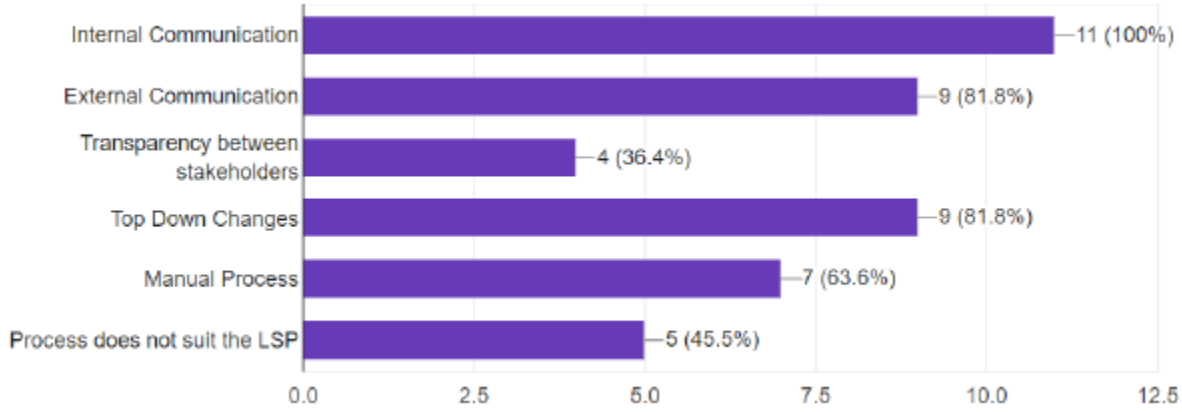

Figure 6. Factors that influence the efficiency of the Supplier Selection Process

Root Cause 2 – Top down changes

Of the 11 respondents, 9 indicated that top down changes were one of the factors that would influence the efficiency of the SSP as shown in Figure 7. This was further backed by the F&D Commodity Manager who also highlighted the impact of top-down changes on the SSP. She supported her statement with a real-life example stating that Company A's global quality assurance team recently launched a new contract known as the Quality Agreement. This Agreement was made compulsory to all new and existing suppliers, resulting in a lengthened lead time on ongoing negotiations.

Root Cause 3 – Unclear communication lines

Furlotti (2014) highlighted in his studies that miscommunication and lack of clarity often delay the decision-making process, deterring parties from closing the projects efficiently. For company A, F&D Commodity Manager expressed concerns towards the complexity of communication among stakeholders in the company. Almost all the survey respondents also chose internal communication as one of the factors that would hinder the efficiency of the SSP as seen in Figure 7.

Ironically, communicating internally seems to be more challenging than interacting with external parties where parties tend to seek affirmation from another with regards to contractual clauses. Despite the process being a team project, stakeholders tend to rely on the F&D employees for directions on who to align with during the contracting phase. Hence, the unclear communication lines on who to approach for advice would continue to fuel the excessive back-and-forth communication if it remains unresolved.

Methods used to tackle inefficiency in supplier selection process

This section addresses the second research question that is to examine *the approaches and workarounds that were implemented in an attempt to mend the gaps of the current supplier selection process.* Our focus was to take note of the issues relating to the effectiveness of the improvised workarounds and solutions in the current SSP.

Key challenges

According to F&D Commodity Manager, Company A encountered the issue of long lead time in its SSP during the period 2008 to 2015. Using the data collected from the SAP system, we

filtered the contracts from this time frame and conducted an analysis on the total lead time of these contracts in both the sourcing and contracting phase. Of the 245 contracts in the database, 152 of them were from the stated time period. Our findings have showed that 52.6 percent (80 contracts) of the contracts have the contracting phase has the bulk of its total lead time and 47.4 percent (72 contracts) have the sourcing phase as the biggest contributor to its total lead time. Findings in this period were relatively similar to today.

With reference to the quantitative and qualitative data collected, there are three possible reasons that can justify the inefficient SSP at that time. Firstly, LSPs disinterest in the project. One of the activities present in the sourcing phase of the SSP is the 'Pre-RFQ Launch' segment whereby frequent communication with the incumbent supplier to align on current scope of services is expected. While frequent communication may suggest efficiency in getting things done, it is not the case in reality. The F&D executive and commodity manager highlighted the challenges of obtaining information from existing suppliers due to several reasons:

i. Inability to let incumbent know the purpose of the 'study' since RFQ is confidential
ii. LSP's fear of losing business to another suppliers
iii. LSP does not prioritise our task

Other reasons that contributed to the inefficiency include excessive back-and-forth communication as well as the large volume of emails sent for a single project for clarifications.

Using Lean Six Sigma Methodology to improve supplier selection process

In this section, we analyse and identify areas that Lean Six Sigma can be incorporated into the improvement opportunities in the supplier selection process, in respond to the third research question.

1. Establishing a proper system for visibility through 5S

To tackle the root cause identified in this paper – no proper system for visibility, we apply 5S into the SSP. 5S is a methodology commonly used to declutter a physical workplace. It is strategically designed to construct an environment that encourages quality work and productivity through the elimination of waste (ASQ, 2019). Although some may argue that the 5S methodology is designed for a physical workspace, the concept and mind-set behind the framework makes its usable for process improvement. Considering that Company A lack a proper platform to promote visibility among the stakeholder, resulting in long contracting lead time, 5S would be useful as a guide to create an effective and value-creating system.

Seiri (Sort)

The first S represents Seiri (Sort) which focuses on distinguishing between what is necessary and unnecessary in the process. Similar to the SIPOC diagram, we first ***identify relevant departments*** that needs to be kept updated in this SSP. In this case, these key players will be the five stakeholders consisting of F&D, business, legal, IRMD and QA. Some examples of information to be shared by the relevant stakeholders include:

Freight & Distribution – Updates on change in company policies and requirements *Business* – Updates on market movements (e.g. inflation, increase in minimum wage) *Legal* – Updates on changing legal requirements in contract

IRMD – Updates/Guides on company insurance and liabilities coverage

QA – Updates on new requirements for suppliers (e.g. ISO Certification)

Seiton (Straighten)

The second S represents Seiton (Straighten) which emphasises on the need for all items to have its own designated storage. In other words, the information that were identified earlier needs to be kept in a storage space in an orderly manner. One electronic system that Company A can leverage on is Sharepoint which is already installed in the laptops of all employees but are often

underutilised. Sharepoint is a cloud-based collaborative platform that integrates frequently-used applications like Microsoft Office and OneDrive. Apart from that, it has a ***Sharepoint Team virtual collaborative site*** that is designed specifically for business purposes. The cloud-based collaborative platform enabled online team collaboration and live communications, thus resulting in closer team work among the different business units involved in the SSP. Seiton (Straighten) concept can be incorporated onto the Sharepoint Team site easily in 3 steps. Firstly, create a team site. Secondly, create tabs and document folders for each department involved in the SSP. Lastly, share the site with the stakeholders identified in Seiri (Sort).

Seiso (Shine)

The third S represents Seiso (Shine) which encourages proactive efforts to maintain the tidiness and order of the process. In this case, sustainable cleanliness in the site can be obtained through responsible efforts by all stakeholders to file the documents in their respective folders. Occasionally, the F&D executive can visit the site to conduct a quick check on the tidiness of the site. The site will be considered in order if there are no irrelevant documents uploaded and documents are labelled clearly.

Seiketsu (Standardise)

The fourth S represents Seiketsu (Standardise) which refers to the development of a set of standards for the process. This can be done by creating another tab, name it 'administrative' and place it at the front of all the other tabs. Then, create a standard operating procedure (SOP) for the usage of site, covering the types of content and storage system that should be adopted throughout. Some suggestions for the content in the SOP include marking a document as important if it contains information that requires attention and indicating the date of latest update. After which, the SOP can be uploaded into the 'administrative' tab.

Shitsuke (Sustain)

Finally, the last S stands for Shitsuke (Sustain) which urges users to be discipline in using the site. Stakeholders should be proactive enough to update the site and team members on changes to keep the visibility within the team. Considering the busyness of Company A's employee, random checks is non-restrictive and can be done by any members of the team during their free time.

Overall, 5S is able to address the lack of platform and visibility by establishing a virtual work site that encourages knowledge-sharing. As long as the stakeholders are committed, this system that is implemented with 5S can be sustainable and beneficial for the contract negotiation in the long run.

2. Establishing a communication guide using stakeholder analysis

To address the root cause – top down changes, a stakeholder analysis is used to identify the stakeholders according to their 'levels of participation, power, interest and influence in the project'. The stakeholder analysis model shown in figure 8, aids in categorising the stakeholders according to their authority, involvement, interest and influence in the SSP. Of the 11 survey respondents, 2 suggested better top down decision and communication to improve the process. However, these suggestions are less feasible as it will be difficult for one to dissuade the top-down decisions and pressure them for quicker announcements. Hence, a more attainable approach is to manage the communication of top-down changes from F&D to the stakeholders according to their position using the stakeholder analysis.

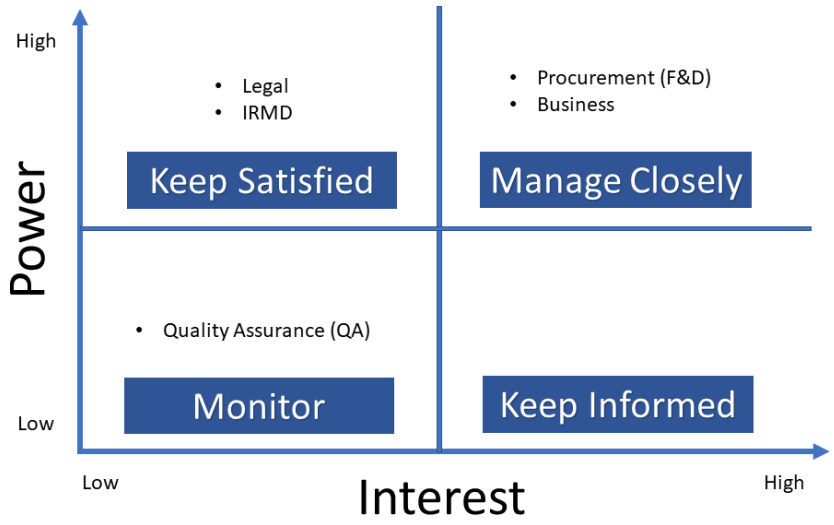

Figure 7. Stakeholder Analysis

Stakeholders in the *'manage closely'* segment have high power and interest in the SSP. Since they are highly involved in the process, communication on top-down changes to these departments should be fast, detailed and comprehensive. On the flipside, stakeholders who are in the *'keep satisfied'* category have high power but low interest. These are advisors who have the authority to make decisions in the process but are only involved when required. Therefore, top-down changes can be conveyed to them during audio or face-to-face meetings. Lastly, stakeholders who have low power and interest are placed in the *'monitor'* group. Stakeholders will only be notified when there are changes within 6 months. If no changes were made, no updates will be given.

3. Establishing a SOP to improve communication

Lastly, we designed a standard operating procedure (SOP) to resolve the root cause of unclear communication line. In this case, the inefficiency of in the contracting phase was due to the excessive back-and-forth which was directly caused by stakeholders' uncertainty towards who to seek for advice. Therefore, to effectively deal with the issue, a simple one-page SOP is implemented to guide stakeholders on the contact point for each category of contract clauses. Besides being an individual solution addressing only the root cause, the complete SOP in this segment can be combined with the Sharepoint Team site to improve visibility across the organisation.

5. DISCUSSIONS

The changing dynamics in the logistics business market call for greater enhancement on the SSP. The current process adopted by many companies, like in case company A, could be conducted in an ineffective and onerous manner. It is paramount to identify and address the root causes of the current process and recommend improvements such that the overall SSP can be optimized. We set off in this action research by invoking two research questions.

RQ 1: What are the factors that contributed to the inefficient supplier selection process?

In RQ1, we seek to identify the fundamental issues and pertinent root causes that lead to a long SSP. A cause-and-effect diagram is used to have an overview of the plausible bottlenecks embedded in the current process of Company A. The top three causes are identified at the end. An

interrelationship diagram is then used to connect the identified causes relating to the bottlenecks of the current process. This helps to shed light on the three major root causes, which are:

(1)Top down changes which hinders the communication within company itself

(2)Unclear communication lines where the company is unsure of the main point of contact and the main decision maker for each supplier

(3)Lack of visibility where information is unorganized and not shared to relevant stakeholders

RQ 2: How can the organisation tackle the inefficiency of the supplier selection process using Lean Six Sigma Methodology?

In addressing RQ2, we suggested methods that can be used to tackle the three root causes identified in RQ1. First, the 5S method is proposed to tackle the root cause – lack of information visibility. It aims to organise the large information transmitted between stakeholders in a shared drive so that information can be retrieved easily from a common platform. It also helps to keep all the stakeholders informed on the progress of the SSP, which will help to reduce the excessive time needed to clarify doubts during negotiation.

Secondly, for the root cause - top down changes, a stakeholder analysis can be applied. This analysis identifies those stakeholders who will be greatly affected by the changes, so that advanced notifications on the changes made to the procurement process can be planned and communicated. This helps to structure communication plans and to ensure the appropriate information are communicated to the relevant stakeholders so that all parties are sufficiently and duly informed ahead of status of progress of the SSPs.

Thirdly, for the root cause - unclear communication lines, a standard operating procedure (SOP) can be implemented. SOP serves to form a shared base where every stakeholder is aware of the main point of contact in the event that communication is required. By having a common knowledge among all parties, the duration taken for the SSP to be completed will be shortened as information will be passed down more accurately and swiftly.

6. CONCLUSION AND IMPLICATIONS

While there has been extensive research on supplier selection and lean six sigma, little has been said on how best to manage the supplier selection process using continuous improvement ideology such as lean six sigma to support supplier selection and procurement of logistics services. This study seeks to address this gap and identify workable solutions that can alleviate bottlenecks in the supplier selection process (SSP). From the onset, this action research study focused on the recurrent issues in the supplier selection process of Company A, a multinational health technology company that engages logistics service providers (LSPs) to manage its logistics activities on a global scale.

Two research questions were formulated to examine the challenges faced by Company A and propose workable solutions to improve the current process. The first research question aimed to understand and identify the key challenges in the current state of company A's SSP. This is achieved by using the cause and effect diagram and an interrelationship diagram to determine the three main root causes, which include – (1) top down changes (2) unclear communication lines and (3) lack of information visibility. The second research question focused on identifying areas that the Lean Six Sigma can be incorporated to improve the SSP. The 5S method, stakeholder analysis and standard operating procedure (SOP) were used to address the root causes.

In terms of research and practice implications, the paper contributes to extant literature in supplier selection, procurement process and lean six sigma by providing a deepened understanding for organizations on the value of lean six sigma for improving supplier selection process. For

consultancies and learning institutions, this work serves as a reference for using lean six sigma to drive procurement and supplier selection processes in supply chains.

In addition, while this study provides a comprehensive analysis and suggests improvements to reduce the total procurement lead time, the solutions relate mainly to the contracting phase as we had focused on the contracting phase since it is the main contributor to the late contracts. Further research could focus on addressing delays in the sourcing phase, which accounted for a sizable 49 percent of the delays in the current SSP.

Finally, this research is limited to data from a single case study, future studies explore further contextual adaptations to ensure that the proposed solutions are appropriate in addressing the salient issues faced by other similar contexts.

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