PROCESS FLOW IMPROVEMENT USING VALUE STREAM MAPPING TO REDUCE WASTE AND LEAD TIME IN MALAYSIA HEALTHCARE

SITI HAIZATUL AISAH BINTI HARON

UNIVERSITI TUN HUSSEIN ONN MALAYSIA
PROCESS FLOW IMPROVEMENT USING VALUE STREAM MAPPING TO REDUCE WASTE AND LEAD TIME IN MALAYSIA HEALTHCARE

SITI HAIZATUL AISHAH BT HARON

A thesis submitted in
fulfilment of the requirement for the award of the
Degree of Master of Science in Technology Management

Faculty of Technology Management and Business
Universiti Tun Hussein Onn Malaysia

FEBRUARY 2017
DEDICATION

I dedicate this thesis to

Almighty ALLAH S.W.T,

My father (Haron Bin Mohd Saad), my mother (Zainah Binti Buang) and siblings,

For your love, care and encouragement.

My supervisor and co-supervisor,

For your help, encouragement and guidance to ensure the success of this thesis.

Friends,

For your help, encouragement, helped me through, make me feel like I am not alone, may Allah ease their journey and never give up.

And everyone who involves directly and indirectly in the process of completing this thesis.

Thank you.
ACKNOWLEDGEMENTS

All praise to God, the Greatest that gives perfection and facility in applying all tasks and responsibilities.

I would like to acknowledge the generous contribution of individuals and organisations to this research, without them this research would not have been successfully completed.

First and foremost, I would like to express my gratitude to my supervisor, Puan Rohaizan Binti Ramlan, my co-supervisor, Dr Kamilah Binti Ahmad, and lecturer, Dr Ahmad Aizat Bin Ahmad for providing me with invaluable guidance, inspiration, encouragement for my research and for being a mentor and supporter with their constant inspiration.

I would also like to express my gratitude to Office of Research, Innovation, Commercialisation and Consultancy (ORICC), UTHM, for supporting this research under the Exploratory Research Grant Scheme (ERGS), Vot E045. I would also like to thank organisations, which participated in this research.

Finally, I would like to thank my parents, siblings and friends for all the love, understanding, and encouragement throughout the research period.
ABSTRACT

The implementation of Value Stream Mapping (VSM) method in healthcare institutions has started since the 1990s, mainly to fulfill the current need for an improved quality and efficiency in delivering services. However, the application of VSM in Malaysia healthcare institutions is still at an early stage. These institutions are under pressure to improve service quality and costs. Most of the healthcare institutions are facing an issue regarding long waiting time. Therefore, the intentions of this study are to investigate any process improvement that is currently being practiced by Healthcare Industry within Malaysia and reduce the waste and lead time in the process flow of patient by using VSM. VSM is one of the lean tools that can be used for process improvement in reducing both waste and lead time. Furthermore, VSM strengthens the analysis and provides clearer vision and plans by connecting all improvement methods in one figure. The study implemented a mixed method which includes distribution of questionnaires to explore the current practices on process improvement and observation process in order to reduce waste and also the lead time. The questionnaires were distributed to 141 respondents from the management team of healthcare industry in Malaysia. This study received 34% feedback through the survey of quantitative data. Results from quantitative data analysis shows that currently, 5S is the most applied process improvement practice in Malaysia healthcare industry. The results from the qualitative data showed that the waste and lead time in the process flow of patient are successfully reduced. The findings proposed that the healthcare should combine the process of registration with the blood and urine tests into one process, and also combine the process of check-up with the process of treatment. The number of staff remains the same. This study also suggests for the health centre to relocate the filing shelves to facilitate easier staff access, reorganize the layout of the clinic and relocate the room according to the process. These suggestions will improve the total lead time and reduced the cycle
time and waste in the process flow for patient. The result of this study is significant for other healthcare as well who are looking for further insight to implement VSM in their process flow, and intended to reduce the waste occurred within their healthcare.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>TITLE</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>iii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT</td>
<td>iv</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>vi</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xiii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiv</td>
</tr>
<tr>
<td>LIST OF ACRONYMS /ABBREVIATIONS</td>
<td>xvii</td>
</tr>
<tr>
<td>APPENDIXES</td>
<td></td>
</tr>
</tbody>
</table>

## CHAPTER 1     INTRODUCTION  1

1.1 Introduction  1
1.2 Research Background  3
1.3 Problem Statement  6
1.4 Research Questions  10
1.5 Research Objectives  11
1.6 Scope of Research  11
1.7 Significance of Research  12
CHAPTER 2 LITERATURE REVIEW

2.1 Introduction 15
2.2 Healthcare 15
2.2.1 Healthcare in developing countries 16
2.2.2 Healthcare in Malaysia 17
2.3 Process Improvement 20
2.3.1 Previous studies of process improvement in healthcare 21
2.3.2 Six Sigma 23
2.3.2.1 Six Sigma in Healthcare 25
2.3.3 Lean 26
2.3.3.1 Lean in healthcare 27
2.4 Value Stream Mapping 28
2.4.1 Sections of Value Stream Mapping 29
2.4.2 General terminology used in Value Stream Mapping 30
2.4.3 Eight wastes of lean 31
2.4.4 Previous Studies on Value Stream Mapping in Healthcare 32
2.5 Research Flow of Value Stream Mapping 39
2.6 Conclusion 41

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction 42
3.2 Research Purpose 43
3.3 Research Design 44
3.4 Quantitative Research Design 46
3.4.1 Population and Data Collection (Quantitative) 46
CHAPTER 5 CONCLUSION

5.1 Introduction 109
5.2 Discussion of the result attained for research questions. 110
5.2.1 Research Question 1 110
5.2.2 Research Question 2 112
5.2.3 Research Question 3 114
5.3 Contribution of research 115
5.4 Limitation of research 117
5.5 Recommendations for further research 117
5.6 Conclusions 118

REFERENCES 119
**LIST OF TABLES**

1.1 Admissions and outpatients attendances in 2013  
2  
2.1 Trend for Total Health Expenditure, 1997-2011 (RM Million & Percent GDP)  
19  
2.2 Previous studies of process improvement in healthcare  
22  
2.3 Previous Studies of Value Stream Mapping in Healthcare  
32  
3.1 Questionnaire distributions method and respond rate  
47  
3.2 Type of question design  
48  
4.1 The gender of the respondent  
54  
4.2 The age of the respondent  
55  
4.3 Familiarity with Process Improvement  
56  
4.4 Length of experience working with process improvement  
57  
4.5 Respondent’s department of work.  
59  
4.6 Introduction of process improvement in healthcare  
61  
4.7 Formal training on process improvement within healthcare  
62
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>Process Improvement tools applied within healthcare</td>
<td>64</td>
</tr>
<tr>
<td>4.9</td>
<td>Obstacles while implementing process improvement in healthcare.</td>
<td>67</td>
</tr>
<tr>
<td>4.10</td>
<td>Level of support while implementing process improvement in healthcare.</td>
<td>69</td>
</tr>
<tr>
<td>4.11</td>
<td>Legend for Figure 4.11</td>
<td>71</td>
</tr>
<tr>
<td>4.12</td>
<td>Table of data collection from observation (refer Figure 4.11).</td>
<td>72</td>
</tr>
<tr>
<td>4.13</td>
<td>The symbol and definition for Figure 4.14.</td>
<td>77</td>
</tr>
<tr>
<td>4.14</td>
<td>Comparison of TAKT time between morning session and whole day session</td>
<td>82</td>
</tr>
<tr>
<td>4.15</td>
<td>The comparison of TAKT time for each process between morning session and whole day session in the healthcare.</td>
<td>83</td>
</tr>
<tr>
<td>4.16</td>
<td>The related time for each process</td>
<td>83</td>
</tr>
<tr>
<td>4.17</td>
<td>Observation during the process of registration</td>
<td>86</td>
</tr>
<tr>
<td>4.18</td>
<td>Observation during the process of blood and urine test</td>
<td>88</td>
</tr>
<tr>
<td>4.19</td>
<td>Observation during the process of check-up</td>
<td>90</td>
</tr>
<tr>
<td>4.20</td>
<td>Observation during the process of treatment</td>
<td>92</td>
</tr>
<tr>
<td>4.21</td>
<td>Calculated data from the current state</td>
<td>94</td>
</tr>
<tr>
<td>4.22</td>
<td>Proposed data for future state map</td>
<td>97</td>
</tr>
<tr>
<td>4.23</td>
<td>The comparison in performance between the current</td>
<td>105</td>
</tr>
</tbody>
</table>
state and future state

5.1 The comparison in performance between the current state and future state
LIST OF FIGURES

1.1 Malaysian Health Budget Allocation from 2010-2016. 2
1.2 Trends for Total Health Expenditure 1997-2013 5
2.1 Research flow of study 40
3.1 Research design through mixed methods approach 45
3.2 Process flow of VSM for this study 51
4.1 The gender of respondent 55
4.2 The age of respondent 56
4.3 Familiarity with Process Improvement 57
4.4 Length of experience working with process improvement 59
4.5 The respondent’s department of work 60
4.6 Introduction of process improvement in healthcare 62
4.7 Formal training on process improvement within healthcare 63
4.8 Process Improvement tools applied within healthcare 66
4.9 Issues while implementing process improvement in 68
4.10 Level of support while implementing process improvement in healthcare

4.11 Figure for table of data collection in Table 4.12

4.12 The process of implementing VSM

4.13 Process flowchart of patient

4.14 The movement of patient

4.15 Current State Map

4.16 The total lead time

4.17 The comparison chart between TAKT time, cycle time and value added time for morning session in the healthcare (current state of VSM)

4.18 The idle time in each process

4.19 The capacity of patient in each process per day

4.20 Comparison of cycle time during current state and future state for the process of registration and the process of blood and urine test

4.21 Comparison of cycle time during current state and future state for the process of check-up and the process of treatment

4.22 Comparison of the total lead time during current state and future state.

4.23 Comparison of the value added time during current state and future state
4.24 Comparison of the non-value added time during current state and future state.

4.25 Future State Map

4.26 Process flowchart of patient for future state

4.27 The data of value added time for future state after VSM

5.1 The waiting time of patient for each process

5.2 The waiting time for each patient (min)
## LIST OF ACRONYMS /ABBREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CQI</td>
<td>Continuous Quality Improvement</td>
</tr>
<tr>
<td>DES</td>
<td>discrete-event simulation</td>
</tr>
<tr>
<td>DMAIC</td>
<td>Define, Measure, Analyze, Improve, Control</td>
</tr>
<tr>
<td>EPU</td>
<td>Economic Planning Unit</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>LMI</td>
<td>Lean Management Initiatives</td>
</tr>
<tr>
<td>MHTC</td>
<td>Malaysia Healthcare Travel Council</td>
</tr>
<tr>
<td>MoH</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>RFID</td>
<td>Radio frequency identification</td>
</tr>
<tr>
<td>SSI</td>
<td>Six Sigma Initiatives</td>
</tr>
<tr>
<td>VSM</td>
<td>Value Stream Mapping</td>
</tr>
<tr>
<td>VA</td>
<td>Value Added</td>
</tr>
<tr>
<td>NVA</td>
<td>Non-Value Added</td>
</tr>
<tr>
<td>C/T</td>
<td>Cycle Time</td>
</tr>
<tr>
<td>C/O</td>
<td>Change Over Time</td>
</tr>
<tr>
<td>SIPOC</td>
<td>Suppliers, Inputs, Process, Outputs, Customers</td>
</tr>
</tbody>
</table>
LIST OF APPENDICES

Table of data collection from observation
Survey Questions
CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia has been listed as one of the developing countries that are successful in various fields. Malaysia is one of the developing countries listed by the World Bank in a group category of upper-middle-income economies with the range of $4,086 to $12,615. Malaysia has enjoyed economic growth and underwent major development programmes aiming to be a fully developed nation by 2020. In order to achieve the target as a successful nation, lots of action/programmes had been done in various fields such as economy, technology, social, cultural, spiritual, and more. Malaysian Plan is one of the steps taken to achieve the target for a better Malaysia in the future that includes services, manufacturing, agriculture, mining, construction and others. Health industry is included under the service sector as stated in the first Malaysian Plan.

Since the first Malaysian Plan, the Ministry of Health had introduced various health programmes to improve patient’s safety and the population’s health. The Health Plan which has been detailed out in 10th Malaysian Plan 2011-2015 aims to improve the country’s healthcare system based on the concept of “1 Care for 1 Malaysia”. This 1 Care is a structured national health system that is responsive and provides choice in quality healthcare, ensuring universal coverage for the population’s healthcare needs based on solidarity and equity. This Health Plan was formulated based on a deep understanding on the needs and challenges, the government’s ability to finance it, and
value for money. It was developed to reflect the aspirations in achieving a high-income country status by 2020 (MoH, 2010). Since Malaysia is categorized in a group of upper-middle-income economies with the range of $4,086 to $12,615 which is considered high, citizens are experiencing the consequences where it involves the rise in hospitalisation, institutional care and health insurance costs (Malaysia Economic Planning Unit, 2010).

The major issues that have been discussed in Malaysian Health Plan 2011-2015 are regarding the increase in healthcare costs. From the report, it was stated that the rising cost of care is due to several factors which are inefficiency, increasing demand for health services in institutions and also wasted resources (MoH, 2010). Besides, there are five cost drivers that had been mentioned which are wealth, epidemiological transition, facing emerging/re-emerging infectious diseases, demographic transition and lastly, technology (MoH, 2010). Other than the aim to maintain the low cost, the healthcare sector also needs to meet the goals in providing care and enhancing health (Dahlgaard, Pettersen, & Dahlgaard-Park, 2011). According to the previous reports, it were mentioned that the allocation budget for Malaysian Health increased each year since 2010 until 2016 except 2011 and 2016 where the amount slightly decreased. Figure 1.1 summarise the data for Malaysian health budget allocation from 2010 until 2016.

![Figure 1.1 Malaysian Health Budget Allocation from 2010-2016.](image)
On the other hand, to complement the continuous growth of Malaysian healthcare, the research organizations are required to study the cost-effectiveness and performance measurement during the implementation of 10th Malaysia Plan. Therefore, it is important for the management to fully utilise available process improvement for healthcare in order to curb the hardship issues from mushrooming. The process improvement methodologies such as Lean and Six Sigma have tremendously improved the quality and efficiency of manufacturing and service sectors for decades (Antony, Krishnan, Cullen, & Kumar, 2012).

Process improvement method has been widely used around the world in improving the operation of an organization (Abdulmalek & Rajgopal, 2007; Mujtaba, Feldt & Petersen, 2010; Shahrbabaki & Jackson, 2011). Value Stream Mapping is one of the process improvement tools that has been tremendously used in healthcare (Castle & Harvey, 2009; Nelson-Peterson & Leppa, 2007; Puterman et al., 2012). However, the implementation of Value Stream Mapping (VSM) in Malaysian healthcare industry is still low. In fact, the result obtained from the preliminary study showed that VSM is one of the process improvement tools that has not been used by respondents of the study. Therefore, this research aims to study the current practice of process improvement in Malaysian Healthcare to the extent of implementing the VSM in the process flow of patient in healthcare.

1.2 Research Background

Healthcare industries are experiencing an extremely challenging situation in maintaining a competitive edge. In recent years, the healthcare providers for example in Malaysia are under a great deal of pressure to improve the quality of services as well as costs. This is due to the growing number of population and greater expectation for healthcare services in Malaysia. The Malaysian government has shown its commitment to improve the country’s healthcare system as detailed out in The Health Plan under the 10th Malaysian Plan 2011-2015. In fact, the government had introduced various health programmes to improve patients’ safety and the population’s health since the first Malaysian Plan (1966-1970). In 2014, the Malaysian government had allocated RM22.1
billion, in order to minimise any possible gap in priorities area for the health sector which includes operation and development expenses (MoH, 2013). The budget allocation for health had been increased in 2015, where the Malaysian government had allocated about RM23.3 billion. In Malaysia, the public healthcare sector is heavily subsidised by the Malaysian government which is almost 90 percent of the total cost and the patient pays a minimum amount for treatment.

Healthcare providers in Malaysia has been urged to transform the way they deliver their service to improve the quality in order to meet the Millennium Development Goals and the Malaysian Health Plan which has been set by the Malaysian government. Malaysia needs to restructure the national healthcare financing and healthcare delivery system, for example by using process improvement method in order to achieve the target (MoH, 2010). In October 2011, the Malaysian Healthcare Travel Council (MHTC) was corporatised to develop and promote Malaysia as the main destination for healthcare services in the region. As stated in Health Expenditure Report 1997-2011, Malaysia had recorded 3.9% GDP in health spending which was similar to other countries in Asia such as The Philippines, Thailand, India and Bangladesh. While in 2015, it recorded 4.3% spending in GDP on healthcare. However, these countries have much lower spending capita compared to Malaysia which ranging from USD67 in Bangladesh to USD353 in Thailand, while in Malaysia spending was USD616 per capita. According to Malaysia National Health Account database 2013, Malaysian Healthcare spending continues to grow at about 12% rate on average per year for the past 15 years. As reported in MNHA Health Expenditure Report (2015), the trend for total health expenditure keeps on increasing since 1997 until 2013. Figure 1.2 shows the data of escalating total health expenditure for 1997-2013.
Figure 1.2 Trends for Total Health Expenditure 1997-2013

(Source: Malaysia, & Malaysia National Health Account Unit, 2015)

The implementation of process improvement or change management in healthcare has started for decades. This method manages to save operational costs where available resources were used diligently in delivering continuous healthcare services across the programmes, healthcare settings and also healthcare providers (Gill, 2012). The advantages of applying process improvement method in an organization have also been mentioned in previous studies (Celano, Costa, Fichera & Tringali, 2012; Liberatore, 2013; Southard, Chandra, & Kumar, 2012).

Lean and Six Sigma are tools that have been used and evolved in healthcare for the process and operations efficiency improvement, as well as financial concern in healthcare delivery (Gamal, 2010; Revere, Black & Huq, 2004; Rohini & Mallikarjun, 2011). Six Sigma is a method that helps to identify problems on medical errors, quality and costs improvements (Revere et al., 2004; Taner, Sezen, Antony, 2007). Lean is well-known as the best tool for removing waste and related lead time reduction in process and operations. Previous researchers suggest than lean can be described as a medium to
reduce waiting time, repeated visits, errors and inappropriate procedures, enhance the process steps that are valuable and crucial, standardize the process flow, eliminate non-value added activities and even make the value streams be more noticeable (Arumugam, Antony & Douglas, 2012; Langabeer, DelliFrancine, Heineke & Abbas, 2009; Wan & Chen, 2008).

Lean in healthcare was known as lean healthcare where it is an improvement system that systematically amends the cost, quality, and safety issues incurred in healthcare. Lean healthcare helps the healthcare organization to reduce waste and cost, as well as improving the quality and safety of healthcare (Lowe, 2013). The process of removing waste and reducing the lead time in healthcare can be done through process mapping or Value Stream Mapping (VSM) (Gill, 2012). VSM can be defined as the representation of value stream with symbols and numbers, as the key to understand the entire transformation of raw materials into finished goods (Nielsen, 2008). VSM was chosen in the past researches as one of the preferred tools to detect the transactional and communication mismatches, process inefficiencies and also for improvement (Gill, 2012). Previous scholars have conducted studies on VSM in different settings (Cookson, Read & Cooke, 2011; Lowe, 2013; Persoon, Zaleski & Frerichs, 2006). However most of the studies focus on the VSM implementation in service industries.

1.3 Problem Statement

Healthcare sectors in Malaysia have changed and growing since the early 90’s. The changes such as demographics, political environment, social perceptions of healthcare quality and information technology have led to dramatic change in the healthcare sector (Trusko, Pexton, Gupta & Harrington, 2003). The advancement in healthcare sector progress is in line with the developing countries growth (Cheong, Shin & Joeng, 2009). New issues and challenges are faced as Malaysian healthcare sector develops. Among major issues identified throughout healthcare delivery are increasing healthcare costs, service and quality performances and also the efficiency of processes and operations (Shazali, Habidin, Ali, Khaidir & Jamaludin, 2013). Rising costs in healthcare are due to several factors namely escalating health expenditure which includes medical care,
consultations, medication, medical procedures and other factors (Gowen, McFadden & Settaluri, 2012; Olszak & Batko, 2012). Besides, the increasing costs are also due to the increasing number of population size where it leads to the rise in demand for healthcare services.

Over the years, service performance has become one of the target issues that need to be emphasized by the healthcare management. This is because the aim of providing care and enhancing health towards the citizen, have become the national goal and focus that need to be achieved (Dahlgaard et al., 2011). Poor healthcare delivery system and crisis in management are among the factors that will affect the overall healthcare quality. The focus on restructuring the national healthcare financing and healthcare delivery system are by adopting process improvement method where it is relevant and significant to fulfil the aspiration in achieving the target of creating an effective, efficient, fair and high-tech system of healthcare as well as responsiveness where it can further improve the access to various levels of appropriate healthcare to all Malaysian citizen (MoH, 2010).

However, there is a lack of evidence on the current state for type of process improvement used by the Malaysian Healthcare providers (Khaidir, Habidin, Ali, Shazali & Jamaludin, 2013). Lack of knowledge in this area may prevent the policy makers and top management of healthcare providers to understand the necessary continuous improvement approaches in healthcare systems and their impact on the quality of services. It should be the main priority for healthcare’s higher management to find ways to be more efficient and effective in delivering services. Therefore, this study attempts to investigate the current practices of process improvement approaches in Malaysian healthcare.

Lean and Six Sigma are two popular continuous process improvement methods. These methods had tremendously improved the quality and efficiency of manufacturing and service sectors for decades (Laureani & Antony, 2012). Lean and Six Sigma has also been applied to healthcare delivery system as a solution to problems that occur within healthcare industry (Celano et al., 2012; Willoughby, Chan & Strenger, 2010). As clarified in a study by Laureani and Antony (2012), there is a small number of previous empirical studies aimed to understand the benefits of Lean and Six Sigma methodologies.
Organization that utilized Lean methodology alone with the absence of Six Sigma shows restricted improvement across organization. Indeed, by integrating the best approach of Lean and Six Sigma methodologies, the organization will magnify improvements in customer satisfaction, cost, quality, speed and others (Laureani & Antony, 2012).

Lea specifically has been recognized as one of the methods for removing waste and reducing lead time. Lean is an alternative of doing more with less where it focuses on eliminating non-value added activities and to increase the efficiency of activities. In previous researches, lean has been widely used as a waste removal and lead time reducer for productions, processes and operations (Murrel, Offerman & Kauffman, 2011). The long waiting time has become one of the major issues that burdens healthcare management and patients (Kollberg, Dahlgaard & Brehmer, 2006). This issue requires a solution to curb the problem from further escalating. The combination of lean and Six Sigma known as Lean Sigma, is able to develop forceful recognition and reduce the non-value added activities in a workflow process (Bahensky, Roe & Bolton, 2005).

The issues regarding waste and long waiting time in previous studies had been solved by implementing Value Stream Mapping (Cadro, 2013; Rahani & al-Ashraf, 2012; Tyagi, Choudhary, Cai & Yang, 2015). In Malaysia, there is still lack of studies regarding the implementation of VSM in Malaysian Healthcare as process improvement tool (Haron, Ramlan, Ahmad & Ahmad, 2015). Referring to this situation, this study attempts to utilize the VSM approach in finding a better solution for improving lead time and the patient process flow in healthcare systems.

The preliminary study on the particular healthcare shows that there is waste issue occurrence (Haron & Ramlan, 2015). However, the waste here is waiting time only. From the study, non-value added time that is considered as waste (waiting time), is greater than the value added time. The study proposed a few solutions to reduce the waste occurrence and successfully improved the process flow of patient.

In Malaysia, the number of admissions has been increasing by 3% annually (MoH, 2010). Given the growing number of demand especially for outpatient services, the healthcare systems is now facing longer and increasing waiting times for medical services. Based on the statistics from Ministry of Health Malaysia, the recorded number
of admissions and outpatients’ attendances in 2013 is in Table 1.1. This situation may have slight medical effect, but excessive waiting time may be detrimental to the patients' health. This situation may be worse in a larger public healthcare centre where the demand for outpatient medical services is generally higher than in the private sector.

Table 1.1: Admissions and outpatients attendances in 2013

<table>
<thead>
<tr>
<th>Government</th>
<th>Ministry of Health</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Admissions</strong></td>
<td>total</td>
</tr>
<tr>
<td>Hospitals</td>
<td>2,110,628 2,163,082</td>
</tr>
<tr>
<td>Special Medical Institutions</td>
<td>52,454</td>
</tr>
<tr>
<td><strong>Outpatient Attendances</strong></td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td>19,353,222 53,000,929</td>
</tr>
<tr>
<td>Special Medical Institutions</td>
<td>268,104</td>
</tr>
<tr>
<td>Public Health Facilities</td>
<td>33,379,603</td>
</tr>
<tr>
<td><strong>Day Care Attendances</strong></td>
<td></td>
</tr>
<tr>
<td>Hospitals</td>
<td>1,189,409 1,189,409</td>
</tr>
<tr>
<td><strong>Clinical Support Service Attendances</strong></td>
<td></td>
</tr>
<tr>
<td>Medical Rehabilitation (Hearing)</td>
<td>92,109 359,831</td>
</tr>
<tr>
<td>Medical Rehabilitation (Speech)</td>
<td>44,508</td>
</tr>
<tr>
<td>Medical Social Services</td>
<td>83,495</td>
</tr>
<tr>
<td>Dietetic</td>
<td>139,719</td>
</tr>
<tr>
<td><strong>Dental Health Attendances</strong></td>
<td></td>
</tr>
<tr>
<td>Dental Clinics</td>
<td>10,984,728 10,984,728</td>
</tr>
<tr>
<td><strong>Maternal &amp; Child Health Attendances</strong></td>
<td></td>
</tr>
<tr>
<td>Ante-natal Attendances</td>
<td>5,794,544 14,067,279</td>
</tr>
<tr>
<td>Post-natal attendances</td>
<td>556,852</td>
</tr>
<tr>
<td>Child Attendances</td>
<td>7,715,883</td>
</tr>
</tbody>
</table>
As shown in Table 1.1, the patient attendances in 2013 for Maternal & Child Health Attendances shows the highest number except for Outpatient Attendances compared to other department with a total of 14,067,279 attending patients. The high number of attending patients in Maternal & Child Health Attendances will increase the probability of long waiting time. This is the reason why maternity clinic being selected as the location for this study. Thus, this research aims to study the issues in selected maternity clinic because it is important to determine the most critical waste and propose a solution on how to eliminate or reduce wastes that occur during the process flow of patient.

### 1.4 Research Questions

Based on the problem statement discussed before, there are three research questions which are:

i. What are the current practices of process improvement method in Malaysian Healthcare industry?

ii. What is the most critical waste that occur during the process flow of patient in healthcare?
iii. What can be suggested to eliminate or reduce the wastes that occur during the process flow of patient in healthcare systems?

1.5 Research Objectives

According to the research questions, there are three objectives to be accomplished:

i. To investigate the current practices of process improvement method within Malaysian Healthcare Industry.

ii. To determine the most critical wastes that occurs during the process flow of patient in healthcare.

iii. To propose a solution on how to eliminate or reduce wastes that occurs during the process flow of patient in healthcare.

1.6 Scope of Research

This research was conducted within the Malaysian healthcare industry and this research was divided into two scopes. The first scope focuses on Malaysian healthcare where it covers the first objective of this study. The target respondents are healthcare professionals who work in healthcare. The second scope is government health clinic in Parit Raja, Batu Pahat where it covers the second and third objectives for this study. This research focused on lean healthcare and Value Stream Mapping (VSM) in the process flow of patient. Observation was done in order to monitor the process flow of patient without interrupting the staffs in the selected healthcare. Potential solutions are proposed to the healthcare in order to improve the process flow of patient and eliminate waste. In this study, the maternity clinic was selected because pregnancy, childbirth, and the puerperium have been recorded as the number one cause of hospitalization in Ministry of Health and private hospitals in 2013.
1.7 **Significance of Research**

This study investigates the current practices of process improvement in Malaysian Healthcare Industry. Six Sigma and lean are necessary for organizations in order to move to the next level in business achievement (Black & Revere, 2006; Gowen et al., 2012). Through Six Sigma and lean methodology, organization will be able to identify problems, improve the efficiency of task, review customer satisfaction, and also attain strategic objectives. Lean healthcare is a method that has been applied in healthcare organization as a crucial method for improvement and Value Stream Mapping (VSM) is a tool used to improve the delivery of service in process flow of patient. By proposing the implementation of VSM in healthcare, it will help the healthcare to:

1. Reduce errors where it will result in enhancing the patient satisfaction (Gowen et al., 2012; Langabeer et al., 2009; Lummus, Vokurka & Rodeghiero, 2006).

2. Remove waste in the system of healthcare delivery as waste will become restriction to performance and most of the non-value added activities will be eliminated (Lummus et al., 2006).

3. Improve the process flow of patient where it will reduce the lead time and increase the efficiency of process and operations (Lummus et al., 2006).

Moreover, this study contributes to the development of methodology used in conducting the research. Data for this study was collected using structured questionnaire and observation in order to achieve the research objectives. Mixed methodology was used in order to ensure that the data matches the need of the study (Saunders, Lewis & Thornhill, 2009). A mixed method approach contributes in maximizing the usage of qualitative and quantitative approaches, provides a sophisticated and complex approach for the study, and as a useful strategy to have a complete understanding of the research problems (Creswell, 2014).
Finally, this study will contribute to scholarly literatures and academic knowledge between the healthcare industry and process improvement method. The development of healthcare industry and process improvement are essential to the growth of the nation, and the healthcare providers in Malaysia had been urged to transform the way they deliver their services in order to meet the goal and objectives of the health plan that had been detailed out in 10th Malaysia Plan 2011-2015.

1.8 Thesis structure

In general, the thesis structure is as follows:

i. Chapter 1
This chapter consists of an overview for this study. It includes introduction of this research, research background, problem statement, research questions, research objectives, scope of research, and significance of research.

ii. Chapter 2
In this chapter, literature review from previous study that is related to this research had been discussed. The literature review will include the explanation from previous studies starting with healthcare, healthcare in developing countries, and healthcare in Malaysia. Next is literature review of process improvement, where it explains the definition, including tools and function of process improvement, as well as the advantages of implementing each of process improvement. Lastly, literature review of Value Stream Mapping (VSM) is included in this chapter followed by the research flow of VMS used in this study.

iii. Chapter 3
This chapter discusses the methodology used in order to accomplish the aim of this study. The techniques use answers to the research questions and achieve the objectives of this research. This chapter covers research purpose, research design (quantitative and qualitative), data collection, and also research instrument used.
iv. Chapter 4  
Data collected from the survey was used to achieve the objective of this research. Surveys from questionnaires and data collected through observation were analysed and also used as input for the process of Value Stream Mapping.

v. Chapter 5  
This chapter consists of discussions on the results from the research findings. It explained all further details including the limitations encountered while conducting this study, and also discussed the suggestions for future research.

1.9 Conclusion

This chapter discussed the introduction and issues that are related to this study. This chapter even discussed the background of research, research objectives, scope of research and also the significance of research. It started with healthcare, followed by the aim of this research concerning the issue related to Malaysian Healthcare and how to solve the related issues.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter presents an overview of process improvement in healthcare. It starts with an exploration on the characteristics of healthcare in Malaysia and other developing countries. As Malaysia is one of the developing countries listed by the World Bank, the characteristics and issues related to the healthcare in developing countries were discussed in furtherance of quality and performance. Information collected from health, business and service management literature shows that process improvement is directly linked to quality and performance where features, costs, and revenues were included. The process improvement in the context of operation, business and service management leads to the discussion of methodologies and tools with an emphasis on process improvement in the healthcare industry.

2.2 Healthcare

Healthcare is a health institution that provides care services to patients. It is the duty of hospital and healthcare centres to take care of the public health. Generally, healthcare organization throughout the world can be divided into three types which are the public, private and also the non-governmental organization. In Malaysia, healthcare is divided into public, private, non-governmental organization, semi-government and semi-private.
Globally, healthcare is one of the sectors that have witnessed significant improvement concerning the public health and healthcare system (Abor, 2013). Most of the countries are facing problem in managing the healthcare system due to the costs (Dahlgaard et al., 2011; Shazali et al., 2013). The costs of healthcare are rising each year where it includes personal healthcare spending, the net cost of insurance, public health activities by the government, research and also construction of medical facilities (Kumar & Steinebach, 2008). Matthews (2013) argued that processes involved in healthcare delivery are crucial to the operational success of healthcare due to impact on the medical errors, throughput, and quality of care within the system. The sources of medical errors in healthcare are related to communication, systems and the failure of culture (Garbutt et al., 2008).

2.2.1 Healthcare in developing countries

In most developing countries, healthcare organizations are continuously improving their healthcare service delivery to the patient (Cheong, Shin & Joeng, 2009). The process improvement is expected to generate an improvement in healthcare such as the healthcare system, increased patients’ accessibility to medical care and satisfaction, improvement in medical quality, reduction in costs, and business rationalization of hospitals (MoH, 2010). In other developing countries such as Korea, the Korean government promoted the national e-health project where the function is aimed to systematically build an integrated healthcare system from 2004 until 2010 (Cheong et al., 2009). E-health can be described as total reform to healthcare system since healthcare production, supply, and management system is exchanged in a digital form. Such innovation is also expected to improve healthcare services as a whole, reduce the imbalance of healthcare benefit, lower the costs of healthcare and strengthen the competitiveness of the related industry.
2.2.2 Healthcare in Malaysia

In Malaysia, the healthcare system is primarily under the jurisdiction of the Ministry of Health Malaysia. The Ministry of Health was established decades ago in order to play the role as the regulator by enforcing the regulations. Within the ministry, the composed health system is fair, equitable, efficient, compatible and appropriate to the customer environment (MoH, 2013). In addition, this system was designed to satisfy the quality, innovation, health promotion, respect for human dignity, and promote individual and also community participation towards improving the quality of life (MoH, 2013). Besides the Ministry of Health, university hospitals which are under the Ministry of Higher Education are also the important providers to the public, and there is a military hospital for military personnel and their families which fall under the Ministry of Defence jurisdiction. Public healthcare in Malaysia was organized based on the National Health Plan that has been drafted according to Malaysian Plan. According to the Ministry of Finance Malaysia, healthcare services include:

a) medical, dental, nursing, midwife, allied health, pharmacy, ambulance services and any other service provided by a healthcare professional,

b) any accommodation and food for the purpose of providing healthcare services,

c) any service for screening, diagnose, or treatment of a person suffering any disease, injury or disability of mind and body,

d) any service for preventive or promoting health purposes,

e) any service provided by private healthcare facilities,

f) any service for curing or alleviating any abnormal condition of the human body by application of any apparatus, equipment, instrument or device or any other medical technology, and

g) any related healthcare service which includes the supply of drugs and medicines, haemodialysis services and blood bank services.
Malaysia Plan is an extensive 5-year strategic plan developed by the Cabinet of Malaysia and the Economic Planning Unit (EPU). Since the 9th Malaysia Plan, the theme of Malaysia Health Plan focuses on achieving a better health among citizens through consolidation of health services (MoH, 2010). In the 10th Malaysia Health Plan period from 2011-2015, the content is still consistent with the 4th National Mission which is an improvement to the standard and sustainability on the quality of life. Apart from focusing on the improvement of the standard and the quality of life, the 10th Malaysia Health Plan stressed on the quality of healthcare and aimed for a healthy community. The plan supports a healthy lifestyle by gearing towards the establishment of a comprehensive healthcare system, public recreation, as well as sports infrastructure. As stated in Health Expenditure Report 1997-2011 which is reported by Malaysia National Health Accounts, the total health expenditure in Malaysia keeps on escalating since 1997 until 2011 as stated in Health Expenditure Report from 1997 to 2011 in Table 2.1.
Table 2.1: Trend for Total Health Expenditure, 1997-2011 (RM Million & Percent GDP)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Health Expenditure, Nominal (RM Million)</th>
<th>Total Health Expenditure, Constant using DOS GDP Deflator (RM Million)*</th>
<th>Total Health Expenditure, Constant using IMF GDP Deflator (RM Million)**</th>
<th>Total Expenditure as % GDP</th>
<th>Total GDP, Nominal (RM Million)*</th>
<th>DOS GDP Deflator*</th>
<th>IMF GDP Deflator**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>8,188</td>
<td>13,838</td>
<td>14,616</td>
<td>2.91</td>
<td>281,795</td>
<td>86</td>
<td>70</td>
</tr>
<tr>
<td>1998</td>
<td>8,891</td>
<td>13,881</td>
<td>14,628</td>
<td>3.14</td>
<td>283,243</td>
<td>93</td>
<td>76</td>
</tr>
<tr>
<td>1999</td>
<td>9,741</td>
<td>15,191</td>
<td>16,018</td>
<td>3.24</td>
<td>300,764</td>
<td>93</td>
<td>76</td>
</tr>
<tr>
<td>2000</td>
<td>11,670</td>
<td>16,915</td>
<td>17,600</td>
<td>3.27</td>
<td>356,401</td>
<td>100</td>
<td>82</td>
</tr>
<tr>
<td>2001</td>
<td>12,920</td>
<td>19,028</td>
<td>19,799</td>
<td>3.66</td>
<td>352,579</td>
<td>98</td>
<td>81</td>
</tr>
<tr>
<td>2002</td>
<td>14,103</td>
<td>20,140</td>
<td>20,956</td>
<td>3.68</td>
<td>383,213</td>
<td>102</td>
<td>84</td>
</tr>
<tr>
<td>2003</td>
<td>17,784</td>
<td>24,586</td>
<td>25,583</td>
<td>4.25</td>
<td>418,769</td>
<td>105</td>
<td>86</td>
</tr>
<tr>
<td>2004</td>
<td>19,031</td>
<td>24,818</td>
<td>25,824</td>
<td>4.01</td>
<td>474,048</td>
<td>111</td>
<td>92</td>
</tr>
<tr>
<td>2005</td>
<td>19,274</td>
<td>24,024</td>
<td>23,943</td>
<td>3.55</td>
<td>543,578</td>
<td>116</td>
<td>100</td>
</tr>
<tr>
<td>2006</td>
<td>23,363</td>
<td>28,033</td>
<td>27,911</td>
<td>3.91</td>
<td>596,764</td>
<td>121</td>
<td>104</td>
</tr>
<tr>
<td>2007</td>
<td>25,894</td>
<td>29,600</td>
<td>29,495</td>
<td>3.89</td>
<td>665,340</td>
<td>127</td>
<td>109</td>
</tr>
<tr>
<td>2008</td>
<td>28,870</td>
<td>29,910</td>
<td>29,790</td>
<td>3.75</td>
<td>769,949</td>
<td>140</td>
<td>120</td>
</tr>
<tr>
<td>2009</td>
<td>31,271</td>
<td>34,798</td>
<td>34,325</td>
<td>4.39</td>
<td>712,857</td>
<td>130</td>
<td>113</td>
</tr>
<tr>
<td>2010</td>
<td>35,355</td>
<td>37,436</td>
<td>37,286</td>
<td>4.45</td>
<td>796,037</td>
<td>137</td>
<td>118</td>
</tr>
<tr>
<td>2011</td>
<td>37,871</td>
<td>37,871</td>
<td>37,871</td>
<td>4.30</td>
<td>881,080</td>
<td>145</td>
<td>124</td>
</tr>
</tbody>
</table>

(Source: Department of Statistics Malaysia, GDP Deflator base year 2000 published in May 2012

The deliveries of public healthcare were intended to be affordable for the society and can be readily accessed at all levels. Access to the public healthcare is direct, where the people may enter as walk-in patients while access to the specialist is through referral. However, access to private healthcare is based on ability of the patient to pay and it does not require any referral. Even though the number of private healthcare has been multiplying ever since, public healthcare is still dominating the healthcare industry as the Ministry of Health is the largest healthcare provider in Malaysia. Malaysia health system faces challenges due to increasing expectations from the public, changing trends in disease patterns and socio-demography, and even fulfilling greater efficiencies requirement by the citizens.
2.3 Process Improvement

To stay competitive and sustain long-term profitability, process improvement methodologies become strategically important for healthcare industry in recent years. Process improvement is also known as change management in the industry. Process improvement as defined by Stamatis (2003) is the act of changing a process to reduce variability and cycle time and makes the process more effective, efficient, and productive. Specifically, process improvement focuses on incremental solutions to eliminate or reduce defects, errors, costs, or cycle time. The application of process improvement techniques has increased in popularity especially for healthcare (Dellifraine, Langabeer & Nemphard, 2010). This statement is supported by Lighter (2011) where process improvement initiatives were rated by healthcare personnel as more important and experienced more frequent improvements to resolve medical errors and others which include patient safety, quality, employee satisfaction, efficiency and also competitiveness. Furthermore, Koelling, Eitel, Mahapatra, Messner and Grove (2005) stated that process improvement is an initiative to increase the operational efficiency and cost-effectiveness of the healthcare delivery process.

The process improvement programmes also include quality groups that use process improvement tools in order to improve the process outcomes (Gowen et al., 2012). Moreover, Arthur (2011) mentioned that healthcare organizations have highly taken process improvement as an effective technique for improving quality, profitability, productivity and even competitiveness. The goals of healthcare process improvement are to enhance the effectiveness of systems across departments while maximizing profits and improving the quality of the patient’s experience and care. Goldstein and Iossifova (2012) reviewed that a high degree of financial resource slack was related to successful implementation of process improvement initiatives for reducing four adverse medical errors. Besides that, Gowen et al. (2012) mentioned that previous healthcare research reported on effective deployment of process improvement programmes depends on other dynamic capabilities, such as organizational structure, hospital ownership, and leadership style.
The implementation of process improvement is associated with improved organizational effectiveness, in terms of service quality, customer satisfaction, net cost savings and patient satisfaction (Marley, Collier & Meyer, 2004). This is in line with the past researchers, who argued that the healthcare organizations implemented process improvement targeting to improve their organizational performance (Gowen et al., 2012; Hilton, Balla & Sohal, 2008). The effectiveness and efficiency were considered as part of organizational performance that can be enhanced by certain process improvement factors such as DMAIC and Value Stream Mapping (De Mast, 2006). Many organizations have implemented process improvement method and have proved that process improvement method has yielded significant result in operations (Bateman, 2005). There are a variety of process improvement tools/technique such as Six Sigma, Lean, Lean Six Sigma, Just-In-Time, Re-engineering, Design of Experiments, Total Quality Management, and others (Gershon, 2010).

Process improvement in healthcare should not be neglected by the management of healthcare organizations since inefficient and faulty of processes in healthcare are one of the main causes that can lead practitioners to make technical mistakes (Rebuge & Ferreira, 2012). In addition, Garland (2005) found that 15% of medical errors are due to human error while the balance of 85% is the result of flaws in processes and the overall healthcare system that obstructs individuals from performing their jobs. In other words, processes involved are the contributing factors to quality and performance as they affect the efficiency and outcomes of the entire system (Matthews, 2013). Lowe (2013) stated that everyone should rethink the way they work and make inevitable changes as they go on their daily tasks. Healthcare professionals will need a strategy or method to attain this aim while maintaining or improving their current level of care.

2.3.1 Previous studies of process improvement in healthcare

Process improvement has been tremendously implemented in healthcare industry. Table 2.2 shows the summary of the studies on process improvement that had been done in healthcare by previous scholars.
Table 2.2: Previous studies of process improvement in healthcare

<table>
<thead>
<tr>
<th>AUTHOR (YEAR)</th>
<th>PROCESS IMPROVEMENT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taner, Sezen &amp; Antony (2007)</td>
<td>Six Sigma</td>
<td>• Minimize delays, measurement, and medical errors.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Maximize resource utilization.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increase patient and physician satisfaction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduce cost.</td>
</tr>
<tr>
<td>Taner &amp; Sezen (2009)</td>
<td>Six Sigma</td>
<td>• Reduce turnover rate</td>
</tr>
<tr>
<td>Celano et al. (2012)</td>
<td>Six Sigma and discrete-event simulation (DES)</td>
<td>• Increase awareness among staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Eliminate unnecessary activities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reduce Six Sigma project cost when adopting DES.</td>
</tr>
<tr>
<td>Southard et al. (2012)</td>
<td>Six Sigma and radio frequency identification (RFID) technology.</td>
<td>• Time saving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cost effectiveness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve safety of the patient</td>
</tr>
<tr>
<td>Gowen et al. (2012)</td>
<td>Continuous Quality Improvement (CQI), Six Sigma Initiatives (SSI), and Lean Management Initiatives (LMI)</td>
<td>• CQI is the most effective PI approach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• LMI offers some added benefits over and above CQI.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CQI enhances patient safety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hospitals report only a moderate level of SSI implementation.</td>
</tr>
<tr>
<td>Liberatore (2013)</td>
<td>Six Sigma</td>
<td>From study, only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 67% had initial improvement in the key process metric</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 10% reported sustained improvement.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 28% reported cost savings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 8% offered revenue enhancement.</td>
</tr>
<tr>
<td>Al-Balushi et al., (2014)</td>
<td>Lean</td>
<td>Factors for implementing lean in healthcare:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• culture of a healthcare setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• lean as a long-term policy</td>
</tr>
</tbody>
</table>
Table 2.2 (Continued)

<table>
<thead>
<tr>
<th>AUTHOR (YEAR)</th>
<th>PROCESS IMPROVEMENT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haron &amp; Ramlan (2015)</td>
<td>Lean</td>
<td>- Reduce lead time and waste in process flow of patient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Improve the capacity of patient, idle time, utilized time and the number of operations</td>
</tr>
</tbody>
</table>

As mentioned in Table 2.2, process improvement method had been implemented in healthcare since decades ago where it focuses on improving the quality of services in healthcare. From the table, Six Sigma methodology had managed to minimize delays and medical errors, eliminate unnecessary activities, reduce costs, time and turnover rate, maximize resource utilization and awareness among staffs, and even increase patient safety, give patient and physician satisfaction, and also the revenue (Taner et al., 2007; Taner & Sezen, 2009; Celano et al., 2012; Southard et al., 2012; Gowen et al., 2012; Liberatore, 2013).

In addition, one of the studies mentioned in Table 2.2 stated that lean methodology had been implemented in healthcare due to the culture of healthcare settings, lean as a long term policy, and also a good measurement system. Lean managed to reduce the waste and lead time, and also improve the capacity of patient, idle time, utilized time and operations in the healthcare (Al-Balushi et al., 2014; Haron & Ramlan, 2015).

2.3.2 Six Sigma

Six Sigma is one of the process improvement initiatives that was designed by leading manufacturing companies and applied to service industry for managing better operation system. Six Sigma started as an improvement programme at Motorola in 1982 in order to assist Motorola to reduce costs and improve the quality of their product (Stamatis, 2003). Six Sigma is a systematic approach to problem solving. Six Sigma has been described by previous researchers in different forms. These differences led to
uncertainty and confusion by others. In a study reviewed by Schroeder, Linderman, Liedtke and Choo (2008), they had collected a few definitions of Six Sigma. The first definition in the study defined that Six Sigma as a high-performance, data-driven approach to analyse the root causes of business problems and solve them. The second definition in the study defined Six Sigma as business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction. The third definition from the study defined Six Sigma as a disciplined and statistically based approach for improving product and process quality. The fourth definition in the study stated Six Sigma as a management strategy that requires a culture change in the organization (Schroeder et al., 2008).

Six Sigma definition by Gowen (2012) is known as a radical breakthrough approach that is extensively focused on the bottom line results, specifically for process improvement projects. However, Stamatis (2003) defined Six Sigma as a quality objective that specifies the variability required of a process in terms of the specifications of the product/service so that the reliability and the quality meet and exceed today’s demanding customer requirements. Other definitions indicate Six Sigma as an organized, parallel-mesostructure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives (Schroeder et al., 2008). Specifically, the term Six Sigma refers to a process capability that generates 3.4 defects per million opportunities. Descriptions that have been collected from previous researches suggest that Six Sigma definitions covered almost all aspects. This is proven by a variation of definitions from different practitioners and academic literatures.

Six Sigma plays an important role as one of the main process improvement tool and has four main goals which are to reduce defects/non-conformance, improve yield, for customer satisfaction and shareholder value (Stamatis, 2003). Six Sigma offers a framework that gathers the basic quality tools and combines them with high-level management support. A disciplined approach towards measurement and improvement that have not been evident in previous quality improvement efforts are required by Six Sigma. Besides that, Six Sigma also encourages customer-focused approach which at the
REFERENCES


Coons, J. A. Beginning the lean improvement journey in the clinical laboratory.


Kamma, T. K. (2010). *Framework for lean thinking approach to healthcare organizations: Value stream mapping to reduce patient waiting time.* SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE.


