

RELATIONSHIP BETWEEN HUMAN FACTORS AND SERVICE LEVEL AGREEMENT USAGE FOR HEALTH CARE SYSTEM

MOHAMMAD NASROLLAH BIN ROZAMI

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By

MOHAMMAD NASROLLAH BIN ROZAMI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, In fulfillment of the Requirement for the Master of Science

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DEDICATION

MY BELOVED FAMILY

My father, ROZAMI BIN SAYAN My mother, HAMIDAH BINTI ABD RAHIM My older sister, NURUL NATIHAH BINTI ROZAMI



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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

RELATIONSHIP BETWEEN HUMAN FACTORS AND SERVICE LEVEL AGREEMENT USAGE FOR HEALTH CARE SYSTEM

By

MOHAMMAD NASROLLAH BIN ROZAMI

April 2019

Chairman: Rodziah binti Atan, Ph.D Faculty: Computer Science and Information Technology

Service Level Agreement (SLA) is a contract between service provider and service recipient, where each service is formally defined. From the SLA management, the service recipient will know what service they will be receive. Most commonly, the parameter of SLA defines QoS (Quality of Service) to give overall performance of a service including the response time, throughput, access time, delay or user complain. The issue such as system failure, service unavailability, technical problem or hardware inaccessibility are examples of problems occurred in service platforms. The issue is normally covered in SLA which explain in detail in terms of official agreement.

Managing SLA can become difficult as it normally depends on human interference such as user complaints, service violation reports and delays response or action from technical personal. Each violation can be caused by the system or human when delivering the service. Also, the lack of providing the opportunities to staffs to learn and develop new skills become one of the barriers to delivering a good quality of service. The human factor is one of the problems need to be considered very well in a hope the quality of the service can meet the satisfaction of the user. The objective of this research is to study the important human factor that influence SLA usage and further proposed an SLA enforcement model with accentuation of these human factors.

This research consists of three phases. The first phase is defining the research design and identify the human factor based on study previous researches papers. There are four human factors used in this research as suggested by most paper reviewed. There are user willingness, skill or knowledge, info sharing and IT staff adequacy. The second phase consist of instrument plan, population and sample research, data collection technique, data analysis method, pilot study and theoretical study. The survey form distributed focused on the two type of groups studied which are service provider and service recipient of healthcare information system. The third phase of this research is developing the model and rules to measure the SLA usage level in domain specific information

system. The Pearson test analysis is used to analyse the level of four element of human factor which can give influence on the SLA usage. The level of impact on SLA usage show differences based on indicated level of human factor. It can be concluded that, there is a positive correlation between human factor (user willingness, skill/knowledge, information sharing, IT staff adequacy) with SLA usage.

The model development was used for this research to find the correlation between human factor and service level agreement usage. Although the result of the Pearson correlation analysis was at moderate positive correlation, the human factor needs to be considered when delivering services. It is important to enforce SLA between both service provider and consumer. This will help to minimize the SLA violation and increase the quality of services.



Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

HUBUNGAN ANTARA FAKTOR MANUSIA DAN PERJANJIAN TAHAP PERKHIDMATAN PENGGUNAAN SISTEM PENJAGAAN KESIHATAN

Oleh

MOHAMMAD NASROLLAH BIN ROZAMI

April 2019

Pengerusi: Rodziah binti Atan, Ph.D Fakulti: Sains Komputer dan Teknologi Maklumat

Perjanjian Tahap Perkhidmatan (SLA) adalah kontrak antara pembekal perkhidmatan dan penerima perkhidmatan, di mana setiap perkhidmatan ditakrif secara rasmi. Dari pengurusan SLA, penerima perkhidmatan akan mengetahui perkhidmatan apa yang akan mereka terima. Kebiasaannya, parameter SLA mentakrifkan QoS (Kualiti Perkhidmatan) untuk memberikan prestasi keseluruhan perkhidmatan termasuk masa tindak balas, pencapaian, masa akses, kelewatan atau mengadu pengguna. Isu seperti kegagalan sistem, ketiadaan perkhidmatan, masalah teknikal atau kebolehaksesan perkakasan adalah contoh masalah yang berlaku dalam platform perkhidmatan. Isu ini biasanya diliputi dalam SLA yang menerangkan secara terperinci dari segi perjanjian rasmi.

Menguruskan SLA boleh menjadi sukar kerana ia biasanya bergantung kepada gangguan manusia seperti aduan pengguna, laporan pelanggaran perkhidmatan dan tindak balas penangguhan atau tindakan dari peribadi teknikal. Setiap pelanggaran boleh disebabkan oleh sistem atau manusia semasa menyampaikan perkhidmatan. Selain itu, kekurangan menyediakan peluang kepada kakitangan untuk belajar dan membangunkan kemahiran baru menjadi salah satu halangan untuk memberikan kualiti perkhidmatan yang baik. Faktor manusia adalah salah satu masalah yang perlu dipertimbangkan dengan baik dengan harapan kualiti perkhidmatan dapat memenuhi kepuasan pengguna. Objektif kajian ini adalah untuk mengkaji faktor manusia yang penting yang mempengaruhi penggunaan SLA dan seterusnya mencadangkan model penguatkuasaan SLA dengan penekanan faktor manusia.

Kajian ini terdiri daripada tiga fasa. Fasa pertama menentukan reka bentuk penyelidikan dan mengenalpasti faktor manusia berdasarkan kajian penyelidikan sebelumnya. Terdapat empat faktor manusia yang digunakan dalam kajian ini seperti yang dicadangkan oleh kebanyakan kertas kajian. Terdapat kesediaan pengguna, kemahiran atau pengetahuan, perkongsian maklumat dan kecukupan kakitangan IT. Fasa kedua terdiri daripada pelan instrumen, populasi dan penyelidikan sampel, teknik pengumpulan

data, kaedah analisis data, kajian perintis dan kajian teoretikal. Borang tinjauan diedarkan dengan fokus pada dua jenis kumpulan yang dikaji iaitu pembekal perkhidmatan dan penerima perkhidmatan sistem maklumat penjagaan kesihatan. Fasa ketiga penyelidikan ini adalah membangunkan model dan peraturan untuk mengukur tahap penggunaan SLA dalam sistem maklumat khusus domain. Analisis ujian Pearson digunakan untuk menganalisis tahap empat elemen faktor manusia yang dapat mempengaruhi penggunaan SLA. Tahap kesan penggunaan SLA menunjukkan perbezaan berdasarkan tahap faktor manusia yang ditunjukkan. Kesimpulannya, terdapat korelasi positif antara faktor manusia (kesediaan penggunaan SLA.

Pembangunan model digunakan untuk penyelidikan ini untuk mencari korelasi antara faktor manusia dan penggunaan perjanjian tahap perkhidmatan. Walaupun hasil analisis korelasi Pearson berada pada korelasi positif yang sederhana, faktor manusia perlu dipertimbangkan ketika menyampaikan perkhidmatan. Adalah penting untuk menguatkuasakan SLA antara pembekal perkhidmatan dan pengguna. Ini akan membantu mengurangkan pelanggaran SLA dan meningkatkan kualiti perkhidmatan.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. Members of the Supervisory Committee were as follows:

Rodziah Atan, PhD

Associate Professor Faculty of Computer Science and Information Technology Universiti Putra Malaysia (Chairman)

Noraini Che Pa, PhD

Associate Professor Faculty of Computer Science and Information Technology Universiti Putra Malaysia (Member)

Razali Yaakob, PhD

Associate Professor Faculty of Computer Science and Information Technology Universiti Putra Malaysia (Member)

ROBIAH BINTI YUNUS, PhD

Professor and Dean School of Graduate Studies Universiti Putra Malaysia

Date:

Declaration by graduate student

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Date:

Name and Matric No.: Mohammad Nasrollah bin Rozami, GS47157

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Signature: Name of Chairman of	
Supervisory Committee:	Rodziah Atan
Signature: Name of Member Supervisory Committee:	Noraini Che Pa
Signature: Name of Member Supervisory Committee:	Razali Yaakob

TABLE OF CONTENTS

	Page	
ABSTRACT	i	
ABSTRAK	iii	
ACKNOWLEDGEMENTS	v	
APPROVAL	vi	
DECLARATION	viii	
LIST OF TABLES	xii	
LIST OF FIGURES	xiii	
LIST OF ABBREVIATIONS	xiv	
CHAPTER		
1 INTRODUCTION		
1.1 Background	1	
1.2 Problem Statemen	it 2	
1.3 Research Question	1 3	
1.4 Research Objectiv	res 3	
1.5 Scope of Research	1 3	
1.6 Term and definition	on 4	
1.6.1 Service level agre	ement 4	
1.6.2 User willingness	4	
1.6.3 User skill/knowle	dge 4	
1.6.4 Information sharing	ng 4	
1.6.5 IT staff adequacy	5	
1.7 Organization of T	hesis 5	

1			C	- T1 ·
	1	roan17ation	ot.	hegi
1.		'i gamzation	U1	THUSI
		L)		

I ITED ATUDE DEVIE

2.1	Introduction	6
2.2	Service Level Agreement (SLA)	6
	2.2.1 Service Level Management (SLM)	8
	2.2.2 Service Violation	9
2.3	Healthcare Information System (HIS)	11
	2.3.1 Component of HIS	11
2.4	Human factor (HF)	14
	2.4.1 User Willingness	16
	2.4.2 Skill/knowledge	17
	2.4.3 Sharing of information	19
	2.4.4 IT staff adequacy	21
2.5	Weighted Mean	22
2.6	Summary	24

RESEARCH METHODOLOGY

3.1	Introduction	25
3.2	Research Activities	25
3.3	Research Domain	26
3.4	Model Development	26
3.4	4.1 Identification of human factors	27
3.5	Survey instrument	28
3.5	5.1 Part A: Respondent Demographic Information	28

	 3.5.2 Part B: Service Level Agreement 3.5.3 Part C: Human Factor 3.6 Respondent Sampling 3.6.1 Data Collection 3.6.2 Data Analysis 3.7 Expert consultation 3.8 Hypothesis 3.8.1 Hypothesis 1 3.8.2 Hypothesis 2 	28 29 29 29 29 30 31 31 31
	3.8.3 Hypothesis 3 3.8.4 Hypothesis 4 3.9 Prototyping 3.10 Summary	32 32 32 32
4	DESIGN AND DEVELOP PROTOTYPE4.1Introduction4.2Prototype Design4.3SLA Enforcement Model – Prototype4.4Weighted Factor4.5Prototype Development4.5.1Structure Folder and Code4.6Summary	33 33 34 35 39 39 42
5	RESULT AND DISCUSSION 5.1Introduction5.2Data analysis5.2.1 Demographics Studies5.3Inference Analysis.5.3.1 Level of workers' knowledge on proposed on factors5.3.2 Correlation between user willingness and model5.3.3 Correlation between skill/knowledge and model5.3.4 Correlation between information sharing and model5.3.5 Correlation between IT staff adequacy and model5.4Summary	43 43 45 45 57 58 58 59 61
6	CONCLUSION6.1Introduction6.2Research Conclusion6.3Research Findings6.4The Future Works	62 62 63 63
REFERENCES APPENDICES BIODATA OF STUDENT PUBLICATION		64 70 76 77

xi

LIST OF TABLES

Table		Page
2.1	SLA Components	7
2.2	Type of component and their users	13
2.3	Categories of Hospital Information System (HIS)	13
2.4	Summary of the reasons of user resistance toward modern system	17
2.5	Summary of benefits and challenges for three types of stakeholders	18
2.6	Summary of the reasons of lack IT skill among the medical	19
	practitioners	
2.7	Summary of the reasons of lack refusal sharing information.	21
2.8	Summary of the reasons of shortage IT staff	21
2.9	Summary of critical review	22
3.1	Mean Score Interpretation of human factor and SLA usage	28
3.2	Guilford's Rule of Thumb Index Interpretation	30
3.3	Variable Reliability in Pilot and Actual Study	31
4.1	Weighted Scores	36
5.1	Profile Respondents (N=30 for actual data)	44
5.2	Identifying the level of view on SLA usage among workers	47
5.3	Identifying the level of user willingness among workers	50
5.4	Identifying the level of skill/knowledge among workers	52
5.5	Identifying the level of information sharing among workers	54
5.6	Identifying the level of IT staff adequacy	56
5.7	Correlation between SLA usage and user willingness	57
5.8	Correlation between SLA usage and skill/knowledge	58
5.9	Correlation between SLA usage and information sharing	59
5.10	Correlation between SLA usage and IT staff adequacy	60
5.11	Summary Pearson Correlation Coefficient for Relationship between	60
	X and Y	

LIST OF FIGURES

Figur	e	Page
2.1	Structure of an agreement	6
2.2	SLA Lifecycle	10
2.3	Flow SLA validation and notification	11
2.4	Components in Hospital Information System (HIS)	12
2.5	Maintenance occurrences of errors per million flights.	14
2.6	Hawkins Model	15
2.7	Human factors challenge for HIS implementation.	16
2.8	Example of provider, pharmacy and patient in healthcare system	20
	environment	
2.9	Formula to calculate a weighted mean	22
3.1	Proposed Model Research Activities	26
3.2	SLA Enforcement Model	27
3.3	Human factors challenge for HIS implementation	27
4.1	The prototyping methodology	33
4.2	The system design	34
4.3	Flow of prototype	34
4.4	SLA enforcement model equation	35
4.5	The internal cascading style sheet (CSS)	36
4.6	The DOM element in index.html	37
4.7	The prototype SLA enforcement model incorporating human factor	38
	(high percentage)	
4.8	The prototype SLA enforcement model incorporating human factor	38
	(low percentage)	
4.9	Folder structure of project	40
4.10	File support for the project.	40
4.11	The jQuery function	41

LIST OF ABBREVIATIONS

AD	Actual Data
BHIS	Basic Hospital Information System
CIS	Clinical Information System
CSS	Cascading Style Sheets
DOM	Document Object Model
FIS	Financial Information System
HER	Electronic Health Record
HF	Human Factor
HIS	Hospital Information System
ICT	Information Communication Technology
IHIS	Intermediate Hospital Information System
IT	Information Technology
ITIL	Information Technology Infrastructure Library
LIS	Laboratory Information System
NIS	Nursing Information Systems
NMMR	National Medical Research Register
PACS	Archiving Communication System
PIS	Pharmacy Information System
РТ	Pilot Test
QoS	Quality of Service
RIS	Radiology Information System
SLA	Service Level Agreement
SLM	Service Level Management
SLO	Service Level Objective
SPSS	Statistical Package for The Social Science
THIS	Total Hospital Information System
VM	Virtual Machine
WSLA	Web Service Level Agreement

6

CHAPTER 1

INTRODUCTION

1.1 Background

The Ministry of Health Malaysia has an objective to help people to achieve or to maintain the health standard for Malaysia people to run a productive economic and social life. The vision of Ministry of Health Malaysia is to have a country which included individuals, families, communities with a good health through fair and equitable health system. Health services should be delivered in a simple and easy way as to enable understanding by the people who receive the service. Ministry of Health Malaysia has taken the initial step to improve the quality of service delivered by implementing Hospital Information System (HIS). One of the missions to approach vision 2020 introduced by current Prime Minister is to ensure high quality health system by emphasize the good nature in community involvement. Hospital Information System (HIS) plays an important role within hospitals in term of administering patient's records. The service provider and service recipient in hospital play important role to manage the information within the hospital. An information will become faster and accurately when two party involved. Due to this, the Service Level Agreement (SLA) was used to act as an agreement tool between the service provider and service recipient to determine the services need to be delivered and received.

SLA is a contract between service provider and service recipient that the services are formally defined (Mirobi et al., 2015). Most commonly, the parameter of SLA defines QoS (Quality of Service) to give the overall performance of a service including the response time, throughput, access time, delay, and launch complaints (Kaur, 2013). The service provider commonly faces some unexpected errors when deliver the service and hence, breached the SLA clauses. The SLA violations that happens can cause the service provider to pay for the penalty to the user or service recipient. Managing SLA can become difficult as it normally is based on human interference such as user complaints, service violation reports, and delayed response or action from responsible party (Stanton et al., 2005). Due to this, human factor plays a very important role to ensure the quality of service that can meet with the user expectation from the provider sides.

The services based on the agreed term in SLA delivered via software and hardware but with human involvement. Every term in SLA should be defined clearly so that it is easy to understand by the recipient to avoid contentious between the service provider and the service recipient (Kaur, 2013). It is important to enforce SLA in term of the human factor for both the service provider and recipient. This will help to minimize the SLA violation and increase the quality of services. However, this requires human interference to monitor and enforce SLA. Due to this, the human factor needs to be analysed to ensure the process of enforcement SLA working properly.

1.2 Problem Statement

Nowadays most of the services are offered through cloud or server-based environment, which has access remote. Government agencies such as a hospital, and immigration department are seriously looking at delivering the services through cloud environment whether in private cloud or public cloud. The cloud services provide has more advantages such as easy to access, easy to manage, and save time. The cost may also reduce to maintaining and managing the IT system for organizations.

SLA acts as agreement tool to ensure the quality of service are met with the terms of agreement. SLA is a very important document to show the services being delivered by the service provider. With this document, all the information regarding the services will be managed in effective ways. The issues such as system failure, service unavailability, technical problem, or hardware inaccessibility are examples of problems occurred in cloud platform-based services. These items normally covered in SLA document that explains in detail, such as "Allowable system downtime for one year less than 5%". When the system's accumulated downtime for that specific year exceeds 5%, there is no hard evidence for why it happened and breached the SLA. In principle, SLA violation should be detected, and penalties need to be paid by the service provider to the service recipient.

Each violation can be caused by the system or human when delivering the service (Dumitru et al., 2015). The purpose of understanding of human factor during services delivering can prevent human errors which can lead to service violation. The lack of providing the opportunities to staffs to learn and develop new skills become one of the barriers to delivering a good quality of service (Carayon et al., 2014). The root cause for the delay to address or repair the problem can make the downtime exceed, and based on observation, disregarded user complaints, too dependent on official statement SLA reports and delayed responses are contributors for SLA breaches. The human factor is one of the problems need to be considered very well in a hope the quality of the service can meet the satisfaction of the user (Carayon et al., 2014).

The human factor research discovers the human behaviour, capabilities, limitation, and other characteristic which interact with the healthcare system usage. The result for services delivering will show the performance of work. One of the challenges to implementing the healthcare information and technology is the need for skilled employee (Hersh et al., 2010). A skilled employee is a person who has special skill or technique, ability, and knowledge to do their work. Lacking suitable employee which has different education and training can lead to the user unwillingness in work (Raisian et al., 2014).

The road to successful use and maintains of the IT in healthcare has not been easy. User willingness is one of the barriers to the adaption of health information technology (Nugawela et al., 2011). The evolution of healthcare technology become more complex and it is not easy to adapt. The changes from paper based to electronic media become challenging to the clinicians or system users. The staff from IT department also need to adapt to the flow of the electronic medical record to maintain remote system records.

The lack of willingness to share information become the challenge for the implementation E-medical system in China (Gao et al., 2013). The hospital has not performed the positive attitudes toward sharing information for some reasons such as property, self-funded systems, and afraid with criticism by fellow professionals (Gao et al., 2013).

During the term of the agreement, SLA is used to act as target to be achieved by the service provider when delivering the services to the service recipient. The key of SLA element is to deliver the services, implement the activity and achieve Key Performance Indicators (KPIs) as well as possible. KPI should work to motivate the employee to improve the performance so that the organization can achieve their business objectives. This is where human factor plays as important role which need be monitored and controlled. The human factor is referring to skill or knowledge, attitude, behavior, and character. The human context is one of influencing the Healthcare Information System adoption in Malaysia Public Hospital (Ismail et al., 2015). The human factor is one the challenges for improving work performance and productivity. Any failure to the interaction between human and system will lead to the low performance of the hospital as medical delivery services.

1.3 Research Questions

This study addressed the following research questions:

- 1. What are the human factor that influence the health care system usage?
- 2. What are the most dominant human factor on SLA usage among IT staff?
- 3. How to relate human factor and SLA usage?

1.4 Research Objectives

The main objectives of this research are:

- 1. To propose SLA enforcement model that relate human factor and SLA usage.
- 2. To identify human factor that influence the health care information system usage.
- 3. To develop a model that incorporating with human factor and SLA usage

1.5 Scope of Research

To achieve the research objectives, we limit the scope of this study for SLA implementation model in the following points:

- 1. Human factors are scoped to cognitive factors only.
- 2. Domain specific information system.
- 3. Two categories of SLA sides, service provider and service recipients.

1.6 Term and Definition

Among the terms and definitions used in this study are:

1.6.1 Service Level Agreement

SLA is a contract document formally defined services provided by the service provider to the service recipient (Mirobi et al., 2015). Most company that provide the service normally will use SLA. This will allow their performance to be defined and benchmarked. The use of SLA is very common in outsourcing, cloud computing, and other areas that provide services. It helps to define the services and the performance that is expected from the service provider to service recipient. A well designed, implementing and maintain service level agreement will help the organization make a profitable investment and increase the long-term business relationship with service recipient.

1.6.2 User Willingness

User willingness describe the way of the worker behave with work or task during working hour. User willingness considered as an important factor to the information system and its application. The changes of the way of the human work and the changes of the procedures would bring out the willingness of the employees (Raisian et al., 2014). The user willingness can give an impact to the future information system implementation. Factor of user willingness due to understand or misunderstanding to the business procedure would affect the company profitability.

1.6.3 User Skill/Knowledge

The skill or knowledge is one of the factors for a successful life. The knowledge is an understanding of something. The skill is activity that can be developed by combining the knowledge and the ability of the person. By understanding this concept, it can help the organization take a proper decision and solve the problem (Rizi et al., 2013 and Jelenic, 2011). It is important to look up the employee's abilities and should provide the opportunities for those abilities. Poor skill or knowledge are not helping the employee to improve their performance. It is the inability or the fact of not be able to do something correctly thus effect the result or output from the task given.

1.6.4 Information Sharing

The term of information sharing referring to the human behaviour to exchange the information. It can be described the information exchange between two or more organization, people, and technologies (Wilson, 2010). The type of sharing information can be classified by three type such as the information shared by organizations, the information shared by individuals, and the information shared between firmware or software.

1.6.5 IT Staff Adequacy

The term of IT staff adequacy is the number of employees with the skills needed in IT department. The number of IT staff need to be increased and provide better education training, motivation, and skills from top employee. A skills employer may affect to the work performance, an industry, or a whole organization. The skill-healthcare staff adequacy needs to overcome by improving the procedure human resources development. It can be done such as provide recruitment and intensive training to the employee (Al-Gharbi et al., 2015).

1.7 Organization of Thesis

This thesis is organized based on the standard as follows. This thesis consists of six chapters that will explain the detail of research study.

The first chapter of the thesis consists is the introduction or background of the research. Then the research problem and research objective are explained. The research scope and the term and definition used in this research also presented in this chapter.

Chapter 2 describe the literature review which provide the previous works relevant to this research. In this chapter, the related work about Service Level Agreement (SLA) structure, Hospital Information System (HIS) and Human Factor are discussed based on accessed resources such as journals, conference and books.

Chapter 3 explains the research methodology. This chapter explain the specific procedure and technique used for this research. The methodology consists questionnaire for data collection. Data analysis also explained in this chapter.

Chapter 4 describe the research process regarding SLA enforcement model development which explain about the prototyping methodology used for development, the structure folder and code and the process of prototype.

Chapter 5 contains the result and discussion. This chapter will be explained about the data analysis from data collection via survey. In this chapter, the result from analysis will show if there any significant relationship between human factor (user resistance, lack of skill/knowledge, refuse to share information, shortage IT staff) with SLA usage.

Chapter 6 conclude the research conclusion, describe the limitation, and the future works.

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