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Investigating the Determinants of Major IT Incident Tickets: A Case Study of an IT Service Provider Firm for Logistics and Distribution Industry

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Abstract

Purpose - This study investigates the determinants that affect the number of IT Incident tickets of an IT Service Provider ("ITSP") to logistics industry in order to improve its management process by reducing the incident tickets.
Research design, data, and Methodology - This study uses weekly data of IT incident tickets from September 2012 to June 2015. Correlation and regression analyses are conducted. Six identified determinants i.e., IT Change, User Errors, Shipment Volume, Network, Hardware and Software Issues are used as the explanatory variables.
Results - Our findings show as following. First, our analysis indicates that IT Change is not a significant determinant as opposed to what commonly believed by many as the most important factor. Second, Software issue is the highest contributor to the Major IT incident tickets, followed by User Error, Network and Hardware issues. Third, it seems there is lead-lag relationship between IT Change and Major IT Incidents tickets as indicated by earlier studies. Fourth, the relationship between IT Change and Major IT tickets is also affected by shipment volume.
Conclusions - As policy recommendation, all identified determinants should be treated according to priority. In addition, improving the way IT Changes are implemented will definitely reduce the IT incident tickets.

Keywords: IT Service Provider, IT Changes, IT Incident Tickets, Logistics and Distribution Industry, Network, Enterprise Cloud Computing.

JEL Classifications: C12, D83, L14, L91, L93.

1. Introduction

Firm ITSP is an IT Service provider which manages all the information technology and system needs and requirements of customers to a logistics industry. It includes supporting requirements mainly for logistics data movement, IT infrastructure, communication software and applications for customers operating in more than 220 countries all over the world.

In order for ITSP to operate efficiently, the firm relies on the Enterprise Cloud Computing platform known as Service Now (https://www.servicenow.com/) to track support activities such as transactions of incidents, changes, problem tickets and reporting. Every request is tracked through a new ticket and each ticket is charged accordingly to the customer. Any incident reported by the customers is also priced based on the priority of attention required to resolve the incident.

The truth of the support system is that whenever a system has been at fault, and even the fault is at the service provider, the service subscriber will still have to pay for the ticket they raised. It is the cost that the customers will have to pay, based on the service level that the customers are subscribed to. On the business end of logistics industry, incidents will usually cause delays to the shipment processing. This is translated into losses due to penalties by the authority and the lowering of customer satisfaction level.

The customers of ITSP have been voicing their concern on the rising numbers of IT incident tickets as this is directly related to their increasing operational expenditures. Following the current uncertain and turbulence-prone

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economic situation, the slowing down of the logistics industry is really challenging the customers of firm ITSP. This is further supported by Armstrong and Associates (2014) report that volume for Freight and Forwarding business globally in 2013 has started to decline, thus resulting lower revenue and negative profit (Armstrong & Associates, 2014).

Many organizations are uncertain in determining the actual causes of major IT incidents. This has also led the organization to be unable to precisely provide adequate resources to support systems without under-utilization issue, especially when there is no incident being reported. There is also a perception that changes are related directly to IT incidents, as it has a higher probability to cause unintended consequences.

Often IT changes intended to resolve issues caused more issues after implementation. Most of the times, there are high chances that changes are being pushed by the users based on new requirements or due to the new policy of the organization or by the government.

Solving these issues will help firm ITSP and its customers to run leaner and more efficient by enabling them to reduce their operational expenditure on ticket support.

For the logistics industry, reducing issue means reducing delays in shipment processing of which will translate to less penalties by the authority and better customer satisfaction.

1.1. Research Objectives

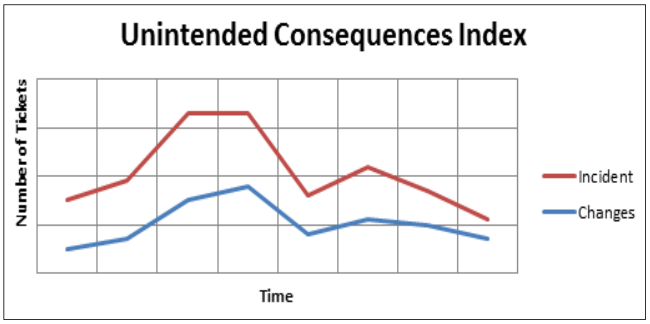
This research aims to investigate the causes of Incident tickets in the scope of the IT support activity of firm ITSP towards its logistic customers. This will also help the customers to ensure their success in achieving their organizational goals through firm ITSP as an effective and efficient IT service provider.

Through this study, the fluctuation of ticket trends will be observed and understood and the causes as in the ticket will be used to understand its relationship. It is also important to identify if there is a trending pattern that can help firm ITSP to craft a framework to minimize the gaps in order to prevent the increase of the incident tickets. At the same time, this research will also look at the relationship of the changes over major IT incidents and other causes.

This research utilizes secondary data for observation and investigation that is based on the change and incident ticket data extracted directly from the Service Now platform. Both incident and change tickets are extracted from September 2012 to June 2015.

2. Literature Review

Beekman and Quinn (2008) have mentioned some disastrous IT changes of some organizations whom failed adopting the Enterprise Resource Planning (ERP) in the first attempt (Beekman & Quinn, 2008). In addition, Henriquez (1996) write about how the usage of computer possibly caused the unexpected consequences, which in this research it may be translated to IT incident (Henriquez, 1996).



Source: Evolven (2016).

<Figure 1> Unintended Consequences Index by Jason Druebert

As shown in <Figure 1>, Jason Druebert (2010) illustrates that when the number of IT change is high, the number of IT incident will move up correspondingly. This situation holds true for companies with a proper standard of Information Technology Information Library (ITIL) change management process which implies minimal unauthorized changes, proper change approval and Change Advisory Board (CAB) meetings (Druebert, 2010).

Ash pointed out that when changes are planned and made given all the ITIL process had been properly defined and followed accordingly, often there is no monitoring of the system change, no investigation of the actual impact of the change as there are no data to investigate and lack of testing environment (Ash, 2004).

Leveson (1995) does not attribute network as a cause of IT Incident. Many logistics applications are utilizing the network to transfer real-time information (Electronic Data Interchange, EDI) as to exchange data, either internally or to the users externally. EDI is useful in adapting to e-Commerce environment in order to compete in digital economy. Most E-Commerce implementation encourages organization to effectively reach and engage customers, improve operating efficiency and boost productivity (Turban et al., 2010) survey made by Computer Security Institute (CSI) partnered with the FBI, polling 503 U.S. government agencies and corporations, it turns out that there are significant losses among participants due to computer misuse and crime by the employees. (Rola, 2002).

Clark (2013) finds hat security awareness within the corporate environment is very low. The complexity and procedural-driven security policy have been a factor that is stopping employees to have a better understanding on the security requirements. (Clark, 2013)

Roberts et al. (2006) states that the attempt in understanding the Motivation, Participation and Performance level of Open Source Software Developers, the variety of

motivation level would depend on individual knowledge, skills and abilities to produce task relevant behaviors; of which these behaviors contributed to individual performance. People tend to work harder and be more in focus when the motivation level is high (Roberts, Hann, & Slaughter, 2006).

3. Data and Methodology

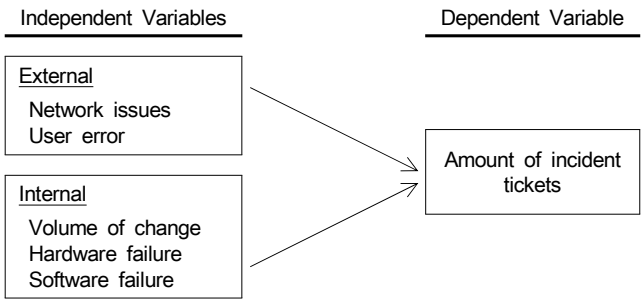
3.1. Conceptual Framework

The number of Major IT incident tickets is determined as the dependent variable. The identified major causes will be the independent variable for this study. The determinants for this research are as illustrated in <Table 1> below.

<Table 1> Table of Dependent and Independent Variables with the Measurement Unit

	Determinants	Unit of Measurement
Dependent Variable	Amount of IT Incident Tickets	No. of tickets
Independent Variables	Amount of Change Tickets	No. of tickets
	Network issues	No. of tickets
	User Error	No. of tickets
	Hardware failures	No. of tickets
	Software failure	No. of tickets

These major causes will be further divided into 2 categories, external and internal causes. External causes are the events that are not within the responsibility or control of ITS while internal is otherwise. Thus, the conceptual framework of this research can be illustrated as in <Figure 2> below.



<Figure 2> The relationship of Independent with Dependent variable

3.2. Data

This research utilizes secondary data for observation and investigation which is based on the change and incident ticket data extracted directly from the database. Data extracted are:

a) Incident Tickets (from September 2012 to June 2015)
b) Change Tickets (from September 2012 to June 2015)

Fields as shown in <Table 2> below are selected for the change ticket data. Fields are selected at a minimal number as there will not be any data manipulation required for change data. Then data is exported and saved as CSV as it has more flexibility. The size is smaller as it is a text-only data.

<Table 2> List of fields selected for use with the Change ticket data

No	Field Name
1	Number
2	Change stage
3	Short Description
4	Type
5	Priority
6	Category
7	Approval in Principle
8	Approval for Implementation
9	State
10	Planned Start Date
11	Planned End Date

3.3. Model

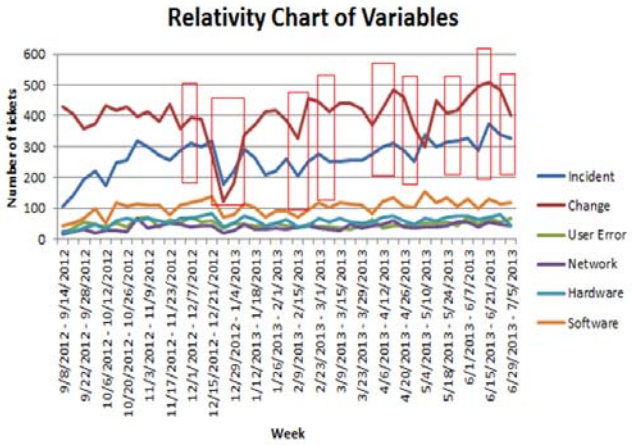
To further examine the factors that affect the number of incident tickets, the following cross sectional regression using the Ordinary Least Square (OLS) regression methodology is developed:

$$AMT_{EIT} = \beta_0+\beta_1 CHG+\beta_2 NWK+\beta_3 User+\beta_4 HW+\beta_5 SW+\hat{I}$$

AMT is the amount of incident ticket, served as the dependent variable that will be determined by the changes in the independent variable. While the independent variables are CHG, NWK, User, HW and SW which stand for the amount of Change ticket, Network issues, User Error, Hardware failure and Software failure accordingly. $\hat{I}$ represents the residuals or error term while $\beta 0$ is the intercept.

3.4. Relativity Chart of Variable

As shown in <Figure 3>, the frequency of incident and change data is considered a measurement; it belongs to the type of continuous data. Graphing a line chart shows the visual relationship observation between all variables. All variables seem to be closely related to incidents and change data trend; Marked in the red box below are the IT Change data that is visually seen to have the influence towards the incidents movement.



<Figure 3> Relativity Chart of Dependent and Independent variable

3.5. Correlation Analysis

Correlation analysis is meant to show the strength and direction of the relationship between variables. For this research, correlation analysis is performed to study the relationship between independent variables; IT Changes, User Issues, Network Issues, Hardware Issue and Software Issues with the dependent variable, the Major IT Incident ticket number. Data entry for the tabulated data into the PSPP software is done and using option Analyze -> Bivariate Correlation

<Table 3> Result of Correlation Analysis

		Incident	Change	User Error	Network	Hardware	Software
No. of Incident Tickets	Pearson Correlation	1	0.21	0.64	0.6	0.69	0.86
	Sig. (2-tailed)		0.006	0	0	0	0
	N	146	146	146	146	146	146
IT Change	Pearson Correlation	0.21	1	0.05	0.37	0.59	0.01
	Sig. (2-tailed)	0.006		0.28	0	0	0.471
	N	146	146	146	146	146	146
User Errors	Pearson Correlation	0.64	0.05	1	0.28	0.37	0.48
	Sig. (2-tailed)	0	0.28		0	0	0
	N	146	146	146	146	146	146
Network Issues	Pearson Correlation	0.6	0.37	0.28	1	0.46	0.35
	Sig. (2-tailed)	0	0	0		0	0
	N	146	146	146	146	146	146
Hardware Issues	Pearson Correlation	0.69	0.59	0.37	0.46	1	0.56
	Sig. (2-tailed)	0	0	0	0		0
	N	146	146	146	146	146	146
Software Issues	Pearson Correlation	0.86	0.01	0.48	0.35	0.56	1
	Sig. (2-tailed)	0	0.471	0	0	0	
	N	146	146	146	146	146	146

The strength of the relationship can be used to predict the movement of a variable, given changes in the other variables. It may also show whether two variables vary directly or inversely, whereby direct means both increase together while for inversely vary variables, while one variable increase, the other variable decreased.

As observed from <Table 3> in above, Software Issues has the largest correlation value at 0.86 while the lowest is unexpectedly the IT Change at 0.21. The correlation value for User Errors, Network Issues and Hardware Issues are 0.64, 0.6 and 0.69 respectively.

3.6. Regression Analysis

From the Regression Statistics result as in the <table 4> below, the R square of 0.90 indicates that about 90 percent of variations in the major IT incident tickets are explained by the variations in the independent variables. Based on the ANOVA result, Significance of F test indicates that the model used for this research is meaningful.

<Table 4> Output of Regression & Analysis of Variance (ANOVA)

Regression Statistics	
Multiple R	0.949
R Square	0.900
Adjusted R Square	0.897
Standard Error	18.688
Observations	146

ANOVA

	Df	Sum of Square	Mean Square	F	Significance F
Regression	5	440442.235	88088.447	252.231	0.000
Residual	140	48893.141	349.237		
Total	145	489335.377			

	Coefficients	Standard Error	t Stat	P-value
Intercept	16.705	10.220	1.635	0.104
IT Change	-0.004	0.014	-0.289	0.773
User Error	1.188	0.159	7.468	0.000
Network	1.142	0.137	8.357	0.000
Hardware	0.345	0.087	3.947	0.000
Software	1.264	0.090	14.055	0.000

Based on the <Table 4>, it can be concluded that for each ticket of IT Change, the number of IT Incident tickets will decrease by 0.004, how this variables in not significant; For each case of User Error, the number of IT Incident tickets will increase by 1.188; For each case of Network Issue, IT Incident tickets number will increase by 1.142; When there is a case of Hardware Issue, IT Incident tickets number will increase by 0.345 and for every case of Software Issue, the number of IT Incident tickets increase by 1.264.

The estimated output from the data is as follows:

$$AMT_{EIT} = 16.706 - 0.004CHG + 1.142NWK + 1.188User + 0.345HW + 1.264SW$$

3.7. Hypothesis Testing

The objective of hypothesis testing is to see if changes in the occurrence of IT Changes, User Error Issues, Network Issues, Hardware Issues and Software Issues will have any impact towards the number of Major IT Incident tickets.

Testing tool: ANOVA (Analysis of Variance)
Question: Are there any changes in the number of Major IT Incident tickets for different levels of each contributing factors?

Null hypothesis: Ho: μ1 = μ2 = ... μn
Alternative hypothesis: H1: At least one mean is different

Where,

μ is the mean of each level of contributing factors while n is the number of levels within each contributing factor that are IT Change, User Error Issues, Network Issues, Hardware Issues and Software/Application Issues respectively. For example, in User Error occurrences, the levels are 20 - 29 occurrences per week, 30 – 39 occurrences per week, 40 – 49 occurrences per week and so on.

<Table 5> ANOVA results

Testing Subject	Testing Tool	Hypothesis	No	Contributing Factors	P-value	Decision
Major IT Incident Ticket number	ANOVA	Ho: μ1 = μ2 = μ3 = μ4 = μ5 = μ6 H1:Atleastonemeanisdiffered	1	IT Change	0.773	Cannot RejectHo
			2	User Error Issues	0.000	Reject Ho
			3	Network Issues	0.000	Reject Ho
			4	Hardware Issues	0.000	Reject Ho
			5	Software Issues	0.000	Reject Ho

From the <Table 5> in above, the result shows that Major IT Incident ticket numbers vary with all tested factors except for IT Change. P-values for User Error Issues, Network Issues, Hardware Issues and Software/Application Issues are actually 0 which is less than 0.05 (reject Ho). There is no significant relationship between Major IT Incident ticket numbers with IT Change as their P-values are greater than 0.05 (cannot reject Ho).

With ANOVA, it can be concluded that that change in the occurrence number of IT Change is proven to have very little or no impact to the Major IT Incident ticket numbers. This is well-aligned with the result observed in the correlation and regression analysis as in the previous sections of this chapter.

4. Discussions

4.1. Summary

Except for IT Change, all the identified determinants for the study are highly correlated to the IT Incidents. IT

Change is surprisingly not the main contributor to the number of Major IT Incident tickets. Software Issues has the highest correlation with the number of Major IT Incident tickets. The rest of the identified determinants, User Issues, Network Issues and Hardware Issue are significantly higher in correlation with the number of Major IT Incident ticket compared to IT Changes. The Ranking of determinants from highest to lowest; Software Issues, User Errors, Network Issues and Hardware Issues.

The full analysis of the research can be summarized as below:

4.2. Identification of the determinants

The determinants of Major IT Incident tickets number, which later translated into the independent variables for this research, are being determined through work experiences and literature review. These factors are also available in the ticketing system as to be referred as the root cause for the closure code. The identification of the determinants is also supported by article as in the literature review.

4.3. The significance of the determinants

Software Issues are found to be the most significant determinant to Major IT Incident ticket number. An occurrence of Software Issues will increase the number of Major IT Incident tickets number by 1.264, followed by User Error, Network Issues and Hardware Issues with the coefficient values of 1.182, 1.142 and 0.345 respectively. Not as perceived by Druebert (2010) and many of the respondents, IT Change is very insignificant towards the number of Major IT Incident tickets, with a negative value -0.004.

<Table 6> Coefficient and, Correlation of the determinants

Ranking	Determinants	Coefficient	Pearson's Correlation between the determinants and major IT incident tickets
1	Software Issues	1.264	0.86
2	User Error	1.182	0.64
3	Network Issues	1.142	0.60
4	Hardware Issues	0.345	0.69
5	IT Change	-0.004	0.21

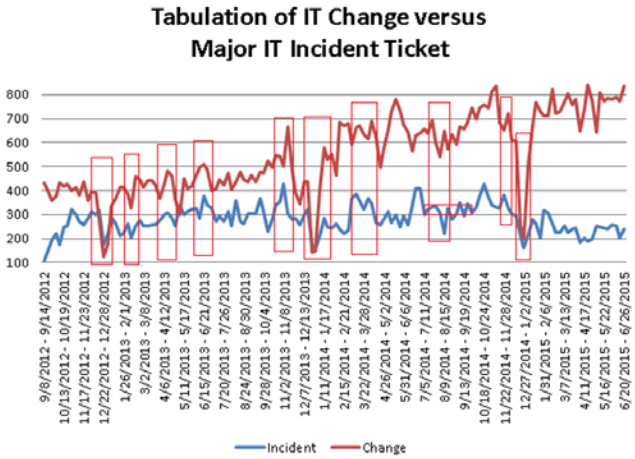
The Pearson Correlation result in <Table 6> shows that 86% of the data for Software Issues correlates to the data for the Y-variable or the dependent variable for this research i.e., the Major IT Incident tickets number. It is then followed by Hardware Issues, User Errors and Network Issues with the Pearson Correlation of 0.69, 0.64 and 0.6 respectively. Data for IT Change has a relatively low correlation to the dependent variable.

On the surface, IT Change is not a determinant to Major IT Incident ticket number. As the impact is largely insignificant. In other words, contrary to what the customers have always perceived, IT Change is not a determinant that contributes to more Major IT Incident ticket.

Improving the significance of effect for IT Change should be the future improvement's area of focus for firm ITSP. This also indicates the maturity level of firm ITSP in handling changes.

Based on <Figure 4> below, there are similar movements that can be clearly observed from the tabulation of both Incident and Change ticket. Similar peaking up and down movement of both Incident and IT Change are marked with ten red boxes. It looks like IT Change is somehow related to Major IT Incident ticket.

Another obvious observation is that both IT Change and Major IT Incident ticket number went down drastically for every end of the year. This also marked a relationship with Shipment Volume decrease during Christmas and New Year holidays, which cannot be done due to unavailability of data.



<Figure 4> Tabulation of IT Changes versus Major IT Incident Ticket number for 3 years

However, the movement of the IT Change is observed as increasing from an average of 400 in September 2012 - September 2013 to an average of 500 from September 2013 to September 2014. It then again increased to more than 700 per week from September 2014 to June 2015. The average of Major IT Incident tickets remains the same at around 300 tickets per week, for the whole September 2012 until June 2015.

Since the tabulation of incidents is grouped into a week or seven days, there are two possibilities of the relationship between IT Change and Major IT Incident number.

Major IT Incident happened after implementation of an IT Change. IT Change may have been taking place during the

weekend, Saturday or Sunday and Major Incident happened on Monday or Tuesday when ABCD customers are already on their daily operational tasks. This is what that is highly observed and perceived by Druebert (2010) and many of the survey respondents

IT Change takes place after Major IT Incident happened. During a week, Incidents may have occurred on any day of the weekdays and a quick change is scheduled to take place on Saturday or Sunday. One incident may be caused by several module or different application thus there is a high possibility of more than one change carried out to fix just a single incident.

The possible relationship as stated in item ii) above is not part of this research's consideration thus this can be part of the future recommendations for research improvement.

5. Conclusions

This research uses quantitative data analysis with the objective to address a specific business related issue; How to get the ITSP customers to run leaner by improving the amount spent on Incident. This research answers all the research questions and at the same fulfills the research objectives comprehensively. A conclusion based on the research questions is listed below:

i. There are four contributing factors to Major IT Incident tickets number in the context of the services provided by ITSP to its customers. Sorted by the highest impact, those are Software Issues, User Errors, Network Issues and Hardware Issues.

ii. The number of Major IT Incident tickets changed with different levels of each contributing factors. Summarized below:
For any Software Issues occurrence, Major IT Incident ticket is increased by 1.264 times
For any User Error occurrence, Major IT Incident ticket is increased by 1.182 times
For any Network Issues occurrence, Major IT Incident ticket is increased by 1.142 times
For any Hardware Issues occurrence, Major IT Incident ticket is increased by 0.345

iii. From ANOVA analysis, H0 analysis for IT Change is not rejected, thus it is proven to be not one of the determinants to Major IT Incident tickets number. From correlation analysis, it has the least percentage of data correlativity to Major IT Incident ticket data. Regression analysis also shows that IT Change has the least significant impact to Major IT Incident ticket, atonly- 0.004 which can be ignored. Thus, from data analysis, IT Change is not proven as the main determinant. Instead, it has the least impact and probable impact is actually to reduce the Major IT Incident ticket number.

iv. Even though the two major factors will be Software Issues and User Issues, by right, all factors shall be put into focus of improvement. All factors should be treated equally important, including the IT Change. This is because the strategies for all factors, Software Issues, User Issues, Network Issues and Hardware Issues are equally correlating to each other, based on Table 4.1 Result of Correlation analysis.

IT Change has the possibility to be the control agent for Major IT Incident ticket number. With its negative coefficient value, IT Change can be improved to increase its impact; which currently is very insignificance. Improving the impact will help to increase the probability of the number of Major IT Incident tickets to be reduced.

This context of this study also eliminates the common perception that IT Change is the main contributing factors to Major IT Incident. In other words, Jason Druebert's view on the IT Change as the determinant to Major IT Incident ticket number is not supported by our result.

However, there is a possibility that IT Change is instead stabilizing the incident ticket number. IT Change has the negative impact to Major IT Incident ticket number. Given more shipments, more applications, and more business requirements, Major IT Incident ticket numbers are stabilizing at the range of 200-400 tickets per week throughout almost 3 year of period between September 2012 and July 2015.

There are four determinants to Major IT Incident ticket number. Those are Software/Application Issues, User Errors, Network Issues and Hardware Issue. The recommendations on the action items will be based mainly on these four determinants, and followed by the improvement measures towards IT Change in general.

6. Policy Recommendations for ITSP

In terms of Software issue, Janaki (2010) suggested eleven factors to be used as the key towards Software Quality. They are Correctness, Efficiency, Expandability, Flexibility, Integrity, Portability, Reliability, Reusability, Survivability, Usability and Verifiability. The software correctness is the degree of how the software design and implementation conform to the requirements. A better software quality is the key of reducing Software/Application issues thus at the same time reducing the Major IT Incident ticket number in general.

For the issue of users error, Humphrey (1995) stated that users need should be the principal focus of any software

quality definition. Crosby (1984) defines quality as conformance to requirements. While software developers hardly able to distinguish between requirements, needs, and wants, one thing that many have been overlooked is the perspective of the users; the people who will be using the software for their daily use.

Human errors are mostly occurred when dealing with system complexity Clark (2013). Other than meeting the requirement of the software, another factor of software quality is the usability. A system may be usable to one but not to another. It is very important to ensure the usability of software or an application from the perspective of the user. Reducing the system complexity will also increase the usability of the system. As suggested by Tira (1970), it is very important to ensure the highest possible quality of the course material.

In a related matter to users' errors, Rola (2002) also suggested that security measure awareness amongst the users should be improved. Users should be aware or informed on the consequences of the errors they will be doing in the system to avoid user errors from keep reoccurring.

Network issues are highly unpredictable. The symptoms and causes vary widely. Due to that nature, it is very critical for an organization or a workplace to ensure continuous network connectivity by having network redundancies in the network connectivity link. Another measure in overcoming unpredicted network issues is by having pro-active event tickets generated whenever abnormalities in the network are found.

While most of the capacity management exercise revolves around the usage, capacity, and utilization, organizations are often observed to overlooking the lifespan of the hardware equipment. The equipment not only involves computer's Central Processing Unit (CPU), network devices, cabling and so on, capacity planning should also cover the capacity and the lifespans of the server racks, air conditioning, electricity supply and physical space, and storage space management. The best to get over with this is to have the support with an adequate spare part supply to be the nearest possible. In the case of any hardware issues occurring in the organization, the support team is just nearby to give the organization the support needed throughout the critical outage time.

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