Six Sigma DMAIC: Process Improvements towards Better IT Customer Support

Noor Nashriq Ramly, *Member, IEDRC, IASCIT,* and Lee Kah Yaw

***Abstract*—In the IT Service Management (ITSM) business nowadays, companies are struggling with ways to handle and align IT services with business needs and underpin the business core process. Since these IT companies are relying on customers to generate their profits, there has been increasing need to take care of customer complaints and issues effectively. Proper processes and procedures need to be implemented according to certain compliance standards so that customer needs will still be their top most priority while at the same time help to facilitate business change, transformation and growth to be aligned with company vision. Looking at trends of customer issues volume, there is increasing needs to address these numerous daily activities to ensure effective customer support being practiced by the organization. This paper discusses on the improvement carried out to reduce the number of IT infrastructure support issues using Six Sigma DMAIC approach in MIMOS. The tools and techniques taken as well as key steps that led to sustainable improvement are explained according to five phases of Six Sigma DMAIC in the later sections. With this study, it is hoped that this paper would be a useful guide to companies that are facing with the same issues and intend to improve total customer related support in their organization.**

***Index Terms*—Six Sigma DMAIC, ITIL, ITSM, Cost To Quality (CTQ), Mistake Proofing.**

I. Introduction

MIMOS IT Department has been implementing ITIL framework for their organization for nearly five years now. This has been a continuous effort and the implementation has helped us to strategize and properly align our IT business core process according to management vision and mission as well as customer needs. However, looking at the trends of customer complaints and request, there is urgent need for the management to pause and start analyzing the current situation to ensure that we do not astray from the right track. Appropriate problem solving methodology needs to be introduced in order to investigate the root cause of the current issues and carry out the improvement plan based on the findings.

One of the most popular and effective problem solving methodologies apart from TRIZ [1] and PDCA [2] is Six Sigma DMAIC. First developed by Motorola in 1980's, it contained a set of practice designed to improve manufacturing processes and eliminate defects. Its application was subsequently extended to improve existing business processes such as in IT, banking, and healthcare business [3]. The power of Six Sigma DMAIC methodology lie on its systematic approach that governed by rigorous steps in its five phases–Define (D), Measure (M), Analyze (A), Improve (I) and Control (C); hence the acronym (Fig. 1).

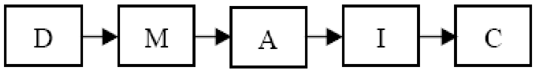

Fig. 1. DMAIC phases

Six Sigma DMAIC was chosen ahead of other methodologies due to its ability to improve certain process by eliminating defects in the existing process and the probability for defects to happen in near future is nearly impossible. The goal is not 99%, not even 99.9%, but 99.999996% statistically free from defects [3]. Normally, this methodology is used by organization when dealing with bottom line benefits or customer satisfaction [4]. In other words, this methodology can help us to deliver sustained defect-free performance with highly competitive quality costs over the long run [3]. This was actually backed up by former General Electric (GE) CEO, Jack Welch in 90's through astounding dramatic improvement in the company after implementing the Six Sigma DMAIC methodology [5].

In Section 2, this paper discusses in detail the key tools, techniques used as well as steps taken in every phase of Six Sigma DMAIC. The last two sections describe briefly our conclusion and future work based on this study.

II. Approach to Six Sigma DMAIC

A. Define Phase (D)

Ticket Count Reduction – Infrastructure			
Business Case			**Problem Statement**
By reducing 25% of overall ticket, estimated cost savings through this efforts as below: 1) FTE (RM6.8K) 2) Projects (RM7K) Total cost savings is RM13.8K (breakdown on the next page)			Currently, the performance of volume of the tickets was ~9tickets per week measured from July 2010 to Dec 2010. . Therefore, there is need for an improvement project to address numerous support issue/request that usually used up most of CE time. By reducing the workload on support task, CE can contribute more on the industry project.
Goal statement			**Project scope**
Metric	***Current level***	***Goal / Target***	Closed tickets for Infrastructure Tickets. Starts with: Initiate user request from system Ends with : Closure of submitted request
Count of ticket	~9 tickets per week	25% reduction of current baseline	
Project plan			**Team Selection**
Phase	***Start***	***End***	Champion: Thillai Raj
Define	Feb 14, '11	Feb 28 '11	Mentor : Lee Kah Yew
Measure	Mar 21, '11	Apr 18, '11	GB: Noor Nashriq Ramly
Analyze	May 16, '11	June 30, '11	Member : Haris Aziz
Improve	July 01, '11	July 31, '11	Member : CE Infrastructure Group
Control	Aug 01, 11	Aug 26, '11	Member : -

Fig. 2. Team charter

The focus of this phase is defining the problem that requires solution and ended with clear understanding of

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scope and evidence of management support in order to guarantee the commitment from stakeholders involved [6]. Apart from that, we identified customer requirements that consisted both internal and external stakeholders. This information was captured in Team Charter for proof of requirement and commitment [7] (Fig. 2).

To come out with good justification and business case for the project, we have collected six months data from our Service Desk System. These data ranged from July 2010 to Dec 2010. Summary of the data is shown in Fig. 3.

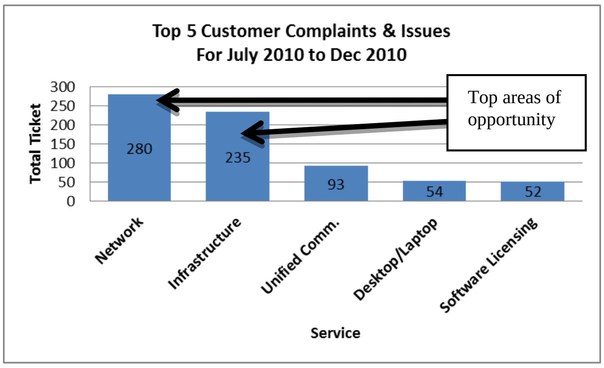

Fig. 3. Top 5 customer complaints for July 2010 to Dec 2010

We concluded that Network and IT Infrastructure were the top two services of customer complaints and requests. However, as Network had been identified for the next improvement project, we put focus on IT Infrastructure tickets that constituted about 235 issues in about 6 months period, with an average of ~39 issues per months which translate to average of 9 issues per week. By reducing 25% of overall tickets, estimated cost savings contributed from Full-Time Equivalent (FTE) staffs and project support effort is RM6.8K and RM7K respectively per year. Thus, total cost savings from these two areas was RM13.8K per year.

Though the cost saving was not huge, this improvement was crucial in a way that technical personnel could put focus on their time and effort to manage other bigger impact improvement projects rather than keep putting effort in repeated daily activities. In addition, IT organization would have more time to put focus in other tactical and strategic activities that provides higher impact to their business.

B. *Measure Phase (M)*

Fig. 4 shows the steps that taken to complete Measure phase. During measure phase, we understood how the current processes were performing by using process mapping technique such as Top Down Charting that was further derived from SIPOC. SIPOC is an acronym for supplier, input, process, output and customer. SIPOC was used to define project boundary and scope to ensure that we could put focus on the real problem [8]. It was constructed to show key elements that involved in our ticketing process e.g. input, process, output indicator and etc (Table I).

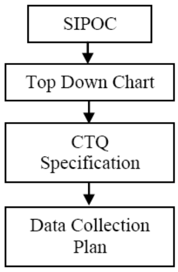

Fig. 4. Steps taken in measure phase

TABLE I: SIPOC DIAGRAM

Supplier	Input	Process	Output	Customer
User	False ticket	Create ticket	Knowledge Base (KB)	User
Network/Infra Engineer	Unsupported services	Investigate issue / request	Created ticket	Engineer
	Duplicate ticket	Seek expertise	Solution	
	Expertise	Work on the solution	Workaround	
		Confirm ticket resolved		
		Update Knowledge Base (KB)		

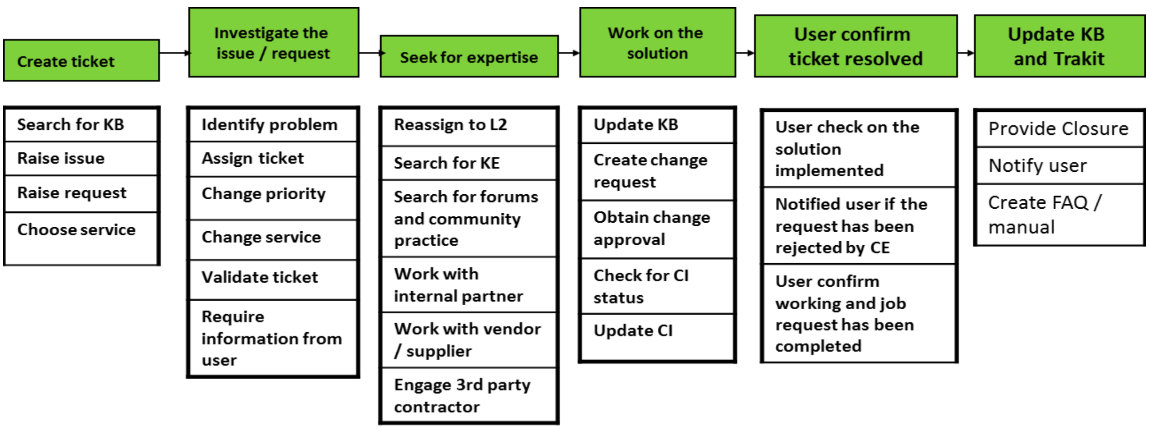

Fig. 6. Top down chart

Next, we came out with Top Down Chart to identify the high-level activities that are important to the overall process and demonstrate how the process will look like after streamlining it by removing the unnecessary and inefficient steps that currently exist as shown in Fig. 6.

Through this process, we identified critical processes that affected our Project Y (performance measure) and came out with Critical to Quality (CTQ) specification table as depicted in Table II.

TABLE II: CTQ SPECIFICATION

CTQ (Project Y)	Operation Definition	Goal
Weekly average number of issues for complaints and request	Issues raised and captured from Helpdesk System for IT Infrastructure	Reduce weekly average number of issues for complaint and request by 25%

This operation definition defines a clear and concise guide of what and how properties are measured and their linkage to critical business requirements and as well as goal of this project [9]. After that, data collection was planned to quantify their actual and current performance against the defined CTQ (Refer Table III).

TABLE III: DATA COLLECTION PLAN

Performance Measure	Where	Sample size	Who	When	How
Average ticker count per week	Seervice Desk Ticket	100% from Jan to July 2011	Noor	Jan to July 2011	100% and automated

The initial performance before improvement is depicted in Fig. 9. We concluded that the baseline performance of issues ticket volume raised was average of ~9 issues per week versus the improvement goal average of ~7 issues per week (25% improvement)

C. Analyze Phase (A)

Summary of steps taken in measure phase are depicted in Fig. 10. We started with Cause and Effect Analysis to find and shortlist the critical causes (X's) that potentially given impact to Project Y. These activities were carried out through Cause and Effect Diagram (Fishbone) and then proceeded to generate Cause and Effect Matrix (C & E Matrix) as shown in Fig. 11 and Fig. 12.

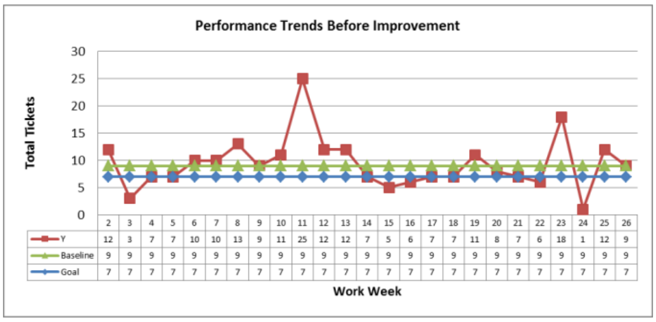

Fig. 9. Performance trend–before improvement

Fig.10. Steps taken in Analyze Phase

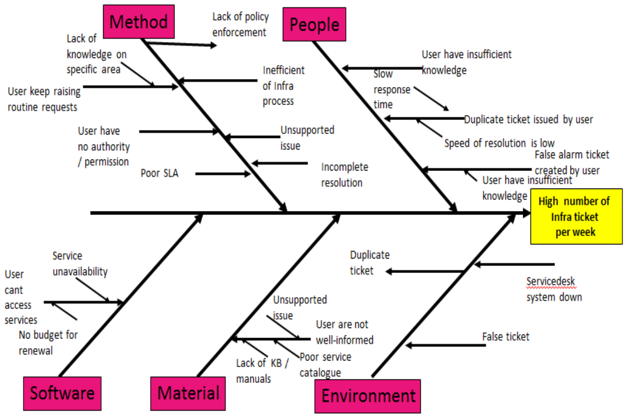

Fig. 11. Cause and effect diagram (fishbone)

----- Input/Process Indicators -----	count of ticket 10 Correlation of Input to Output	<<<<Output Indicators <<<<<<<<Importance --------- Total ---------
service unavailability	9	90
inefficient process	7	70
poor service catalogue	6	60
Lack of knowledge	6	60
work culture	6	60
Knowledge base (manuals)	5	50
false ticket	5	50
incomplete resolution	5	50
Lack of policy enforcement	5	50
differentusers with same issues	4	40
response time	4	40
unsupported issue	4	40
duplicate ticket	3	30
permission	3	30
policy enforcement	3	30
poor SLA	3	30

Fig. 12. Cause and effect matrix

As continuation from Cause and Effect Analysis, 5-Why

TABLE IV: 5-WHY ANALYSIS

Shortlisted Root Cause	Why1	Why2	Why3	Why4	Actionable
Poor service catalogue	User are not aware of CE supported services	Service Catalogue is not properly communicate	Catalogue is not updated, reviewed validated	N/A	Defined & validate CE Service catalogue. Proper communication need to be done to user.
Service unavailability	Machine down	Hardware failure	Maintenance issue	Out of budget	No.
	Service down	Service malfunction	Wrong configuration	User not well-trained	Provided configuration training to users
User Knowledge of specific area	User has insufficient knowledge	Ignorance	No training provided	N/A	Provided configuration training to users
	Lack of manual	Process is not standard	Process is not well-defined	N/A	Defined & validate CE core processes.
Inefficient process	Too many process in place	Process is not suitable for certain cases	No standard process in place	Process is not well-defined and validated	Defined & validate CE core processes.

Analysis was constructed for every selected X's (refer Table Ⅳ). These validation activities are carried out over and over again through peer review as well as subject matter expert (SME) sessions until absolute root cause have been selected and verified. This activity ensured that we broke down the cause into more explicit elements thus obtained the correct and absolute root cause for the improvement rather than taking actions that were merely band-aids [10].

D. Improve Phase (I)

Significant/Critical X's	Root cause	Potential Solutions
Inefficient process	Recurring request on one-time backup.	Using FreeNas for one-time backup automation
Inefficient process	Hardware failure is done through reactive monitoring & manual.	Proactive detection on HP hardware faulty detection
Inefficient process	No visibility on storage utilization & user keep requesting more request for new storage	Monthly review on data management & generate actions accordingly
Inefficient process	No proper & standard process for server request	standard process for new server request
Inefficient process	Multiple request raised for one specific project – low visibility	consolidate point of requests by team leads/ projects
Inefficient process	Multiple PIC for specific project – intend to create duplicate tickets & affect communication	Single point of contact for infra requests for every project
Inefficient process	User creation is done separately with server request	User creation done in every new server request
Inefficient process	Reactive detection on user account issue	Performed quarterly LDAP account maintenance
Inefficient process	No standard form/ process for Grid account maintenance	Centralized account maintenance for Grid
Inefficient process	Firewall request is done separately with server request	Firewall request is embedded in new server request

Fig. 14. Potential solutions

In response to root causes found, various set of corrective actions (solutions) were considered and selected for implementation (see Fig. 14). Selection of possible solution to be implemented was carried out through rank solution table (see Fig. 15). It was expected the selected solutions would eliminate or at least minimize the impact of root cause to the problem.

			Sigma Level	Time to Implement	Cost/ Benefit	<<Criteria
			10	8	6	<<Importance
No	X's	Possible Solutions	Ratings			Total
1	Inefficient Process	Using FreeNas for one-time backup automation	9	7	7	188
2	Inefficient Process	Proactive detection on HP hardware faulty detection	9	7	7	188
3	Inefficient Process	Monthly review on data management & generate actions accordingly	8	5	6	156
4	Inefficient Process	standard process for new server request	8	7	8	184
5	Inefficient Process	consolidate point of requests by team leads/projects	8	7	7	178
6	Inefficient Process	Single point of contact for infra requests for every project	7	7	7	168
7	Inefficient Process	User creation done in every new server request	8	9	9	206
8	Inefficient Process	Performed quarterly LDAP account maintenance	7	8	7	176
9	Inefficient Process	Centralized account maintenance for Grid	8	7	6	172
10	Inefficient Process	Firewall request is embedded in new server request	9	9	6	198

Fig. 15. Rank solutions

To assess effectiveness of solutions implemented, a pilot run was planned. Pilot plan was constructed as in Fig. 16.

Corrective Actions	Resp	Start Date	Due Date	Status
Using FreeNas for one-time backup automation	Sheikh	July 01, '11	July 31, '11	Closed
Proactive detection on HP hardware faulty detection	Hafiz	July 01, '11	July 31, '11	Closed
Monthly review on data management & generate actions accordingly	Hafiz	July 01, '11	July 31, '11	Closed
standard process for new server request	Hafiz	July 01, '11	July 31, '11	Closed
consolidate point of requests by team leads/ projects	Aziz/Hadi	July 01, '11	July 31, '11	Closed
Single point of contact for infra requests for every project	Aziz/Hadi	July 01, '11	July 31, '11	Closed
User creation done in every new server request	Hilmi	July 01, '11	July 31, '11	Closed
Performed quarterly LDAP account maintenance	Hilmi	July 01, '11	July 31, '11	Closed
Centralized account maintenance for Grid	Hilmi	July 01, '11	July 31, '11	Closed
Firewall request is embedded in new server request	Anan	July 01, '11	July 31, '11	Closed

Fig. 16. Pilot run plan

The finding derived from the pilot plan was plotted in a control chart as depicted in Fig. 17. We can see that there are positive improvement showed after solution has been carried out i.e. center line before and after improvement is 9.4 and 7.05 respectively.

One-Sample-T Test was performed to statistically validate the improvement results against the project baseline that was first defined in Project Charter. Fig. 18 below shows the statistical analysis result of One-Sample T Test. The practical conclusion as derived from statistical conclusion is that the weekly average number of complaints and requests was significantly reduced as compared to baseline; as p-value is less than 0.05.

E. Control Phase (C)

In order to ensure the gain is maintained over the long term, a control plan was generated and handed over to process owners for implementation as listed in Table Ⅴ.

Generally, the plan outlined the significant factors/parameters, the responsibilities personnel and how they were controlled and monitored by means of a set of control methods such as standard procedures, control charts and mistake proofing. Also, it detailed down the contingency plan for each significant factor/parameter should an out of control situation occurred [9].

The improved process mapping should cover any modifications that been identified in the previous phase. It should be reviewed and updated as needed so that everyone in the team is aware of the new arrangements. This is particularly crucial if multiple improvements were made and the new process is substantially different from the original process (see snapshot of improved process mapping in Fig. 20).

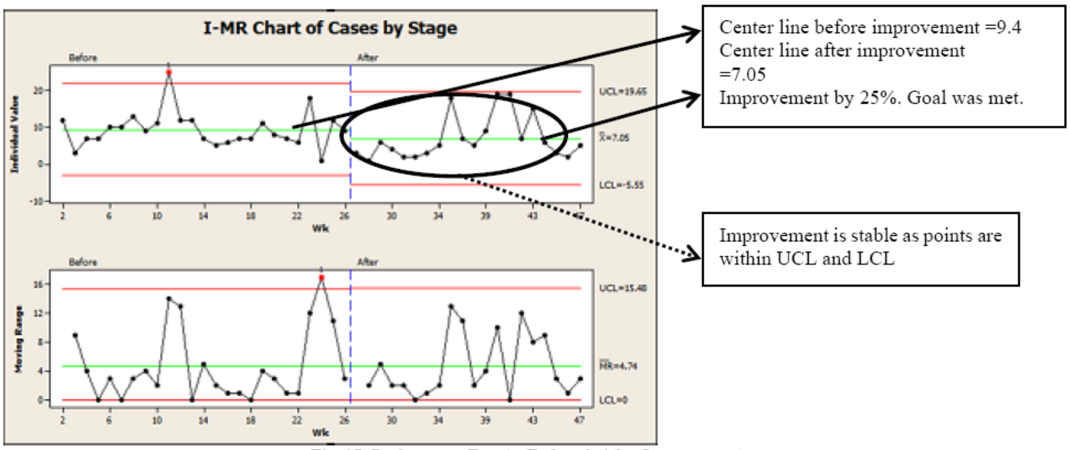

Fig. 17. Performance trends (before & after improvement)

One-Sample T: After Improvement
Test of mu = 9.4 vs < 9.4

Variable	N	Mean	StDev	SE Mean	95% Upper Bound	T	P
After Improvement3	21	7.14	5.76	1.26	9.31	-1.80	0.044

1 sample T - test

Ho p > 0.05 : μ_{after} = 9.4

Ha p < 0.05 : μ_{after} < 9.4

P value =0.044	Reject Null Hypothesis
Conclusion	The improved processes performance was significantly lower than 9.4 cases/week (baseline). The improvement action taken were considered effective.

Fig. 18. One-sample T: improvement validation

TABLE V: SOME OF THE ITEMS IN CONTROL PLAN

Parameter	Control Method	Control Limit	Frequency	Resp.	Contingency Action Plan
IT Infra Ticket Count	I-MR charts	Max 13 issues per week (UCL)	Weekly	Nashriq / Hadi	Perform RCA if exceed.
Storage Utilization Reviews	Trend charts for storage utilization	50% of storage is more than 3 years old	Monthly	Hadi	Reclaim unused storage / buy additional storage

Process Mapping "As Is"

1. User will keep on request new one time backup after few months
2. Multiple tickets for different request for certain project.
3. Multiple PIC for every project request resulted in duplicate ticket.
4. Manual notification for any HP server faulty.
5. Storage are given by request without having capacity planning in place.
6. No standard form to capture new server request.
7. User account is done separately from server request

Process Mapping "As Should"

1. User will advise need of recurring one-time backup in future.
2. Consolidation of requests on same project via projects plan. No ticket required
3. One PIC for every project request.
4. Automation of early hardware detection for HP servers faulty
5. Monthly review of storage utilization to prepare for capacity planning
6. Standard server form is sent to user for any new server request.
7. Include user account creation in server request

Fig. 20. Process changes/reduction: before vs. after

Mistake proofing is a system that is designed to ensure no possible mistake can be done in the process. Normally it is carried out in areas that have repetitive and manual tasks performed. In our case, one of the mistake proofing that we have carried out is on the detection method using System Insight Manager that acts as early detection failure for HP server. It will automatically send email to HP for any abnormal activity for HP servers that would in future effect server unavailability (see Fig. 21).

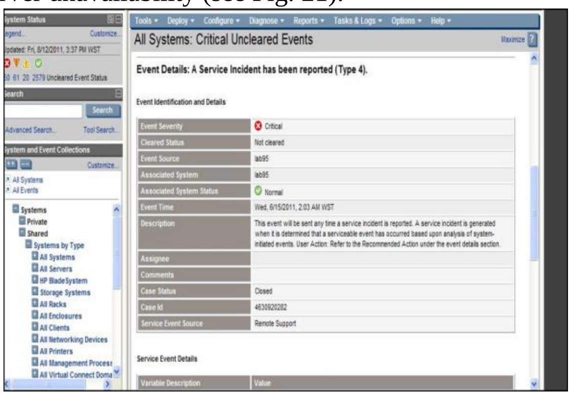

Fig. 21. Detection method (mistake proofing)

Sample of storage utilization that are used in monthly review are depicted in Fig. 22. These are currently used to derive plans for capacity management so that we can predict utilization of storage in future. Hence this would help in minimizing volume of storage issues in the future.

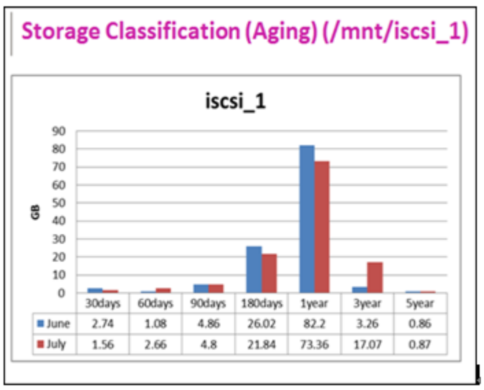

Fig. 22. Sample of storage utilization chart.

Another point to be considered while closing the project is replication opportunity that can be carried out in other respective business units and processes. Replication defines as extending a successful solution across several other business units with identical or similar process. This would save time and cost to the organization as the solution is already implemented and proven. Fig. 23 shows the replication plan carried out in our organization.

Solution	Replication		
	Process	Location	When
Consolidate point of requests by team leads/ projects	Multiple tickets for different request for certain project.	Network Tickets	June 2012
Single point of contact for infra requests for every project	Multiple PIC for every project request resulted in duplicate ticket.	Network Tickets	June 2012

Fig. 23. Replication Plan

III. CONCLUSION & FUTURE WORK

Through this improvement project, we found that volume of customer complaints and requests had been successfully reduced to 75% of initial volume of IT Infrastructure ticket. This result proved that our Six Sigma DMAIC approach had effectively improved our overall process by finding the root cause and selecting the best solutions for high volume IT Infrastructure issues that we faced previously. However, we understand that continuous monitoring need to carry out from time to time to ensure that any deviations from control targets are identified and corrected before they result in defects and subsequently negatively affecting improvement effort that took place.

We plan to continue implementing Six Sigma DMAIC to other areas of services as well. Through this initiative, we can ensure that we cover all improvement areas needed that are related to issues tickets volumes that may affect our overall customer satisfaction in future.

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