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# S.P.A.C.E - Statistical Process Analytical Control Exercise: A Rapid insights generation methodology for Incidents, Problems and Changes in IT Infrastructure Services

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## ABSTRACT

*Statistical process control (SPC) is a method of quality control which uses statistical methods. SPC is applied in order to monitor and control a process. Monitoring and controlling the process ensures that it operates at its full potential however, the right way to apply the SPC is still a big challenge for all industries due to the transformation in every industry in the context of emerging technologies such as big data, Analytics and Internet of Things (IOT). Application of SPC in manufacturing industries are highly matured compared to its applications in service sector, especially in Information Technology (IT) industry. As the size of data is growing exponentially and the need of ghettoizing noise and signal in the data is also increasing. In this paper, the novel methodology called SPACE (Statistical Process Analytical Control Exercise) is described. The uniqueness in this methodology is the integration of Statistical process control techniques and Data Analytics techniques established in a cause and effect manner. This methodology is expected to help any professional in the IT infrastructure services industry and drive improvements especially in the context of Incidents, Problems and Change failures.*

***Keywords***

***Data Analysis, Statistics, Analytics, ITIL(Information Technology Infrastructure Library), Remote IT Infrastructure services, Statistical process Control, Analytics, PBA(Process behavior analysis) charts,Service Management, Incidents, Problems, Changes***

## 1. INTRODUCTION

As in all business, quality is of paramount importance and the outcome of the same is realized quite fast. Many successful global organizations use the correct set of quality tools to identify, assess and analyze their qualitative and quantitative data for delivering high quality standard and improvements. The Basic Quality tools that are used across different sectors and different company sizes are the same [1]. Here the Basic Tools of Quality refers to the seven tools of Quality which are,

1. Histograms
2. Cause and Effect Diagrams
3. Check Sheets
4. Pareto Charts
5. Flow Charts
6. Control Charts
7. Scatter Diagram

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## 2. Origin of research problem

These seven quality tools are used randomly for any given problem in the industry in the context of improving the Quality. There is no particular sequence or order prescribed in using the seven quality tools. This is huge disadvantage for the business analysts or data analysts or Lean Six Sigma consultants in identifying the suitable technique for the given business problem. While, Lean or Six Sigma problem solving approach has specific pre-requisites and criteria, there is no methodology that helps the analysts to follow specific algorithm to get quick insights from the incidents, problems and change management data sets.

SPACE methodology address these challenges or gaps. It helps in identifying the insights very quickly by following certain specific algorithm for Incidents, Problems and Change management records. It also helps in avoiding this random selection of tools and prescribes data analysis steps that gives the best insights in a very short span of time. Existing literature reviews are with respect to seven QC tools and their applications and there is no paper that presents the aforementioned concept

## 3. Literature Review

IT Infrastructure Services is process driven and customer centered. The services are affected by a number of factors, such as Technology, Software, User Knowledge, Internal Process, and External Process (at Customer End). Though the application of the seven tools is applicable for any industry but the IT infrastructures is a special case to be considered. One of the major aspects in this industry is the handling of the incidents and service level availability. Such a case of healthcare application related incidents and service availability was studied in the paper 2015 by Selvan et.al, where the impact of downtimes of the IT infrastructure within the service level agreement. Thus, brought in the necessity to increase the service availability to 99.99% from 99.91%. It can be inferred/understood from the above case and similar cases that though there are issues that are quantitatively high and would impact the business. There are some critical issues that would impact the business as well and the same can be the root cause of many other issues.

This brings the necessity of understanding the data further more before the deep dive analysis of any sort. Which would eventually reduce the time required to perform the analysis and would also provide a holistic view of the issues.

The use of seven tools of quality to achieve continuous quality improvement by selecting the appropriate quality tools and techniques discussed by Mirko Sokovic et. al., [4]. The seven tools of quality along with the Six Sigma DMAIC approach enables a structured approach for establishing the continuous improvement. Mirko Sokovic et. al., also discusses the possibilities and areas where the seven quality tools can be applied in association with PDCA, Lean Six Sigma and Six Sigma DMADV of approach. Further he also appreciates the possibilities of having other approaches and frameworks which has these tools as their basis to deliver continuous improvements.

Paliska has discussed the use of these tools and has also provided a framework for process industries. Wherein Paliska.et.al. have shared the sequence and selection of the seven tools to establish a process of continuous improvement [2].

As per Paliska et al., the model begins with data collection and followed by Pareto Analysis which is then taken for either root cause analysis with the help of cause and effect diagram or comparing the present and past state of things which is then taken for a root cause analysis and finding solution, implementation and control. The sequence of steps is repeated for continuous improvement.

Luis Fonseca et. al., [1] in the year 2015 studied the extent of utilization of the quality tools based on the sector and size. In their study, Luis Fonseca considered the seven quality tools as the basic tools and other analytical techniques as advanced. Outcome of the study projected that the basic quality tools were applicable for usage irrespective of the sector type and size of the company, whereas the advance quality tools were more applicable in larger company sizes only.

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Anil Kumar Raghavan Pillai et. al., [5] in the year 2014 studied the integration of ITIL service delivery to Lean Six Sigma to identify further areas of improvement. Anil Kumar et. al., witnessed that this integration has significant improvement in sigma level depicting reduction in the defects. Further, Anil Kumar et. al., appreciates the benefits gained by this integration such as the cost reduction, enhanced decision making and improvements in operational efficiencies.

There is no specific work in the area of Incidents, Problems and change failure data analysis steps in the aforementioned papers.

## 4. SPACE Methodology

The uniqueness of this methodology lies in the combination of SPC techniques with Data Analytics. Using these two powerful approaches has yielded greater and more sustainable results.

The SPACE approach begins with the data collection and ends with creating the SPACE dashboard which is the assimilation of the analysis and decisions taken based on the analysis. The Steps involved in the SPACE approach are as follows,

This approach is applicable for IT Infrastructure Incidents, Problems, Change failures and Service Level Agreement issues.

Data analysis assistant shown in figure 1 is the novel feature as part of the SPACE methodology.

This feature can be developed as a plug-in or as an add-on feature in any of the existing data analysis or data analytics products. Currently this is available in an excel based automated template and this can be obtained by contacting the author. This feature answers the basic and fundamental question of any analyst professional. Such as “Where do I start my analysis for a given data set (incidents, problems or Change records”). This feature can also enable the cognitive or data analytics product developers in the area of “how do I automate the process of Incident, problems and change failures?”

**Figure 1: Data analysis assistant**

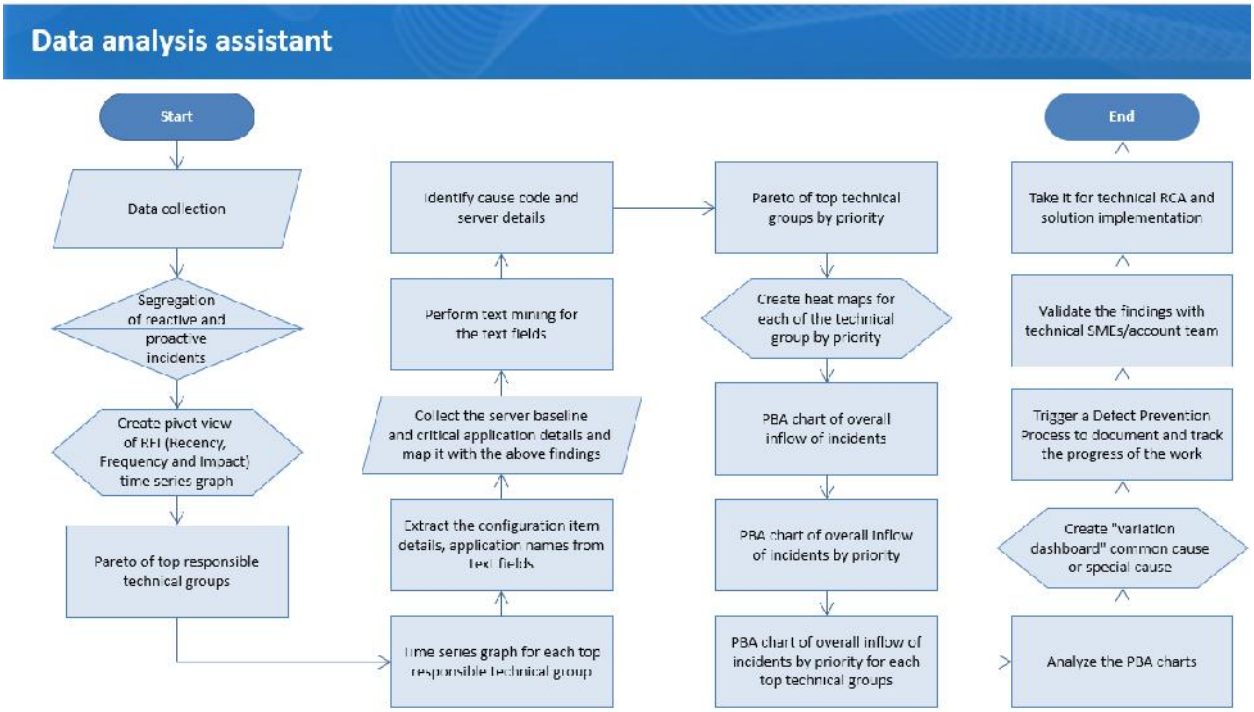


Table 1 explains the management dashboard based on data analysis assistant results. For example: There are various departments within a business unit in an organization. The departments in any IT infrastructure

International Journal of Engineering Technology Science and Research
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Volume 4, Issue 9
September 2017

services business unit are like technology service lines such as “Operating system team, Network support team, Database support team, Storage support team, Backup and recovery technology support team” labelled as department A, B,C and so on shown in Column A.

By following the data analysis assistant feature, the analyst can identify the min, max, mean values of critical priority incidents or alerts etc shown in Column B. The variation type has to be measured by the respective analyst along with the front line operations management team shown in Column C. This dashboard gives the basic prediction ability to the management and also helps in understanding the “variation within their departments” with respect to the variable in study(critical priority incidents in this case)

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September 2017

**Table 1. Statistical process analytical control exercise management dashboard illustration**

| Department | Critical Priority Incidents | | | Variation type |
|---|---|---|---|---|
| | Min | Max | Mean | |
| **Department A** | 0 | 2 | 1 | Special cause |
| **Department B** | 2 | 26 | 12 | Special cause with a up/down trend |
| **Department C** | 3 | 36 | 16 | Common cause |
| **Department D** | 0 | 6 | 3 | Special cause |
| **Department E** | 0 | 4 | 12 | Common cause with a up/down trend |

### 4.1 Algorithm for Incidents (Major Incidents, Severity 1/2/3/4) analysis

1) Collect the major incident dump for last 6 months.
2) Ensure that the tickets are segregated into "Alerts" and "Incidents and for this analysis purpose you have to exclude "Alerts"
3) Consider only the incidents data in an excel sheet and no alerts data
4) Check the quality of data, meaning blanks, missing fields, and count of fields it should be minimum 10 fields such as "incident ID", "open date", "assigned by", "resolver group", "closed date", "resolved date", “configuration item", "subject", “description or summary”, “category" etc...
5) Add new fields such as "Day", "Hour", "Month", "Month Number". Month number means, it is the number of the month where the incident data belongs to, meaning if the start of the incident record in the dump is 1-Oct-2015 then the month number is 10 and then it will be like 10,11,12,13,14,15...and so on....13 means it is January 2016 and 14 is February 2016. The reason for this is to minimize the effort in Excel Pivot creation and formatting, as the data gets sorted in ascending order automatically. This helps in building quick pivots
6) Create a IMR chart (PBA process behavior analysis chart) if you have the incidents every week
7) If there are no major incidents every week but it is happening rarely then use the "rare event chart"
8) After plotting the chart in PBA format, then analyze the exceptions (special cause of variation and assignable cause of variation)
9) If there are more special causes then it is straight forward to fix the incidents through regular defect prevention process (regular RCA methodology)
10) If there are no exceptions and then it is only common cause variation then look at your process, procedures, work instructions, resources availability etc.

### 4.2 Algorithm for Problem Analysis

Assumption:

Is problem management applicable for only Major incidents or only Sev 1, Sev 2 incidents?

1) If step 1 is yes, then find out how many Major incidents and Sev1, Sev 2 incidents and see the ratio of incidents versus problem records. If the problem records count is higher than the incidents count, then it means there are so many cause codes (root causes) for the incidents which is not ideal. If the incident records are higher than the problem records count then there are so many duplicate incidents (or in other words, repetitive incidents are being reported) and the root cause for all those repetitive incidents are same. Meaning there is no permanent solution in place and the corrective and preventive actions are not effective. So, strengthen the problem management root cause process.

2) If step 1 is No, then find out whether problem management is being done for all priority of incidents?

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September 2017

a. What is the incidents versus problems ratios of each priority of incidents? Meaning, Number of problem records created for Major incidents?

b. Number of problem records created for Sev 1 incidents?

c. Number of problem records created for Sev 2 incidents?

d. Number of problem records created for Sev 3 incidents? And so on... This mapping gives us idea of how many incidents are becoming pervasive and repetitive

**4.3 Algorithm for Change failure analysis**

1. Collect the complete change management dump of last 6 months

2. Ensure that the data consists of all the fields from native ticketing tool. (Later you can remove the unwanted fields, actually, there is nothing called unwanted fields, if its unwanted field why would the tool has those fields built-in and why the company that created those tools would have designed those fields.

3. Perform basic data analysis to identify how many changes are getting failed and what are the cause codes of change failures.

4. Validate the change failure cause codes by performing a text analytics on the description fields like (change summary or change description or comments section) this reveals whether the cause codes selected in the tool are valid and appropriate.

5.

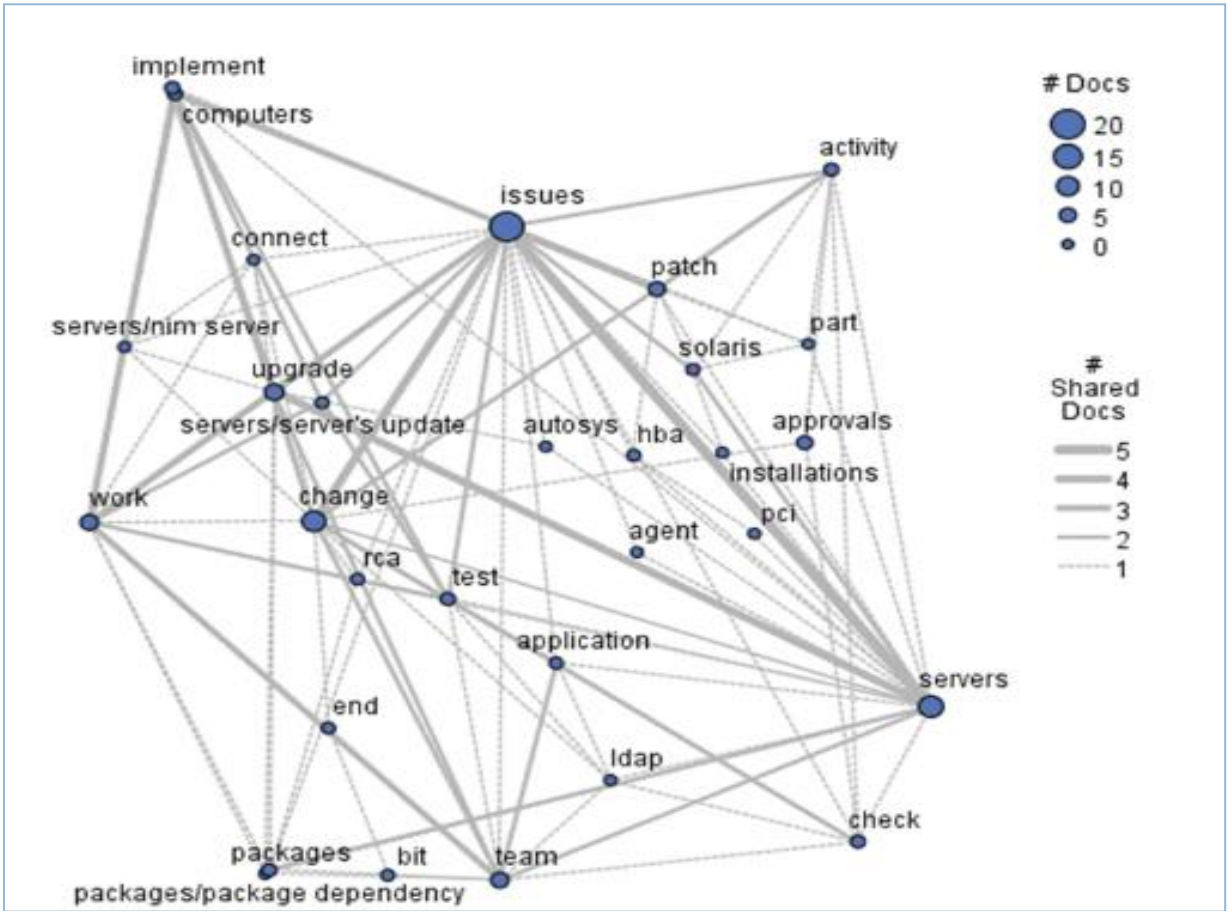


**Figure 3 Text mining of change failure reasons**

International Journal of Engineering Technology Science and Research
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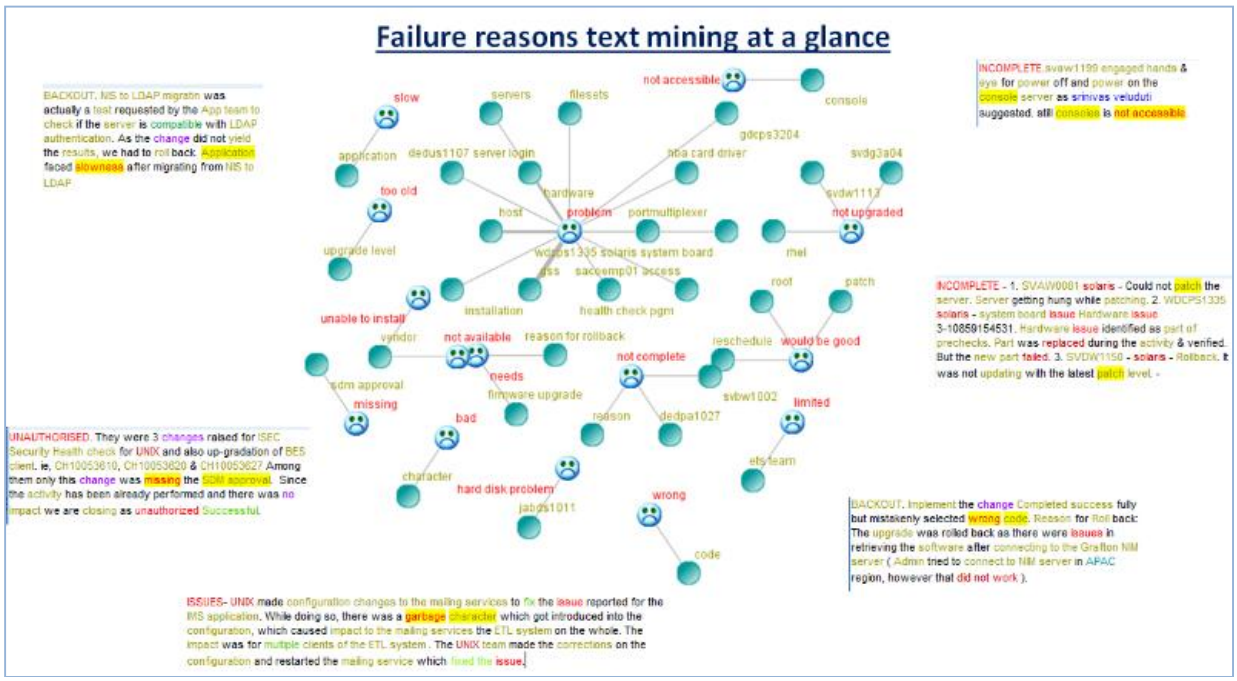


**Figure 4 Text mining of change failure reason**

**Table 2 - Differences in native ticketing tool cause codes and text mining extracted cause codes**

| No | Cause codes in the change management tool | Comments field in the tool (each point below is from multiple change records) |
|---|---|---|
| **1** | Product | 1. Change did not complete within the change window because the SAN storage team did not provision the storage LUNS correctly to the server<br>2. Not able to apply .Net patches on 3 windows 2003/2008 servers, case opened with vendor<br>3. Application was not starting after patching reboot, Uninstalled patches and vendor contacted<br>4. Port number was updated wrongly – There was a critical ticket INC #232445 raised by the customer, with the help of the ticket, the web hosting team has modified the config with the correct port number<br>5. Change window took 11 extra hours to complete, multiple hard disk failures on the server and unhealthy back used for restoration |
| **2** | Others | This change was mistakenly closed as an SWI, working with CM to change disposition |
| **3** | People | 1. Change was raised for migration through incorrect process/template<br>2. The automated deployment through SEAR application failed, No logs indicating the cause of failure, the agents will need to be manually installed<br>3. Space issue on data store to create data drive |

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### 4.4 Steps for operational service level agreement analysis

1. Controlling the volume of incidents is the only way that can improve the SLA meeting performance
2. If the workload is less then, the team members would be able to spend more time in the root cause analysis, corrective and preventive actions, performance and capacity planning.
3. Collect the "time to resolve" data of Incidents and plot a process behavior chart and add contractual "expected targets" and "Minimum targets" as voice of customer lines in the same chart.
4. Using any of the analytical tool, perform the normality test
5. If the data is normal then go to step 6
6. calculate the probability distribution and plot the probability distribution graphs using the mean, standard deviation and target value (contractual SLA targets)
7. If the data is non-normal then go to step 8
8. Use Johnson transformation and transform the data points and then test for normality. Once the data is transformed then perform step 6

**Figure 5: Johnson transformation output**

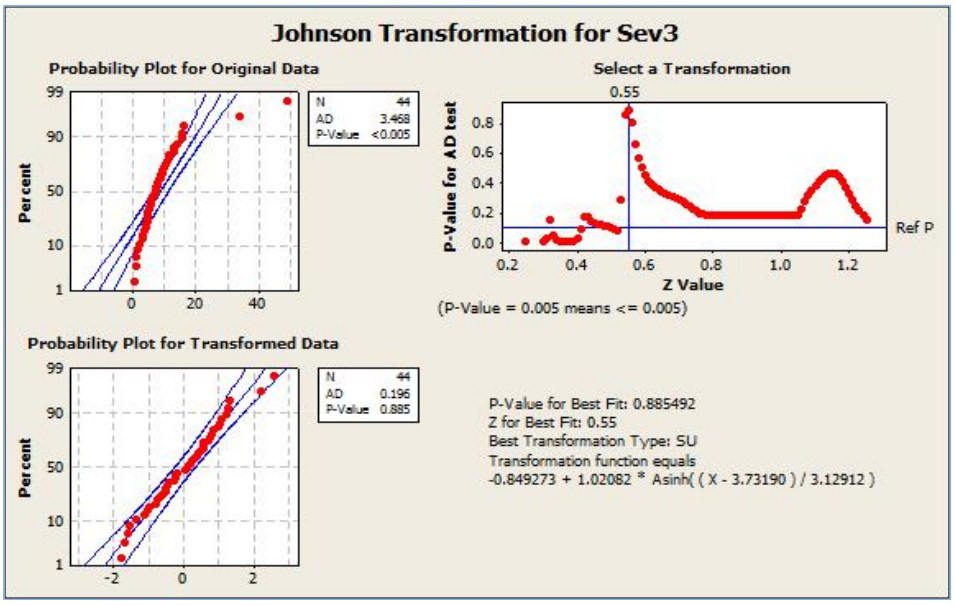
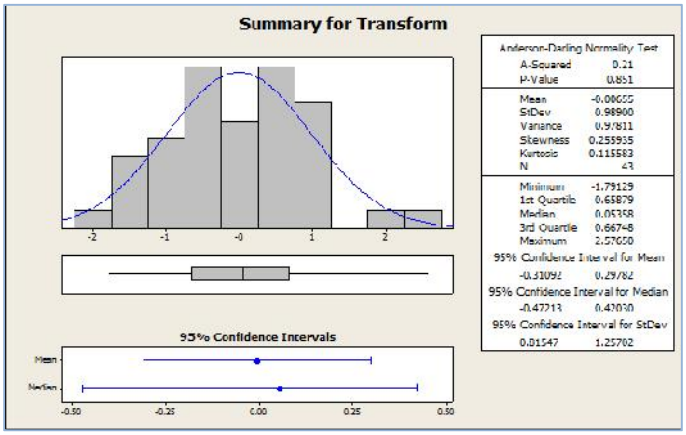



**Figure 6: Summary of transform**



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IJETSR
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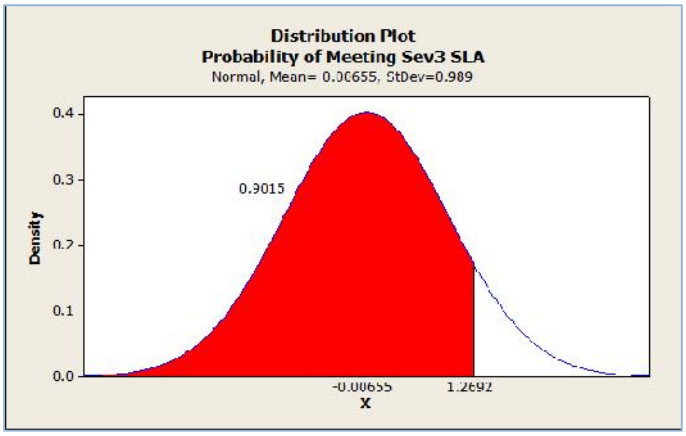
September 2017

**Figure 7: Summary of distribution plot**




Within hours from the time of data collection completion, SPACE can answer any of the questions described in table 3 relevant to any department(technology service lines) in any business unit in the organization within

**Table 3 Operations insights questions for management**

| # | Questions that SPACE can answer |
|---|---|
| 1 | What is the trend of Incidents/Alerts/Problems/Change failures volume? |
| 2 | Is the volume within control or out of control (accuracy and precision)? |
| 3 | Is the volume predictable or unpredictable? |
| 4 | Is the organization required to make any fundamental change in the process/procedures? |
| 5 | Is the organization required to deploy additional work force to address the problems? |
| 6 | Does the specific contract has overstaffing or understaffing? |
| 7 | What will be the future staffing requirements? |
| 8 | Which configuration item has affected severely due to the incidents/problems and change failures? |
| 9 | Which day/time/hour/ the incidents are being triggered? |
| 10 | What is the probability of meeting or breaching the contractual SLAs? |
| 11 | Is there any correlation between incidents and problems and any association with change records? |
| 12 | Change implementation success in IT infrastructure – is it by design or by chance? |
| 13 | Does “testing” has any influence on “outcome of change implementation”? |
| 14 | Can the organization (service provider) able to meet the SLA targets? |
| 15 | What is the capability of an organization (service provider) in terms of meeting its SLAs and what are the influencing factors of SLA breaches? |
| 16 | How do we bring MTTR in control (voice of specification)? How do we know that the technical support team are performing to the maximum level? |
| 17 | How do we validate the cause codes of incidents/problems and change failures? How do we know that they are the right cause codes? |
| 18 | Association between MTTR and category of configuration items? |

**Benefits of SPACE**

- Measurable results
- Enables in cost reduction strategies
- Operational efficiency
- Smooth integration between functional units
- Effective problem resolution and performance prediction
- Optimum utilization of machine and resource capabilities
- Understanding of Common and special sources of variation leads to continual improvement
- Feedback to technical service lines and business teams
- Helpful in forecasting
- Helpful in evaluating Achievements – helps to understand “success by design or chance”?

## Conclusion

In an ITIL environment there are occasions where a lower severity incident may take up a higher severity depending on its intensity/impact on the business. This being the case the usual method of analysis would not lead to a proper improvement or the result of the analysis make be biased. In the usual method of analysis one needs to know where to begin with an analysis.

With the help of this methodology, a quality professional in IT infrastructure services industry would be able to identify the insights of Incidents, Problem and changes very rapidly and report it to the management and executives. The proposed framework is designed to establish a relationship between the general analytical and statistical techniques and the ITIL Service Delivery requirements. This framework would also capture the crucial attributes in the Incident, Problem and change dataset needed at any time of time in terms of the incidents management and its quality.

## Future Work Scope

Based on the proposed methodology, there is very high scope for developing a full fledge automated analysis tools that automatically analyzes Incidents, Problems and Change failures in any of the IT infrastructure services business.

## REFERENCES

[1] Luis Fonseca,Vanda Lima and Manuela Silva, "Utilization Of Quality Tools: Does Sector And Size Matter?" International Journal for Quality Research 9(4) ISSN 1800 -6450, PP. 605-620, 2015.
[2] Paliska. G, Pavleti? D. and Sokovi?. M, "Application of Quality Engineering Tools in Process Industry" Advanced Engineering, Vol.2, ISSN 1846-5900, PP.73-86, 2008.
[3] Selvan C, Raju R and Jitendranath Palem, "Impact of IT infrastructure Availability Service Level Agreements and Need for the Service Centric Approach and Analytics in Healthcare" International Journal of Engineering Technology, Management and Applied Sciences Vol.3 ISSN 2349-4476, pp. 66-75, 2015.
[4] Mirko Sokovic, Jelena Jovanovic, Zdravko Krivokapic and Aleksandar Vujovic "Basic Quality Tools in Continuous Improvement Process" Strojniški vatnik - Journal of Mechanical Engineering 55, 2009.
[5] Anil Kumar Raghavan Pillai, Ashok Kumar Pundir and L. Ganapathi, "Improving Information Technology Infrastructure Library Service Delivery Using an Integrated Lean Six Sigma Framework: A Case Study in a Software Application Support Scenario" Journal of Software Engineering and Applications Vol.7 pp 483-497, 2014.
[6] Donald J Wheeler book “Understanding Variation: The Key to Managing Chaos” Second edition