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Reduce the Customer's Complaint Resolution Time in Migration of Oracle Database Servers in Vmware

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Reduce the Customer's Complaint Resolution Time in Migration of Oracle

Database Servers in Vmware

by

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Abstract

The following report titled "Reduce the Customer's Complaint Resolution time in migration of oracle database servers in VMware" clearly elaborates about the process, technical design and flow of the VMware support project. The whole processed is carried out at NTT data, which is a client of VMware technologies, Inc. Since 1967, NTT DATA has played an instrumental role in establishing and advancing Japanese IT infrastructure, in particular large-scale and mission critical IT systems. Originally Data Communication Headquarter of Nippon Telegraph and Telephone Public Corporation, its heritage contributed to social benefits with a quality-first mindset. Having spun-off from NTT in 1988 and going public in 1995, the company maintained a hybrid culture of long-term commitment and challenge to innovation in order to contribute to the progression of business and society. Tier-1 IP network is driven by financially-backed service level agreements (SLAs), secure networking and managed VPNs, reliable content distribution capability via Smart Content Delivery. Across the organization without any geographical specification, an average of 185 support tickets is being generated on a daily basis. Generally a Service level agreement is done initially between the company and the in order to achieve the success rate of the projects. An initial study has been conducted In VMware support project to see whether if the resolution time in SLA is meeting the client requirement. But It is observed that process mean of resolution time is at is at 9.146 hrs. and Standard deviation is 3.081 hrs. To improve the Resolution time of oracle support database project on VMware to meet the client SLA of 8hrs. Also to

consider if any external and internal factors affect the root cause of the study. The Process improvement initiative for making this process as capable. DMAIC Methodology, Box plot, probability chart are used in the   project for the measuring and study of the process.

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Chapter I: Introduction

Introduction

Assuring customer satisfaction by timely and cost effective delivery of high quality IT services and products that meet customer's business needs through rigorous conformance thus continual improvement and innovation. VMware is the leader in virtualization and cloud infrastructure solutions that enable businesses to thrive in the Cloud Era. Customers rely on Vmware to help them transform the way they build, deliver and consume Information Technology resources in a manner that is evolutionary and based on their specific needs. Oracle support projects play crucial role in the Organization economy. For any support Service level agreements (SLA) are key performance indicators. A service-level agreement (SLA) is a negotiated agreement between customer and NTT Data. When not met these may attract the customer complaints and penalties. As the SLA analysis performed at organization level have indicated few issues. We have considered undertaking an improvement project in this area. This is further elaborated in the next sections of this report Virtualization is a proven software technology that makes it possible to run multiple operating systems and applications on the same server at the same time. It is transforming the IT landscape and fundamentally changing the way that people utilize technology. To deliver on NTT Com's global cloud vision announced in 2011, NTT offers a new business cloud service that will utilize network virtualization technology in its production environment across 11 data centers in nine countries. With advanced network virtualization technology from Vmware, NTT will provide

customers seamless connectivity between cloud infrastructures, and will support customers cloud migration by connecting with a customer's on-premise data center. It supports customers using the cloud by offering services that deliver the latest technologies. By incorporating Vmware network virtualization into its EC service, NTT will provide seamless and flexible connectivity between customer data centers and the NTT cloud without changing the IP addresses of a customer's existing, on-premise environment. This virtualized network helps customers to easily migrate into the cloud, and also seamlessly and unobtrusively connects resources on the cloud and in the enterprise data center. NTT Com will use Vmware network virtualization as a network overlay built from software. Network virtualization eliminates the need for complicated manual provisioning of the network, thus vastly simplifying the customer onboarding process for NTT Com, while lowering both operational and capital expenses.

Problem Statement

Resolution time to close the ticket for oracle support project was analyzed at the organizational level during the Vmware migration process. It was observed to be that the average time to close a ticket in oracle support project is around 8 hours, but in most of instances the resolution time here is greater than 8 hours. This resulted capability issues and not meeting the project deadlines.

Nature and Significance of the Problem

There were several support tickets raised during the migration process of the Vmware Virtual machines which are using Oracle database. Therefore process was

not capable at organization level and thus Process improvement was initiated and executed for making this process as capable. Not meeting the customer specified SLA may lead to customer complaints. Hence to avoid this, the improvement of current performance was done.

Objective of the Project

The objective of this project was to improve the Resolution time of Oracle support projects to meet the client SLA of 8hrs. And make the business more efficient by implementing the migration effectively which was very necessary to the production environment to resolve the issues.

Project Questions/Hypotheses

1. What effect will be on the production servers during the migration?

2. What type of issues would become more severe?

3. What effect would it cause during to users/customers during the migrations and upgrades?

4. How will the Firewall ports and Distributed Vswitch help?

5. What backup is used in case of   storage data loss?

Limitations of the Project

This particular resolution time is only involved with the migration of current system to Virtual machines system. Unavailability of resources to meet the deadline of project. Sharing the results from this project statistically which may need the data of the companies. Also Sales, Revenues and profitability those were generated by this report will not discussed.

Definition of Terms

      VMWARE-Vmware developed a range of products, most notable of which are their hypervisors. Vmware became well known for their first type 2 hypervisor known as GSX. This product has since evolved into two hypervisor products lines, Vmware's type 1 hypervisors running directly on hardware, along with their hosted type 2 hypervisors.

      Vmware software provides a completely virtualized set of hardware to the guest operating system. Vmware software virtualizes the hardware for a video adapter, a network adapter, and hard disk adapters. The host provides pass-through drivers for guest USB, serial, and parallel devices. In this way, Vmware virtual machines become highly portable between computers, because every host looks nearly identical to the guest. In practice, a system administrator can pause operations on a virtual machine guest, move or copy that guest to another physical computer, and there resume execution exactly at the point of suspension (VMware vSphere 4-ESX and vCenter Server, n.d.).

      P2V-The single most popular use for virtualization, by far, is to consolidate physical servers to virtual servers. Absolutely, the easiest way to do this is to perform a physical to virtual (P2V) conversion. With a P2V conversion, you use either an imaging application or a dedicated P2V conversion application to take all data on a physical computer, move that data to the virtualized infrastructure, modify the drivers on the transferred operating system, and boot that converted virtual machine–now

virtualized (Performing a P2V conversion to VMware ESX Server using VMware Converter Enterprise, 2008).

V2V-Virtual to virtual (V2V) is a term that refers to the migration of an operating system (OS),application programs and data from a virtual machine or disk partition to another virtual machine or disk partition. The target can be a single system or multiple systems. To streamline the operation, part or all of the migration can be carried out automatically by means of specialized programs known as migration tools (What is Virtual to virtual (V2V)?-Definition from WhatIs.com. (n.d.).

Oracle Database-Oracle database server is a computer program that provides database services to other computer programs or computers, as defined by the client–server model. The term may also refer to a computer dedicated to running such a program. Database management systems frequently provide database server functionality, and some DBMSs (e.g., MySQL) rely exclusively on the client–server model for database access.

Such a server is accessed either through a "front end" running on the user's computer which displays requested data or the "back end" which runs on the server and handles tasks such as data analysis and storage (Database server, n.d.).

Summary

This chapter covered the brief introduction of the problem encountered at the organization. A clear project study objective has been highlighted. This chapter also discussed about the nature and significance of the problem. Further, the study

hypotheses were briefly presented which were verified throughout the project execution and answered along with the results. Project queries that are to be responded following the completion of the project, limitations of the project in addition to all the terms and definitions that are of primary importance for this project have also been detailed out in this chapter.

Chapter II. Background and Review of Literature

Introduction

This chapter focuses towards reviewing the literature of the problem, literature related to the methodology that has been implemented in the process of solving the problem and the background of the organization services and the issues related to it.

Background Related to the Problem

NTT DATA's history goes back to 1967, when the DATA Communications Bureau was established within the Nippon Telegraph and telephone Public Corporation (now NTT). If this was its "First Founding" as a company, then the "Second Founding" occurred in 1988 when NTT DATA Communications Systems Corporation was spun off into a separate company from NTT. Its "Third Founding" as a company was in 2008, when it marked the 20th anniversary of its establishment. Today, NTT DATA is in the process of becoming a "Global IT Innovator," which together with its customers uses information technology to change society. NTT DATA Corporation is the 6th largest global IT services company and part of the NTT Group, a Fortune 32 telecommunications and IT services company based in Japan, with $13B in revenues (History | NTT DATA, 2012).

Since 2001, NTT DATA has accumulated know-how through testing and in-house use of Vmware products as tools f or building virtualization servers. By concluding the agreements to become a distributor of the products to domestic sales agents (secondary agents) and users, and to serve as Vmware Authorized Consulting Partner, NTT DATA is now able to offer a menu of authorized Vmware

consulting options. NTT DATA, in coordination with the NTT DATA group, will engage in Vmware license sales and consulting, and it will offer systems applying Vmware products.

Oracle support projects play crucial role in the Organization economy. For any support Service level agreements (SLA) are key performance indicators. A service-level agreement (SLA) is a negotiated agreement between customer and NTT Data. When not met these may attract the customer complaints and penalties. As the SLA analysis performed at organization level have indicated few issues. We have considered undertaking an improvement project in this area. This is further elaborated in the next sections of this report.
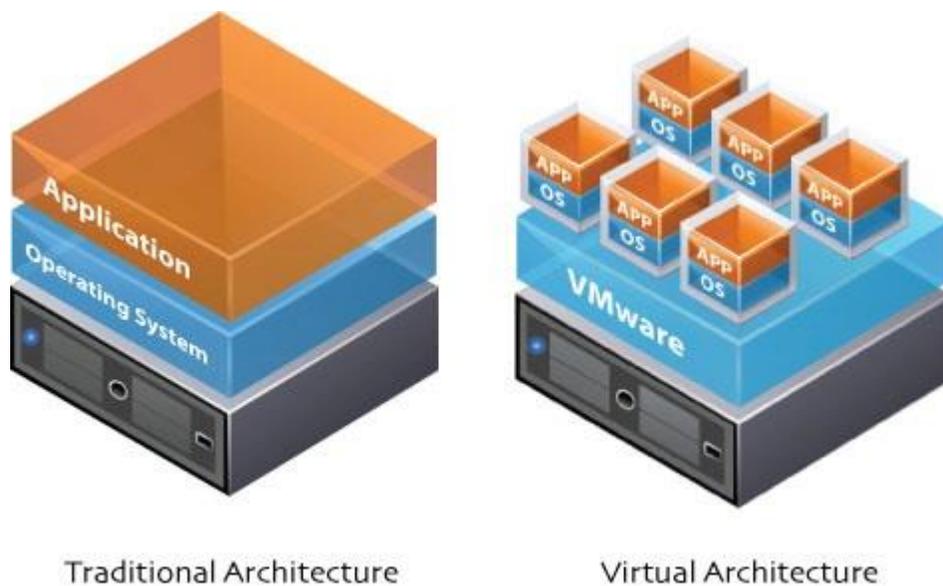
Figure 1: Traditional Architecture vs. Virtual Architecture

Literature Related to the Problem

      Migrating virtual machines. You can move virtual machines from one host or storage location to another location using hot or cold migration .With vSphere vMotion you can move powered on virtual machines away from a host to perform maintenance, to balance loads, to collocate virtual machines that communicate with each other, to move virtual machines apart to minimize fault domain, to migrate to new server hardware.

Figure 2: Vmware Storage Migration

      You can use cold or hot migration to move virtual machines to different hosts or data stores.

      Cold migration. You can move a powered off or suspended virtual machine to a new host. Optionally, you can relocate configuration and disk files for powered off or suspended virtual machines to new storage locations. You can also use cold

migration to move virtual machines from one data center to another. To perform a cold migration, you can move virtual machines manually or set up a scheduled task (VSphere 5.5 Documentation Center, n.d.).

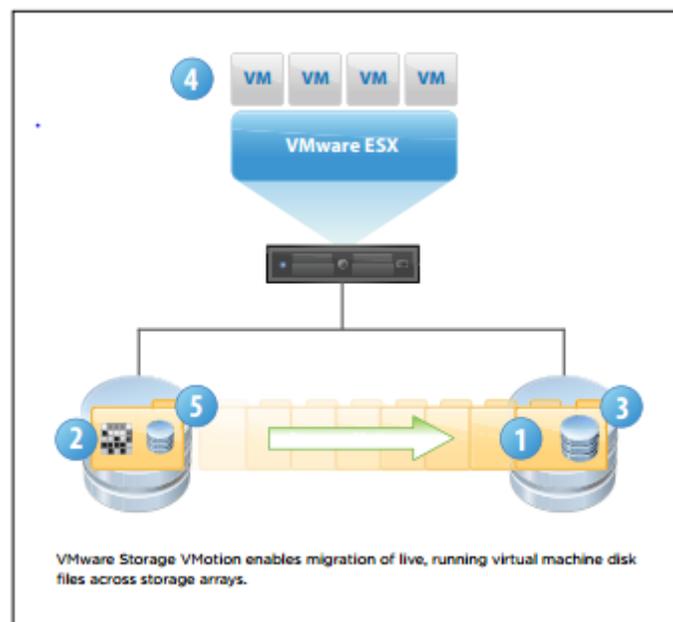**Hot migration.** Depending on the type of migration you are using, vMotion or Storage vMotion, you can move a powered on virtual machine to a different host, and move its disks or folder to a different datastore without any interruption in the availability of the virtual machine. You can also move a virtual machine to a different host and to a different storage location at the same time. Vmotion is also referred to as live migration or hot migration (VMware vSphere 5.1, n.d.).

Migration with Vmotion. Moves a powered on virtual machine to a new host. Migration with Vmotion allows you to move a virtual machine to a new host without interruption in the availability of the virtual machine. Migration with Vmotion cannot be used to move virtual machines from one datacenter to another.

Migration with storage Vmotion. Moves the virtual disks or configuration file of a powered-on virtual machine to a new datastore. Migration with Storage Vmotion allows you to move a virtual machine's storage without interruption in the availability of the virtual machine.

Hot vs. cold migrations. Vmware vCenter Converter is capable of accomplishing both hot migrations and cold migrations.

Hot migrations are those which occur while the source system is in a running state. Hot migrations are not recommended for certain tasks—like migrating Active Directory Domain Controllers into a virtual machine (this task should be performed

during a cold migration)—but work well with systems where local data remains static

(VMware P2V Migration: Importing Virtual Machines into VMware ESXi Part 1, n.d.).

Cold migrations, on the other hand, occur while the source system is offline. Cold

migrations are ideal for systems like Oracle servers and mail servers that have data

that is regularly updated or altered. During cold migrations, the physical computer

itself is still running, but the operating system that is being cloned is inactive. Cold

migrations are initiated by booting Vmware Converter from a disc.

P2V: Hot migration.

1. To perform a P2V migration in vCenter Converter Standalone, click
   "Convert Machine." Select "Powered-on Machine" from the drop-down
   menu on the Source System tab.
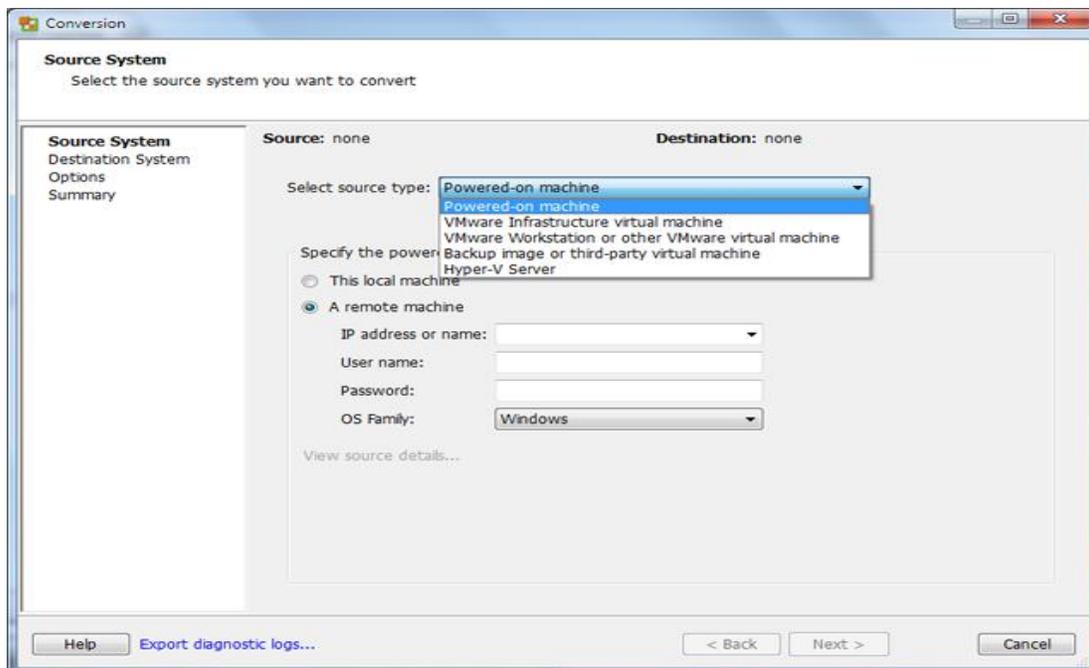
Figure 3: Vmware Conversion

2. Select "This Local Machine" if you intend to migrate the physical machine to where Vmware vCenter Conversion is installed. Otherwise, click "A Remote Machine" and then enter the IP address and login credentials for the source system. Click "Next."
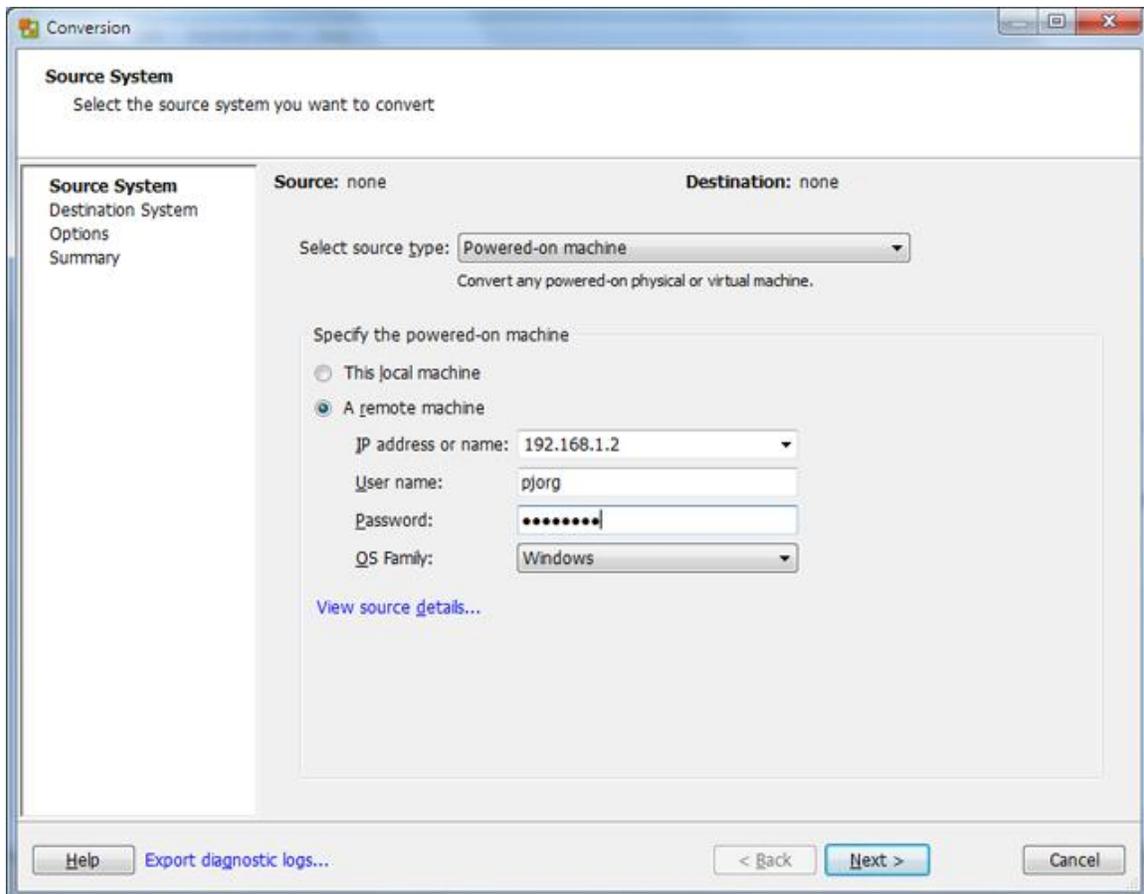
Figure 4: Selecting Source System

Select "Vmware Infrastructure Virtual Machine" from the drop-down menu. Enter the server address and login credentials for the system running Vmware ESX/ESXi. Click "Next."
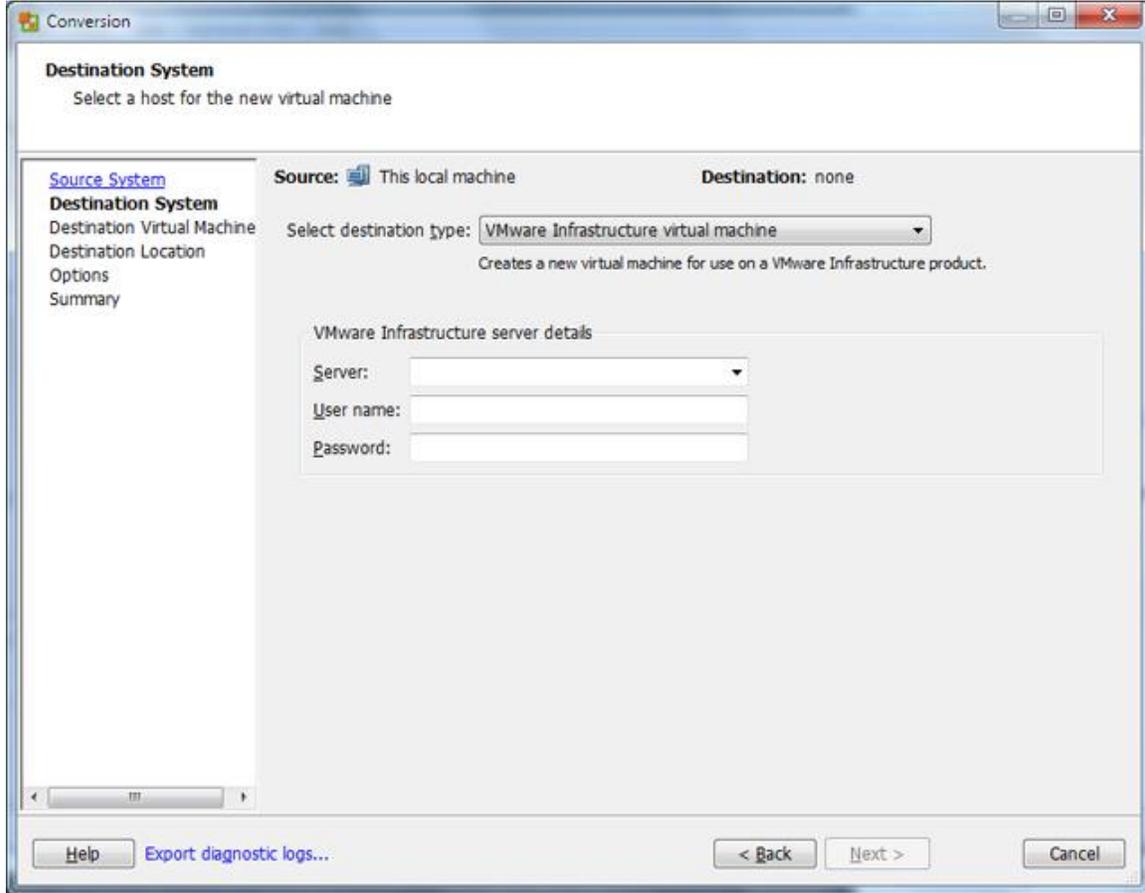
Figure 5: Selecting a Destination Host

3. Review the system parameters on the Options tab. To make changes to a

device, network or service option, select the desired setting from the list.

Click "Advanced Options" to synchronize the source system with the

destination system immediately after cloning or at a scheduled date and

time. If you're cloning a Windows machine, it is recommended that you

check "Install Vmware Tools on the Destination Virtual Machine" and

"Remove System Restore Checkpoints on Destination" on the Post-

Conversion tab.

Click "Next" after making the desired modifications, if applicable.
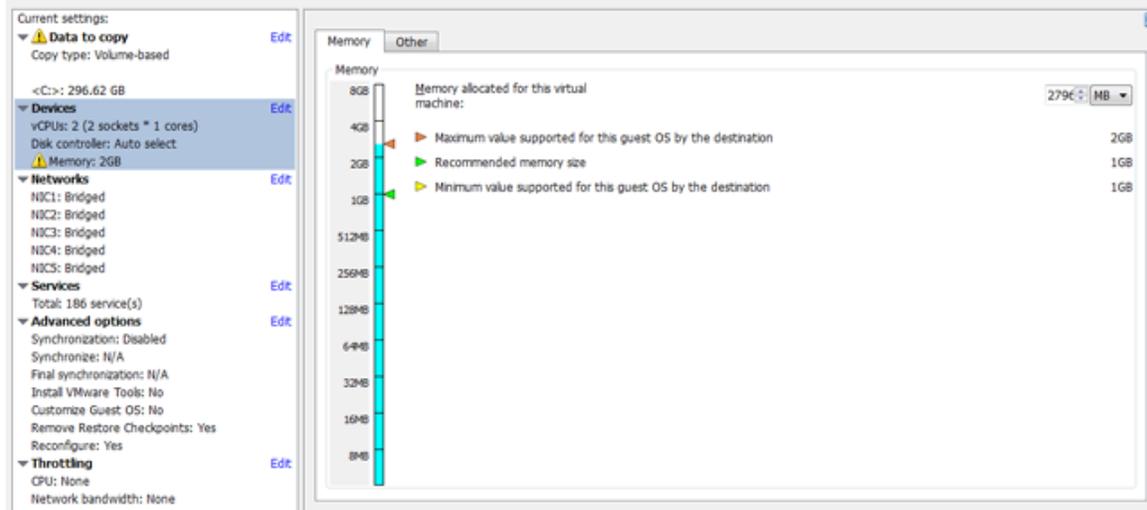
Figure 6: Configuration Review

4. Review your configuration on the Summary tab; then click "Finish" to

   perform the migration.

P2V: Cold migration.

1. Boot to Vmware Converter, and then click "Import Machine" from the

   toolbar. Click "Next"; then click "Physical Computer." Click "Next" again.

2. Select "A Remote Machine" or "This Local Machine" on the Source Login

   screen. If selecting "A Remote Machine," enter the name or IP address for

   the source system; then enter the login credentials. Click "Next."

3. Select "Automatically Uninstall the Files When Import Succeeds" if

   prompted, and then click "Yes" to continue. On the Source Data screen,

   select "Convert All Disks and Maintain Size" to import an identical hard disk

configuration to the destination machine. To make modifications to the disk

configuration, click "Select Volumes and Resize to Save or Add Space."

Uncheck a volume to remove it from the migration. To specify a new

volume size for a disk, select the drop-down menu below "New Disk

Space." Choose "Maintain Size" to use the original volume size or choose

"Minimum Size" to import only the part of the disk that has been used. You

can also manually specify the size of the disk by typing the desired

capacity in GB or MB.

4. Select "Vmware Infrastructure Virtual Machine" from the drop-down menu

   on the Destination Type screen. Click "Next." Enter the server address and

   the login credentials for the ESX/ESXi server.

5. Name the destination system. Click "Next." Select the preferred host to run

   the virtual machine from. Click "Next" again.

6. Select a datastore for the virtual machine. The datastores should be large

   enough to hold the data stored to the source system's hard disks. To

   assign a datastore to each hard disk, click "Advanced"; then select a

   datastore for each hard disk and configuration file. Click "Next."

7. Select the number of network interface cards (NICs) to import. Check

   "Connect at Power On," if preferred. Click "Next." Check "Install Vmware

   Tools," "Customize the Identity of the Virtual Machine," and "Remove All

   System Restore Checkpoints." Click "Next."

8. On the Computer Info screen, enter the computer, owner and organization names. Generate a new security identity (SID), if desired, then type the location where the Sysprep files are stored, if applicable. Click "Next." If you're importing a Windows system, enter the licensing information for the machine. Click "Next."

9. Select a time zone from the drop-down menu. Click "Next." Select a NIC and then click "Customize," to alter the network parameters, if preferred; otherwise, use the default settings. Click "Next."

10. Enter the workgroup or Windows server domain information on the Workgroup or Domain screen. Input the necessary login credentials; then click "Next."

11. Review your settings on the Summary screen. To power on the destination VM after completing the conversion, check "Power on the New Virtual Machine after Creation." Click "Finish" to begin importing the source system to the ESX/ESXi server machine (VMware P2V Migration: Importing Virtual Machines into VMware ESXi Part 1, n.d.).

V2V: Cold migration.

1. Power down the source machine before proceeding. Select "Convert Machine" from the toolbar to launch the Conversion wizard.

    See steps **2a** and **2b** to import a VM from a hosted virtualization platform; See steps **3a** and **3b** to import a VM from a bare-metal virtualization platform.
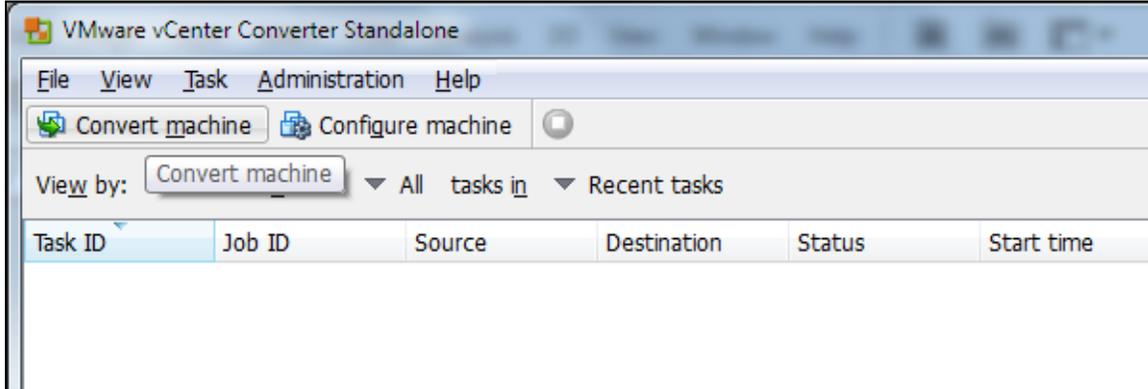
Figure 7: Vmware Vcenter Converter Standalone

    2a. Hosted Virtualization: Choose "Vmware Workstation or Other Vmware

Virtual Machine" or "Backup Image or Third-Party Virtual Machine" from the

Source Type drop-down menu, depending on which platform the source

machine is using.
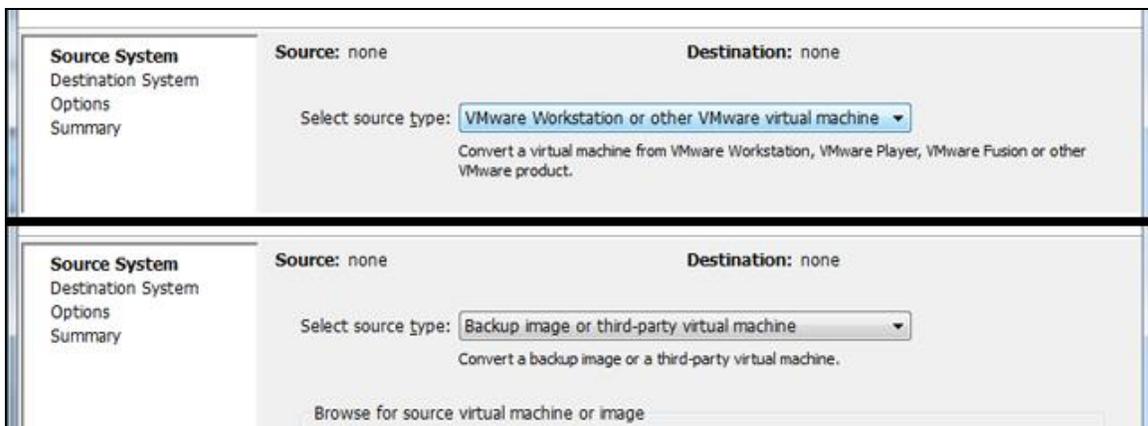
Figure 8: Selecting the Source Type

        Hosted Virtualization: Enter the full file or network path linking to the

virtual machine. Supported third-party platforms include Microsoft Virtual

PC and Microsoft Virtual Server (.vmc), and Parallels Desktop (.pvs). Use

.vmx for virtual machines created in Vmware. Note that if you're importing a

VM from Microsoft Virtual PC, you should remove the Virtual PC Additions

from the machine, as they can interfere with the conversion process.

Enter the login credentials for the server if accessing a network share,

and then click "Next." Skip to step 4.
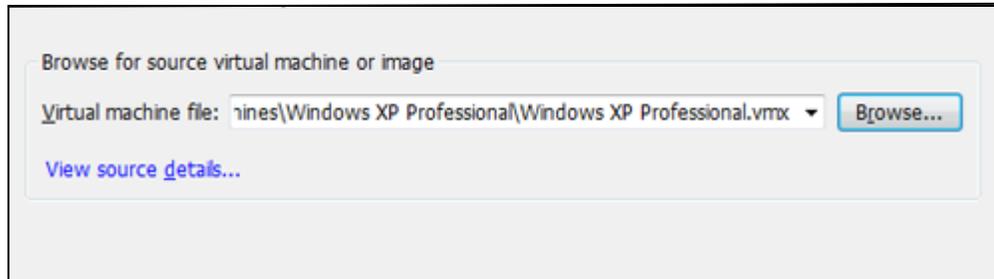
Figure 9: Browsing for Virtual Machine or Image

Bare-Metal Virtualization: Select "Vmware Infrastructure Virtual

Machine" or "Hyper-V Server" from the drop-down menu on the Source

System screen. If vCenter Converter is not installed to Hyper-V Server, a

prompt will appear requesting permission to install the application to the

system. Confirm the installation of the software to proceed with the

conversion.

Enter the server address and login credentials for the ESX/ESXi or

Hyper-V Server. Click "Next" to go to the Source Machine screen.

2b. Bare-Metal Virtualization: Search through the inventory to locate the source

system. If you're accessing ESX/ESXi through vCenter Server, choose

"Hosts and Clusters" or "VMs and Templates," depending on where the

source machine is housed. Select the virtual machine to import into the

ESX/ESXi Server, and then click "Next."

Figure 10: Selecting the Source Machine

3. Select "Vmware Infrastructure Virtual Machine" from the Select Destination Type drop-down menu. Enter the address, user name, and password for ESX/ESXi Server into the required fields. Click "Next" to go to the Destination Virtual Machine screen.

Figure 11: Entering the Destination Server Details

4. Enter a new name for the destination machine or use the default name. Select a destination location for the VM if managing ESX/ESXi through vCenter Server. Click "Next" to go to the Destination Location screen.

5. Select a host, resource pool, or cluster to accommodate the virtual machine; select a datastore where the files associated with the virtual machine should be stored (optional); and then select the virtual hardware version from the drop-down menu (optional). Use Version 4 for machines running ESX/ESXi 3.x, Version 7 for machines running ESX/ESXi 4.x, and Version 8 for machines running ESX/ESXi 5.x. Click "Next" to go to the Options screen.

6. Click "Edit" to make changes to a hardware device. If you are importing a virtual machine based on the Microsoft Windows operating system, select "Advanced" from the middle pane to view the Post-Conversion tab. Uncheck "Remove System Restore Checkpoints on Destination." Check "Reconfigure Destination Virtual Machine" to personalize the OS (e.g., create a unique name and password, enter a new product license, or change the workgroup or domain settings). Click "Next" after making the desired changes.
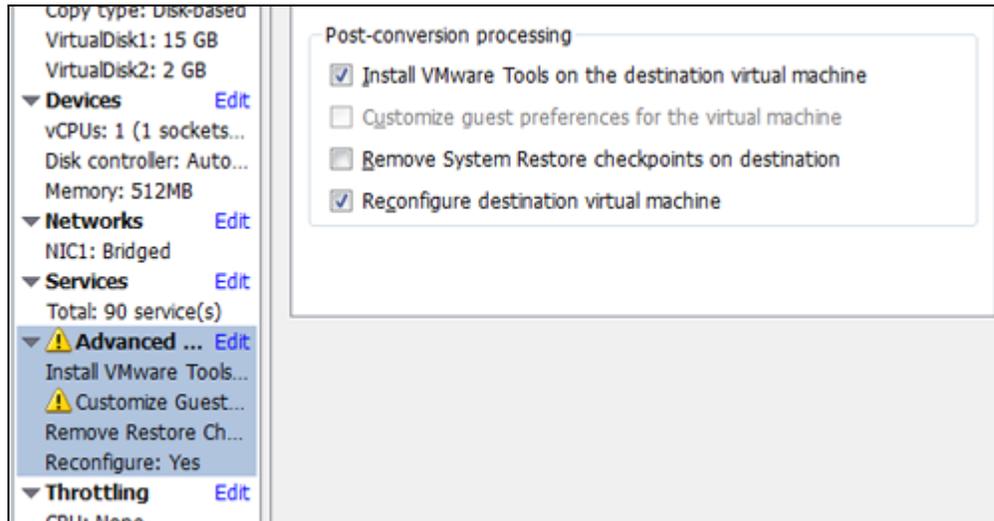
Figure 12: System Restore Checkpoints on Destination

7. Review your selections on the Summary screen; then click "Finish" to begin

importing the VM (VMware V2V Migration: Importing Virtual Machines into

VMware ESXi Part 2, n.d.).

Literature Related to the Methodology

DMAIC procedure is considered to bring very important and measurable

improvements to the current processes that are below expectations in a business.

This methodology is mostly used in processes or products in a firm that do not

meet the customer expectations or even products that currently have defects.

The DMAIC Process is an acronym that stands for several phrases which

are as follows; Define, Measure, Analyze, Improve, and Control.

The first phrase is define in which the Team comes up with a certain project

to improve on the business goals and also improve on the requirements and needs

of clients. The main objective of is coming up with an unknown solution in order to

solve an existing problem. Defining the problem is the first important measure in resolving an existing problem.

The team of highly qualified and experienced staff in the company works hand in hand in defining the problems that exist in measurable terms. Identifying characteristics that are critical to quality helps in identifying factors that have impact on the quality. This makes it possible for the team to come up with a map process which is to be improved measurable, defined and deliver goals.

The Measure phrase involves defining metrics and carrying out the lengthy process of statistical data collection. This includes identifying and determining important and necessary measures needed in the evaluation of the success of the project. A measurable baseline is established by determining the initial stability and capability of the project. Other measures established include valid metrics and clear measurable indicators such process, input, and output. This is followed by analysis to come up with a series of process steps and also defining the operational plan in order to measure the available indicators.

The analysis phase is when the Team discovers what might be causing the problem and how it might be corrected. This involves researching on the reasons for defects by coming up a variation process enhanced by set of variables (all based and deeply rooted in statistical theory). During the process, the highly qualified and experienced team comes up with ways of upgrading the project and determining processes that will have beneficial results to the firm in the long term.

Optimization and verification of important inputs is done in order to eradicate the problem. Causes of the problem are determined. This is done through test evaluation and then creating improvements. In case the required improvements are not done, the staff uses a Tool known as the cost/benefit Analysis. An implementation plan is developed and a new management approach is taken in order to adapt and implement the solution.

The next phase is the control phase which mainly depends on previous steps. This includes the appropriate management methods and main monitoring plan that reveals important steps the shareholders will have to continue to follow. The fore mentioned plan is exercised and this is done to make sure that the main variables remain in the acceptable range. The highly qualified team develops reaction plans, a hands-off process, and training. This is to ensure that the project has a long term positive effect on the company. It is also important to document the project, and the solution that was discovered.

Summary

The concentration of this chapter has been focused towards making the readers understand more about the background of the problem, in depth details of the literature related to the problem. Also, all the background literature review towards the methodology of the project has been explained in a detailed manner.

Chapter III: Methodology

Introduction

In this methodology, various methods were measured to accomplish the main aim or intention of the current study. The main reason of this study was to learn the importance of regulating the metrics for refining the performance of the process. This process with various research methods which were beneficial in an effective e completion of the development is explained. This methodology gives particulars about the every step of the development process. The investigation of the project, the approach and the methods used in gathering the necessary data and the development of analyzing this data.

The most critical part of this project involves planning for the migration itself. At the same time, the primary principles of project organization still are relevant; these include clear possession of the project, a different scope, and the use of a development plan with clear milestones.

The sheer number of variables involved and the limitations of out-of-the-box migration approaches can complicate the project and introduce unacceptable risk. Below approach and tools are used to analyze and solve this problem.
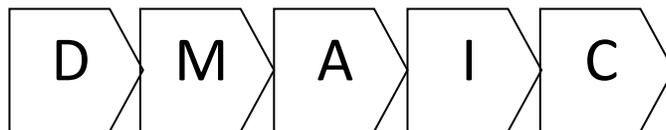
A. **Define Phase**: Tools used to define problem. Used to identify the scope, objectives and participants in a project
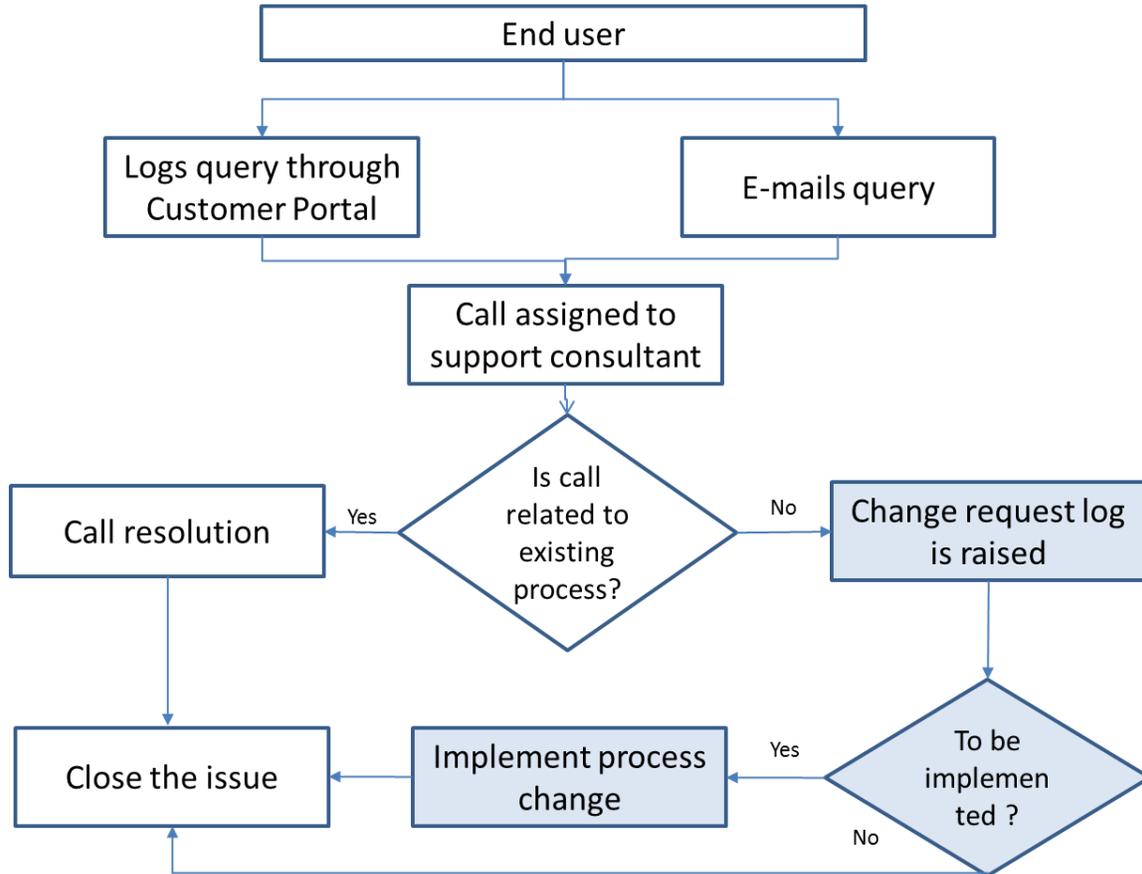
Figure 13: Process Map

- Process Map
  - Used process mapping (a workflow diagram) to bring forth a clearer understanding of a process or series of parallel processes.

B. **Measure Phase**: Tools used to Measure problem

- BOX plot
  - Used Box plot as a graphical representation of the sample that shows its shape, central tendency, and variability. Also helps in identifying the outliers.

- Individual Distribution Identification Plot

    - This plot helps to fit data with 15 parametric distribution families. Based on probability plots and goodness-of-fit tests, we can choose a distribution that best fits data.

- Descriptive Statistics

    - Used to calculate descriptive statistics individually

C. **Analyze Phase**: Tools used in Analyze phase
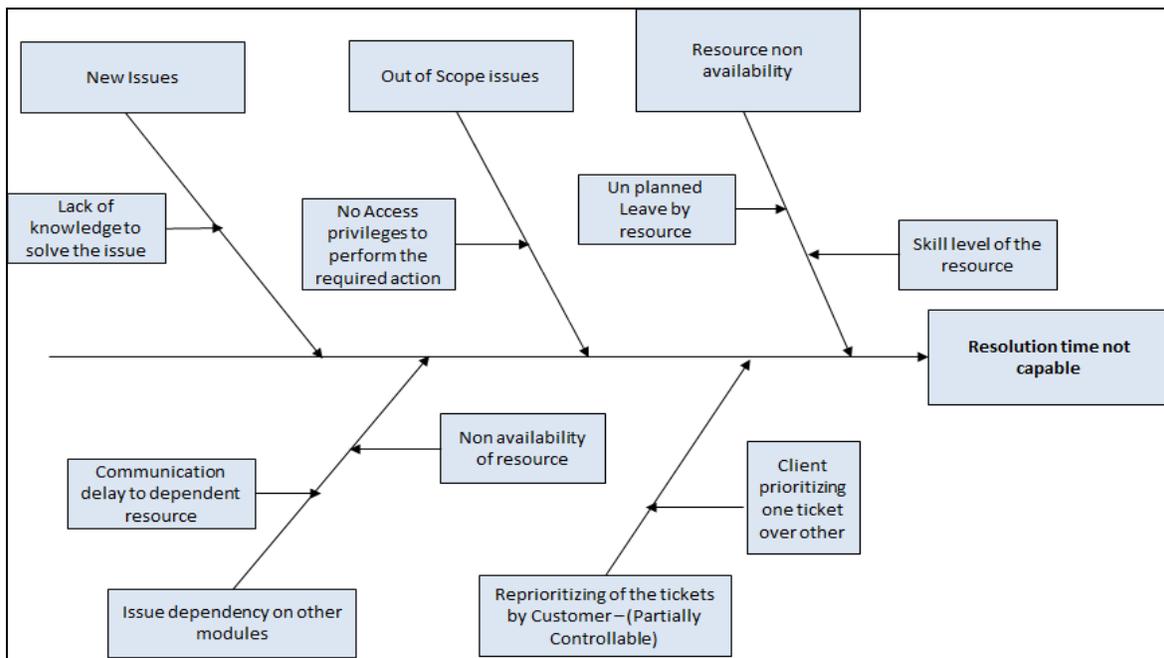
Figure 14: Fish Bone Diagram (Cause-Effect Diagram)

- Brainstorming

    - Used to collect the various ideas of the subject experts on the problem

- Fish bone analysis

  - Used to identify possible causes of the problem

D. **Improve Phase**: Tools used in Improve phase

Attribute	Action Taken
New Issues	We have Prepared the knowledge base document to avoid the time taking process on resolving the issues
Out of Scope issues	We inform the users that no access previlages to perform the require action
Issue dependency on other modules	Improvement in communication of dependency of modules/resources
Reprioritizing of the tickets by Customer – (Partially Controllable)	We have a discussion done with client .
Pending Review or update from Onsite Coordinator	Regular follow-ups to get the reviews done as early as possible
Un planned Leave by resource	Try Effectively communicating on the leave policy
Skill level of the resource	Trainings for the Junior Resources in the team

- BOX plot

  - Used Box plot as a graphical representation of the sample that shows its shape, central tendency, and variability. Also helps in identifying the outliers

  - Used to compare the distributions of two set of samples

- Hypothesis test: t-test

- Used to evaluate two mutually exclusive statements about a population

E. **Control Phase**: Tools used in Control phase

- Control Charts: I-MR chart

  - Used control charts to track process statistics over time and to detect the presence of special causes

Design of the Study

Six Sigma or DMAIC is a potential approach to solve any kind of scientific problem. It was a mix of both quantitative and qualitative approach. The tools used in the define phase lay the foundation for the project. The team accurately and succinctly defines the problem, identifies customers and their requirements, and determines skills and areas that need representation on the project team. It increases the chances of a successful project which makes DMAIC a process most projects.

Data Collection

The Ticketing tool which was used in the project was "**Service Now Incident Management**" .It streamlines the process of restoring service following an unplanned disruption. Incident Management allows IT to capture incidents through a self-service portal, chat, email, phone, and incoming events and prioritize them based on agreed service level targets. Incidents can be automatically routed to the appropriate resolution group, complete with related information. An On-Call Scheduling feature ties directly into Incident Management to escalate and assign incidents to the right support teams and assignment groups, with triggers to escalate and send bi-

directional notifications so escalations may be acknowledged. Knowledge articles help agents minimize resolution times and service level management helps keeps all work on track.

Initially 3 months data was taken during the months of February and may. And later 2 months, i.e., June and July   the analysis was done and after that 2.5 months of post improvement analysis was performed.

Data Analysis

There are a few techniques, which were followed and implied to make this study effective in terms of reducing the errors during the migration which impacted the resolution time according to the SLA.

Box plot. Boxplot is a convenient way of graphically depicting groups of numerical data through their quartiles. Box plots may also have lines extending vertically from the boxes (whiskers) indicating variability outside the upper and lower quartiles. Outliers may be plotted as individual points. Box plots are non-parametric: they display variation in samples of a statistical population without making any assumptions of the underlying statistical distribution. The spacing between the different parts of the box indicates the degree of dispersion (spread) and skewness in the data, and show outliers. In addition to the points .Boxplots can be drawn either horizontally or vertically (Box plot, n.d.). .

Distribution plot. A distribution plot is a graph that you can use to view and compare the shapes of distribution curves and to view areas under distribution curves corresponding to either probabilities or data values. This graph plots probability

density functions (PDF) which describe the likelihood of each data value. Usually, you specify the distribution and parameter values. You can also specify a region of interest to shade under the curve (What is a probability distribution plot?, n.d.).

Probability plot. The probability plot is a graphical technique for assessing whether or not a data set follows a given distribution such as normal. The data are plotted against a theoretical distribution in such a way that the points should form approximately a straight line. Departures from this straight line indicate departures from the specified distribution. Probability plots can be generated for several competing distributions to see which provides the best fit, and the probability plot generating the highest correlation coefficient is the best choice since it generates the straightest probability plot (Probability plot, n.d.).

Normal probability plot. The normal probability plot is formed by plotting the sorted data vs. an approximation to the means or medians of the corresponding order statistics. Some users plot the data on the vertical axis others plot the data on the horizontal axis. In a normal probability plot (also called a "normal plot"), the sorted data are plotted vs. values selected to make the resulting image look close to a straight line if the data are approximately normally distributed. Deviations from a straight line suggest departures from normality. The plotting can be manually performed by using a special graph paper called normal probability paper. With modern computers normal plots are commonly made with software.

T-test. A t-test is used for testing the mean of one population against a standard or comparing the means of two populations if you do not know the

populations' standard deviation and when you have a limited sample (n < 30). If you know the populations' standard deviation (Difference Between Z-test and T-test | Difference Between | Z-test vs T-test, n.d.).

F-test. An F-test is any statistical test in which the test statistic has an F-distribution under the null hypothesis. It is most often used when comparing statistical models that have been fitted to a data set, in order to identify the model that best fits the population from which the data were sampled. Exact "F-tests" mainly arise when the models have been fitted to the data using least squares. The name was coined by George W. Snedecor, in honor of Sir Ronald A. Fisher. Fisher initially developed the statistic as the variance ratio in the 1920s (F-test, n.d.).

I-MR chart. An I-MR chart plots individual observations (I chart) and moving ranges (MR chart) over time for variables data. Use this combination chart to monitor process center and variation when it is difficult or impossible to group measurements into subgroups. This occurs when measurements are expensive, production volume is low, or products have a long cycle time.

When data are collected as individual observations, you cannot calculate the standard deviation for each subgroup. The moving range is an alternative way to calculate process variation by computing the ranges of two or more consecutive observations (What is an I-MR chart?, n.d.).

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Timeline

Table 1: Project Timeline

S. No.	Project Timeline	Completion Date
1	Project Idea Formulation and Research	February-2015
2	Project Proposal Write-up	April-2015
5	Define	May -2015
6	Measure	July-2015
7	Analyze	July/August-2015
8	Improve	August-2015
9	Control	October-2015
10	Final Defense	November-2015

Summary

The migration and analysis techniques which best suited the project scope were detailed. Details of the tools and techniques used and evaluation would help future projects of similar kind. The timeline details were also shared.

Chapter IV: Data Presentation and Analysis

Introduction

This chapter will focus on the data, interpretation and strategies used to analyze and formulate the recommendations. Also this chapter will outline the process and evaluations performed to optimize the migration process

Data Presentation

Table 2 Before Improvement

Ticket ID	Before Improvement
INC02165	13.08
INC02166	7.82
INC02167	11.02
INC02168	7.19
INC02169	9.71
INC02170	6.64
INC02171	14.07
INC02172	5.25
INC02173	7.83
INC02174	11.55
INC02175	11.72
INC02176	4.21
INC02177	12.71
INC02178	9.87
INC02179	9.56
INC02180	7.8
INC02181	13.99
INC02182	7.92
INC02183	8.66
INC02184	10.94
INC02185	9.73
INC02186	8.86
INC02187	12.72
INC02188	14.8

INC02189	13.67
INC02190	7.8
INC02191	5.77
INC02192	9.88
INC02193	5.53
INC02194	14.38
INC02195	7.57
INC02196	14.67
INC02197	8.89
INC02198	7.95
INC02199	11.64
INC02200	10.95
INC02201	14.12
INC02202	8.35
INC02203	12.71
INC02204	7.98
INC02205	7.17
INC02206	3.1
INC02207	8.13
INC02208	10.57
INC02209	13.08
INC02210	8.24
INC02211	11.22
INC02212	6.72
INC02213	9.03
INC02214	5.72
INC02215	12.42
INC02216	7.91
INC02217	17.25
INC02218	7.8
INC02219	9.98
INC02220	13.59
INC02221	11.65
INC02222	6.61
INC02223	5.96
INC02224	8.44
INC02225	4.8
INC02226	8.01
INC02227	9.41

INC02228	7.08
INC02229	7.61
INC02230	12.13
INC02231	9.77
INC02232	7.8
INC02233	9.64
INC02234	5.45
INC02235	8.44
INC02236	10.03
INC02237	17.53
INC02238	6.35
INC02239	5.15
INC02240	8.92
INC02241	8.6
INC02242	8.34
INC02243	3.35
INC02244	7.46
INC02245	12.91
INC02246	14.09
INC02247	13.26
INC02248	8.38
INC02249	4.64
INC02250	6.31
INC02251	9.55
INC02252	7.6
INC02253	9.4
INC02254	8.49
INC02255	7.99
INC02256	6.41
INC02257	4.13
INC02258	7.69
INC02259	10.06
INC02260	12.62
INC02261	6.98
INC02262	9.74
INC02263	11.07
INC02264	10.75
INC02265	6.98
INC02266	9.6

INC02267	7.45
INC02268	1.19
INC02269	8.67
INC02270	3.55

Table 3: After Improvement

Ticket ID	After Improvement
INC03410	3.22
INC03411	2.73
INC03412	1.34
INC03413	2.9
INC03414	4.74
INC03415	1.59
INC03416	5.2
INC03417	4.45
INC03418	4.35
INC03419	4.34
INC03420	4.13
INC03421	3.82
INC03422	3.78
INC03423	2.06
INC03424	4.13
INC03425	2.96
INC03426	4.57
INC03427	2.22
INC03428	3.51
INC03429	4.44
INC03430	3.26
INC03431	3.09
INC03432	4.26
INC03433	3.7
INC03434	4.2
INC03435	3.63
INC03436	2.62

INC03437	3.92
INC03438	4.7
INC03439	6.16
INC03440	5.88
INC03441	4.47
INC03442	3.99
INC03443	2.94
INC03444	3.95
INC03445	4.24
INC03446	1.28
INC03447	2.05
INC03448	2.27
INC03449	3.45
INC03450	3.84
INC03451	3.77
INC03452	5.09
INC03453	4.66
INC03454	4.47
INC03455	3.66
INC03456	3.07
INC03457	5.33
INC03458	4.57
INC03459	3.85
INC03460	5.15
INC03461	3.65
INC03462	3.26
INC03463	4.2
INC03464	1.8
INC03465	5.15
INC03466	2.89
INC03467	3.77
INC03468	3.14
INC03469	5.18
INC03470	4.75
INC03471	3.51
INC03472	4.1

INC03473	3.83
INC03474	2.93
INC03475	3.7
INC03476	3.16
INC03477	3.62
INC03478	5.28
INC03479	3.75
INC03480	3.15
INC03481	4.34
INC03482	4.03
INC03483	4.34
INC03484	4.36
INC03485	3.37
INC03486	4.9
INC03487	2.96
INC03488	4.31
INC03489	3.99
INC03490	2.44
INC03491	3.75
INC03492	6.82
INC03493	4.43

Data Analysis

The above presented data has been collected through an internal Ticket Management Tool which maintains companywide tickets and their resolution times. The project specific tickets have been filtered and then are further analyzed using Minitab.

Following are the results on analyzing the data through Minitab for listing down the possible control actions/measures.

Initially, a Box plot is used for analyzing the spread of data and also for any outliers. Below are the Box plots.
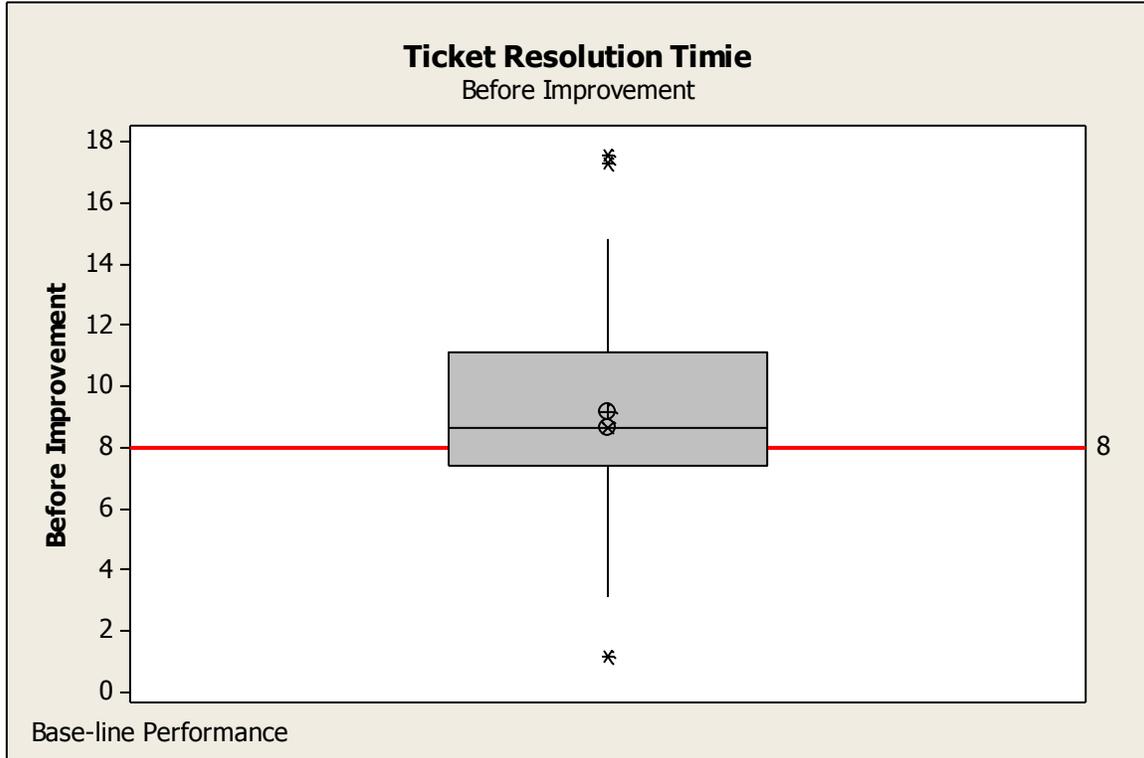
Figure 15: Box Plot of Ticket Resolution Time Before Improvement

It is observed that majority of the data points are above the SLA 8 hours.

There are outliers which are responsible for the rise in the average resolution time in

Oracle support projects. On calculation the average resolution time before

improvements,

```
Variable              Mean   StDev   Minimum   Median   Maximum
Before Improvement   9.146   3.081     1.186    8.628    17.533
```

The process mean is higher than the SLA and also has a very standard

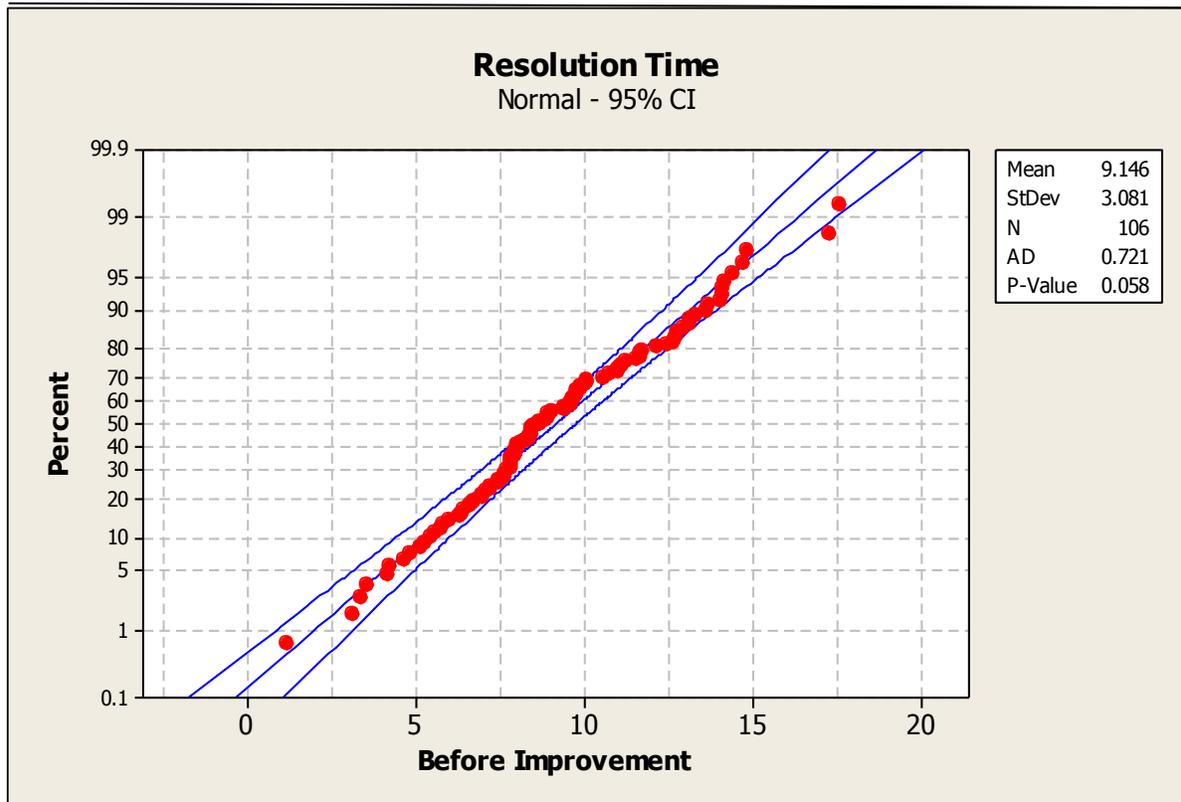deviation. The normality of the process parameters is shown below,

Figure 16: Probability Plot Before Improvement of Resolution Time

It looks the data follows a normal distribution and can be analyzed using the same distribution in analysis of the parameters. Further, the probability of resolution time of ticket being less than 8 hours is calculated. Below is a Distribution plot for probability.

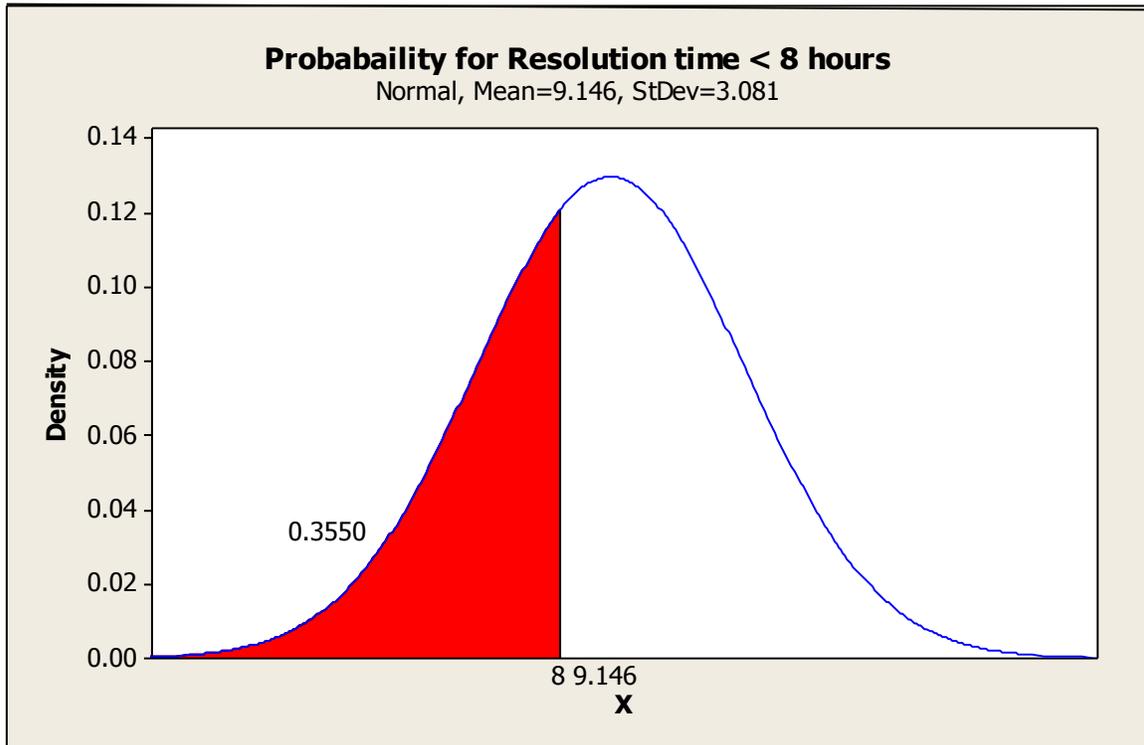**Probaility for Resolution time < 8 hours**
Normal, Mean=9.146, StDev=3.081

Figure 17: Distribution Plot for Resolution Time Less than 8 Hours

From the above graph, it can be inferred that the probability of having a resolution time lesser than 8 hours is about 35%, which is a huge opportunity to optimize the process and bring in various improvements and control plans.

On implementing planned improvements, the data has been collected for a period of two months which are about 84 data points of resolution time of the tickets in Oracle support projects. Initially the data is scrutinized using a Box plot.
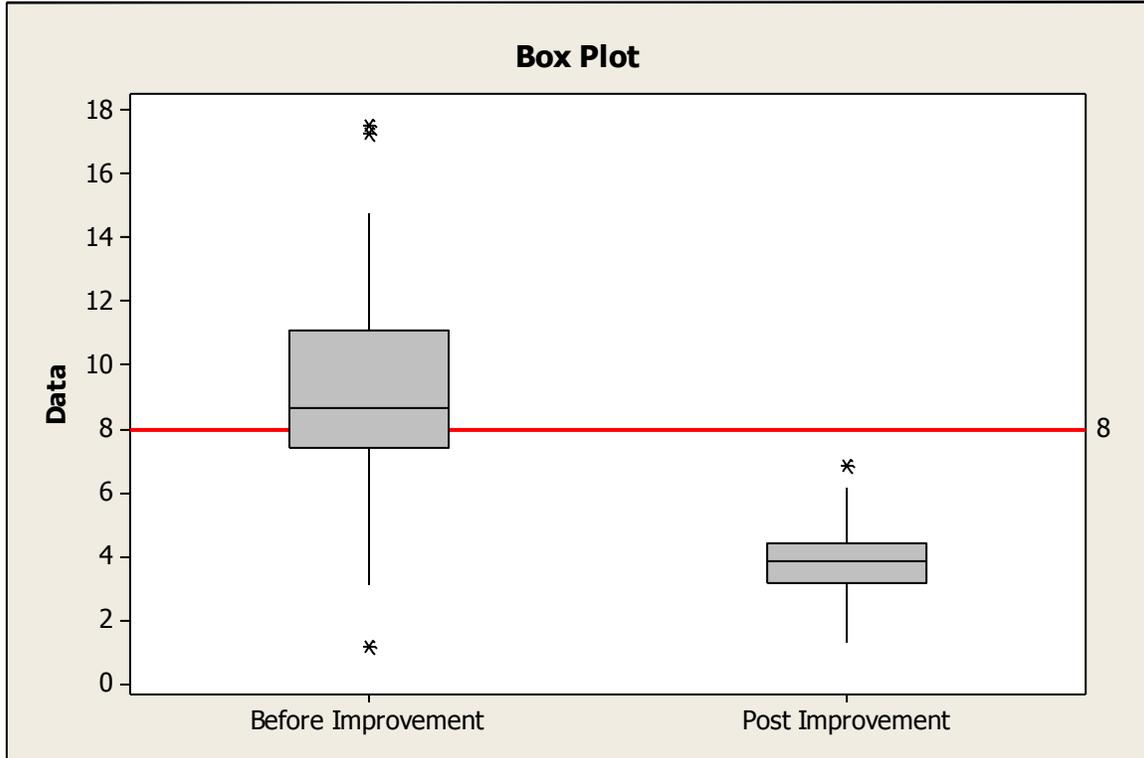
Figure 18: Comparison of Box Plot Before and After Improvement Time

It is evident that the post improvement resolution times have graphically improved. It has a outlier, but the outlier is way within the SLA. The probability of having a random resolution time of a ticket after implementing and making the improvement s to the process is given below.
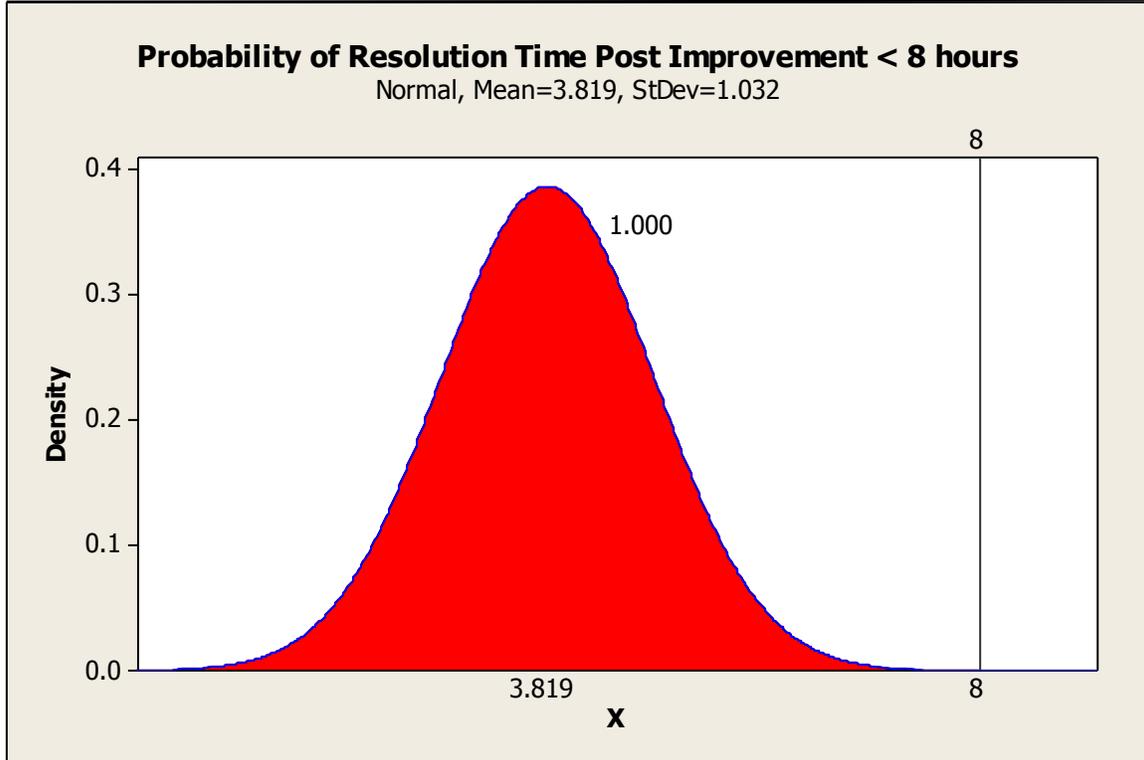
Figure 19: Distribution Plot of Post Improvement Less than 8 Hours

From the data it is understandable that the resolution time of a random ticket in a oracle support project post implementation of the improvements is 1.000. Although graphically the improvement in the process is evident, it was brought into confidence with testing the improvement statistically using t-test for mean comparison and f-test for variances. Below are the results of the hypothesis testing for before-after means and variance.

Two-sample T-test and CI: Before improvement, post improvement.

```
Two-sample T for Before Improvement vs Post Improvement

N   Mean   StDev   SE Mean
Before Improvement  106   9.15    3.08      0.30
Post Improvement     84   3.82    1.03      0.11


Difference = mu (Before Improvement) - mu (Post Improvement)
```

```
Estimate for difference:  5.327
95% lower bound for difference:  4.797
T-Test of difference = 0 (vs >): T-Value = 16.66  P-Value = 0.000  DF = 133
```

Due to unequal sample size, a two sample t-test is opted for the mean comparison although paired t-test is more appropriate which requires equal sample sizes for comparison. Since the p value is less than 0.05, the null hypothesis is rejected and the alternate hypothesis is accepted. Null hypothesis is average resolution time before improvement is equal to average resolution time after improvement. While the alternate hypothesis is considered as the resolution time before improvement is higher than resolution time after improvement.

The variances are then compared using a two sample f-test. Following are the results,

```
Method

Null hypothesis         Sigma(Before Improvement) / Sigma(Post Improvement) = 1
Alternative hypothesis  Sigma(Before Improvement) / Sigma(Post Improvement) > 1
Significance level      Alpha = 0.05

Statistics

Variable              N  StDev  Variance
Before Improvement  106  3.081     9.490
Post Improvement     84  1.032     1.066
Ratio of standard deviations = 2.984
Ratio of variances = 8.904

95% One-Sided Confidence Intervals

            Lower Bound   Lower Bound
Distribution   for StDev  for Variance
of Data           Ratio         Ratio
Normal            2.508         6.291
Continuous        2.496         6.228

Tests
                                        Test
Method                      DF1  DF2  Statistic  P-Value
F Test (normal)             105   83       8.90    0.000
Levene's Test (any continuous)  1  188      50.88    0.000
```

Since the p value is less than 0.05 in both f-test and levene's test, the null hypothesis is rejected and the alternate hypothesis is accepted. Null hypothesis is variance of resolution time before improvement is equal to variance of resolution time after improvement. While the alternate hypothesis is considered as the variance of resolution time before improvement is higher than variance of resolution time after improvement. This adds confidence to the improvement statistically making it significant.

Summary

Data presentation and analysis explains how the migrations are carried, and also what are the key characteristics of data and objects. Different evaluation methods used to calculate the output. The merits and additional features are detailed. The next chapter will cover the result of the project, conclusions based on the results and possible recommendations for the betterment of the organization.

Chapter V: Results, Conclusion, and Recommendations

Introduction

This chapter explains the ability to utilize data, and analyze the results. This is done by making use of numerous techniques of exploration which is already discussed in the preceding chapters. To complete the development of analysis successfully, the necessary information was gathered from the statistical analysis of the data through the post and pre implementation, this process would come out with a conclusion.

Results

Figure 20: IMR Chart for Post Improvement Performance

I-MR chart is suggested for the monitoring the resolution times of various tickets, each individually to keep control of the process. Although there is an outlier just as we saw in the Box plot, there was a specific assignable cause which was solved subsequently.

Conclusion

This migration project has been considered as one of the most prestigious projects handled by the organization and the result was hugely appreciated by the business users. The reduction of time is the most important problem that was addressed by this project. New features and other additional functionalities will enhance the user's experience. The reduction of errors and unexpected breakdowns during migration was also one of the key aspects that was achieved in this project. These aspects directly portray the reduction in the utilization of the resources by the organization.

Based on the final results of the project, it was clearly portrayed that the project has been appealing to the customers while the company started to establish relations with new additional users.

Recommendations

The study established that the migration challenges in Oracle Database servers and their approach is very suitable for process to be roubst for upcoming migration projects.

- ➤ Reduce the migration challenges and also the cheking with the network and storage team to avoid the possible errors which makes the future migrations simple without   breakdowns.

- ➤ Proper Knowledge transfer and proper role access to the resource might help to avoid inconsistency.

- ➤ At regular intervals, the team must reflect on how to become more effective through meetings and interacting with the prospective customers, fine tune and adjust the behavior accordingly.

- ➤ Also hiring new resources rather than extending the timeline which increases the performance.

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