# SECURE BORDER LESS ENVIRONMENT, DESKTOP AS A SERVICE – THE NEW NORMAL!

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## Abstract

A CMMI Level 3 certified organization has been explored for this project work. One particular project is selected as a focus project to analyze the modern processes with their tools & techniques. However, there are some other projects selected and evaluated to compare the performance of the focus project with those projects of the organization. This project is selected as the success rate in software industry is very less. Detail statement of problem is mentioned in Idea Generation section.

**Research Methodology** with different data collection methods are described in section 4.0 [**Methodology**].

Findings & recommendations are described in the section 8.0 [**Conclusion & Recommendation**].

**Keywords** Secure Border less Environment, Desktop as a Service, Software Design Document

**List of Tables:**

**List of figures:**



**List of Symbols, Abbreviations and Nomenclature:**

SBLE – Secure Border Less Environment• DaaS – Desktop as a Service •NASA - National Aeronautics and Space Administration• US – United States• PMI - Project Management Institute• PMP - Project management Professional• USA - United States of America•PDCA – Plan Do Check Act • IT - Information Technology• NA - Not Applicable• FR - Functional Requirement• FS - Functional Specification• SDD - Software Design Document• WBS - Work Breakdown Structure• PDLC - Product Development Life Cycle• PLC - Product Life Cycle• IS - Information Service• HR - Human Resource• OOAD – Object Oriented Analysis•& Design VSS – Visual Source Safe• JDBC – Java Data Base Connectivity• PL/SQL – Procedural Language/ Structure Query Language• UML – Unified Modeling Language• SPM – Software Project Manager• AMC – Annual Maintenance Contract• CR – Change Request• BAP – Business Assurance Program• 7 CSI - Customer Satisfaction Index• CTD - Cumulative Till Date• DRE - Defect Removal Efficiency• RE - Review Effectiveness• TE - Test Effectiveness• MTTRSP - Time Taken To Respond• MTFB - Mean Time taken To Solve• QMS - Quality Management System• GUI – Graphical User Interface• QAG - Quality Assurance Group• QAT – Quality Audit Team• IQA – Internal Quality Audit• PPQA – Process•& Product Quality Assurance CI – Configuration Item• CEO – Chief Executive Officer• SPD – Software Product Development• PMBoK – Project Management Body of Knowledge• CMMI – Capability Maturity Model Integration• TBD – To Be Decided•

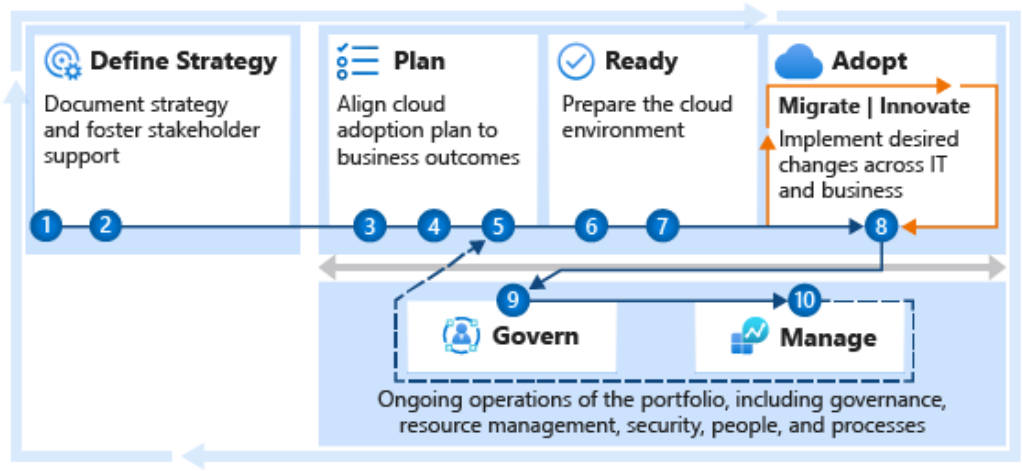
**Introduction:**

Windows Virtual Desktop is a desktop and app virtualization service that runs on the cloud. The model getting discussed is completely new in this new normal situation. The key need of the business is equipping the engineers and the support architects, BPOs, KPOs with zero dependency on any location.

**Key Capabilities in business:**

- ❑ Create a full desktop virtualization environment.
- ❑ Publish as many host pools as per the need
- ❑ Reduce costs with pooled, multi-session resources.
- ❑ Improved scalability

**How does it work with Customer/ End-Users**




## 2.0 Scope

Scope of this journal is limited to modern trends of project management used in software product development for the research organization.

Following is the major list regarding the scope of this project work.

1. Agile project management methods & processes are followed or not.
2. Different project management tools & techniques are used or not.
3. Different processes are monitored or not.
4. Whether findings or outcome of different processes are analyzed or not.
5. Find out improvement scope in any area of project management processes.
6. Finally, preparation of a recommendation list for future project.

## 3.0 Aims & Objectives

The aim of this particular Journal: Verifies and tests existing facts and theory and these help improving our knowledge and ability to handle situations and events.

General laws developed through research may enable us to make reliable predictions of events yet to happen. It aims to analyze inter-relationships between variables and to derive PDCA explanations: and thus enables us to have a better understanding of the project to control it.

**Objectives are set under three heads:**

### 3.1 Assess the digital estate

Discovery and assessment provide a deeper level of technical alignment, which helps to create an action plan that IT associates can use to deliver on the strategy. During this step, the validation of the business case by using data about the current
state of the environment is getting done. We perform quantitative analysis of that data and a deep qualitative assessment of the highest priority workloads.
The output of the digital estate assessment provides the cloud platform team with a clear view of the end-state environment and the requirements that are needed to support the adoption plan.

**Deliverables:**

- Raw data on the existing inventory.
- Quantitative analysis of the existing inventory to refine the business justification.
- Qualitative analysis of the first 10 workloads.
- Updated business justification in the strategy and plan template.

**Support-to-delivery completion:**
Inventory existing systems: Understanding the current state from a programmatic, data-driven approach is thefirst step. Find and gather data to enable all assessment activities is next in question.

The cloud adoption plan template provides an accelerated approach to developing a project backlog. The backlogcan then be modified to reflect assessment results, rationalization, needed skills, and partner contracting.
A review of the short-term cloud adoption plan and backlog helps the cloud platform team understand the needs of the environment for the next few months. This background helps them to tighten the "definition of done" for the first few landing zones.

Complexity and data available for each workload can also affect timelines.

**Cloud adoption plan template:** Deploy the basic template.
**Workload alignment:** Define workloads in the backlog.
**Effort alignment:** Align assets and workloads in the backlog to clearly define efforts for prioritized workloads.
**People and time alignment:** Establish iteration, velocity, and releases for the migrated workloads.

### 3.2 Principles

The core principles of a well-managed operating model are based on a set of common architecture principles. Thegetting started guidance in this article series will help supporting teams, as they scale these principles across the cloud platform and throughout the portfolio of workloads.


Cloud Adoption Framework ensures the principles scale across the portfolio to enable adoption teams through a well-managed environment.

### 3.3 Time to Completion

Actual progress has to match or beat planned progress. All significant stages of the project must take place no later than their specified dates, to result in total completion on or before the planned finish date. The timescale objective is extremely important because late completion of a project is not very likely to please the project purchaser or the sponsor. We can control this by monitoring the schedule variance (actual vs. baseline).

### 3.4 Hypothesis to be tested

The hypothesis to be tested here is “Whether complete modern trends are followed or not”.

### 3.5 Methodology

#### 3.5.1 Strategy to digital transformation and operational excellence expectations.

A clear business strategy is the foundation for any digital transformation and operational excellence effort. IT can reduce costs and streamline IT processes. Without a clear strategy, it's difficult to understand how those changes might affect the business outcomes identified in the broader transformation effort.

**Deliverables:**
Record motivations, outcomes, and business justification in the strategy and plan template.
Ensure learning metrics are well understood and included in the business outcomes section. Those metricsguide operational excellence activities and reporting within IT.

**Pillars to support deliverable completion:**

Understand motivations: Critical business events and some migration motivations tend to be cost sensitive.
These areas can increase the importance of cost control for all later efforts. Other forward-looking motivations related to innovation or growth through migration might be focused more on top-line revenue. Understanding motivations helps you prioritize cost management.
Business outcomes: Some fiscal outcomes tend to be extremely cost sensitive. When the desired outcomes mapto fiscal metrics, you should invest early in the Cost Management governance discipline.
Business justification: The business justification serves as a high-level view of the overall financial plan for cloud adoption. It can be a good source for initial budgeting efforts.
Learning metrics: To maintain alignment between the overarching business strategy and the more tactical change-management plans, establish learning metrics. These metrics should be designed to show iterative and incremental progress toward the plan.

**3.5.2** Sources of data Primary sources of data are used for analysis which is directly collected & precisely according to research needs.

**3.5.3** Data Collection Method Primary data are first hand information collected through Interview & participative observation method.

**3.5.3.1**Interview Data for this Project has been collected through interviews of the project managers of the on-going and past projects.

**3.5.3.2**Observation In this observation, the observer is a part of the phenomenon or group which is observed and he acts as both an observer and a participant. Here modern trends in project management are studied by a team leader by taking part in software product development and data are collected up to 2 decimal places. The advantages of participant observation are: The observer can understand the actual result of the observed events, and get a deeper insight of their

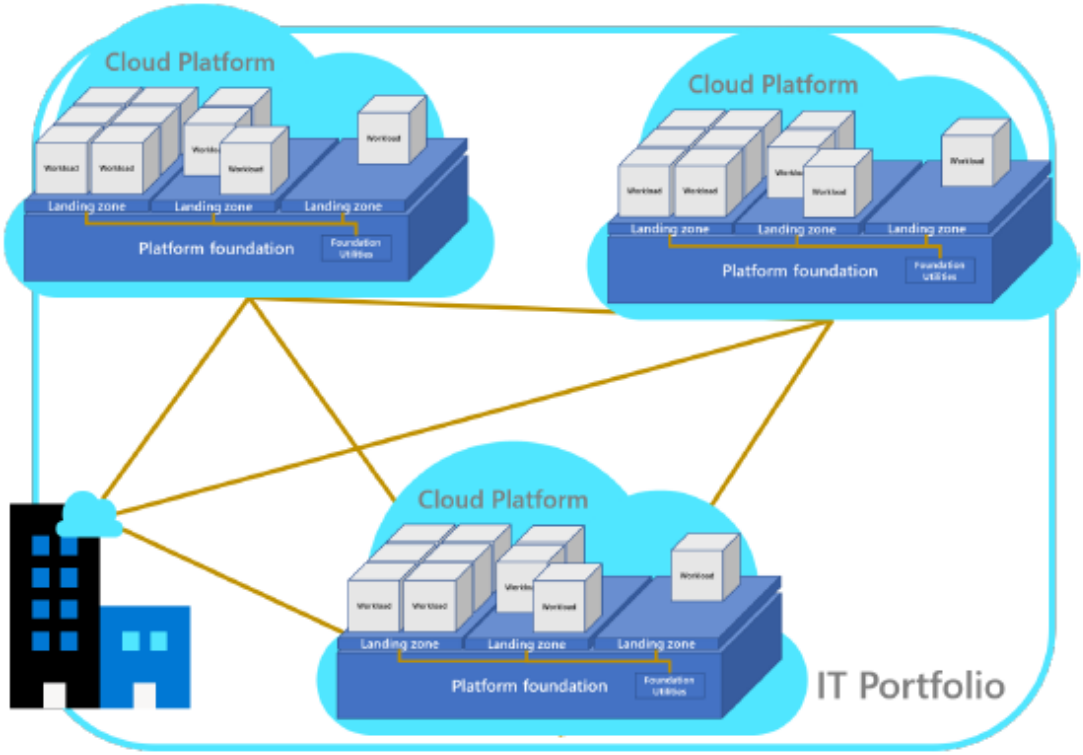
occurrences. The observer will be able to record the context which gives meaning to the observed behavior.

**3.5.3.3** Records I have used existing records of the projects of different types.

## 4.0 Idea Generation

### 4.1 Need Identification

When companies support workloads through matrixed approaches or centralized approaches, a broader hierarchy likely exists to support those workloads:




Landing zone: Landing zones provide workloads with access to all of the foundational utilities (or shared plumbing) that are provided from a platform foundation that's required to support one or more workloads. Landing zones are such a critical component in the cloud, that the entire Ready methodology in the Cloud Adoption Framework is dedicated to landing zones. See "What is a landing zone" for a deeper definition.

Foundational utilities: These shared IT services are required for workloads to operate within the technology and business portfolio.
Platform foundation: This organizational construct centralizes foundational solutions and helps ensure that those controls are enforced for all landing zones.
Cloud platforms: Depending on the overall strategy for supporting the full portfolio, customers might need multiple cloud platforms with distinct deployments of the platform foundation to govern multiple regions, hybrid solutions, or even multi-cloud solutions.
Portfolio: Through a technology lens, the portfolio is a collection of workloads, assets, and supporting resources that span all cloud platforms. Through a business lens, the portfolio is the

collection of projects, people, processes, and investments that support and manage the technology portfolio to drive business outcomes.

Together, these two lenses capture the portfolio.

### 4.2 Alternative evaluation

The project life cycles (Project development life cycle, product development life cycle, Project delivery & implementation life cycle etc.) are evaluated for different types of projects. Different processes of standard like CMMI, ISO, PMBoK and some modern key processes are evaluated for different types of projects (like - Pure development Project, AMC project, MSO project, BAP project etc). Selection of a project life cycle or certain project management processes are done depending on project complexity, resource expertise, technology used etc.

### 4.3 Project defined processes

#### 4.3.1 PMBoK Processes

The objective of this Project Management Process is to ensure that the project management functionaries focus on dispatching project deliverables as per expressed, implied and agreed client expectations, on agreed dates, and in a mode that is acceptable to the client. While doing so, due attention is paid to optimum utilization of project resources and optimization of project costs Project management processes are divided into five groups, defined as the Project Management Process Groups, each group comprising one or more processes. This grouping helps in understanding the relevance and significance of the sequence of, and interaction between the various processes in project management. However, a process group is not a totally discrete phase occurring in isolation from another process group, and the processes have inherent interactions between themselves throughout the implementation life cycle of a project.

Brief **definition** of these process groups are as under:

1. **Initiating process group** – defines and authorizes the project or a project phase.

2. **Planning process group** – defines and redefines objectives and plans the course of action required to attain the objectives and scope that the project was undertaken to address.

3. **Executing process group** – integrates people and other resources to carry out the project management plan for the project.

4. **Controlling process group** – regularly measures and monitors progress to identify variances from the project management plan so that corrective action can be taken when necessary to meet project objectives.

5. **Closing process group** – formalizes acceptance of the product, service or result and brings the project or a project phase to an orderly end. Broadly, the process groups tend to be deployed in the sequence listed as the project progresses. In the event that a project goes off-course, re-planning comes into play, and if a project is found to be in serious trouble, it may have to go all the way back to the initiating process to be restarted. To summarize, the result or output of one

process group often becomes an input to another. In the central process groups planning, executing and control), all the links are looped i.e. the links of these central process groups are iterated – planning provides execution with a documented plan early on, and then provides documented updates to the plan, as the project progresses.

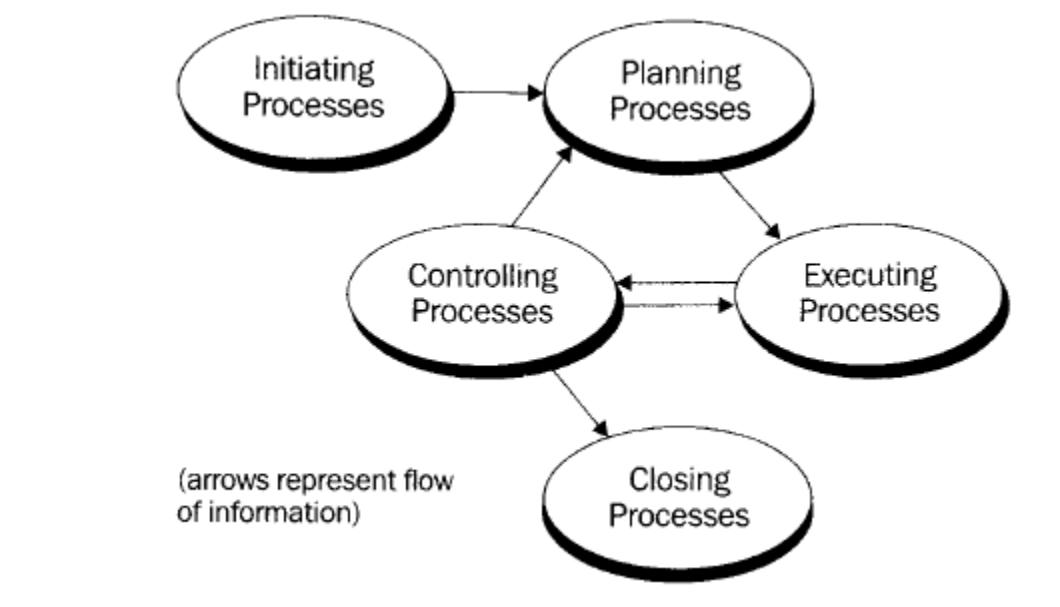



**Figure 1: Links among Process Groups in a Phase**

Also, though these process groups are presented above as discrete, one-time events; these events overlap and take place at different levels of activity across each phase in the project life cycle. Fig. 1 illustrates this overlapping.

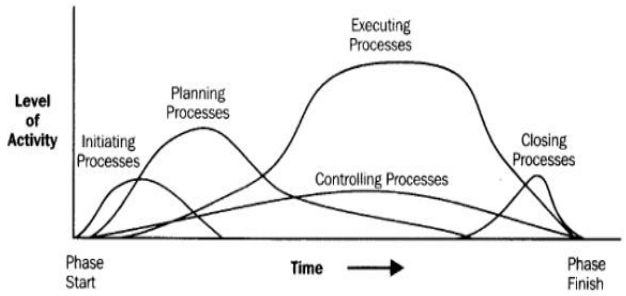



**Figure 2: Overlap of process groups in a phase**

The Process Groups are not project phases: Where large or complex projects may be separated into phases or even subprojects such as feasibility study, concept development, design, prototype, build, and test etc., all of the Process Group processes would normally be repeated for each phase or subproject. Finally, a phase will usually involve all these five process groups within their iterations inside the phase, before that phase is closed to provide the input to the next phase. For example, closing the design phase requires acceptance from the client on the design document, which defines the product description for the ensuing implementation phase. Project management processes describe and organize project activities. Project management processes that are common to most projects have been classified into nine classifications by PMBoK. Though each of these processes discusses the significance of individual activities in relation to the project, all the processes are interrelated. For instance, project procurement management, which is a process for acquiring goods and services from a firm external to the project organization, will need to be performed to satisfy the project requirements implicit in scope management, cost management, quality management etc.

1. Project Integration management

2. Scope management

3. Time management

4. Cost management

5. Quality management

6. Human resource management

7. Communications management

8. Risk management

9. Procurement management

**Table 1:**

**Requirements Traceability Matrix**

Project Code: ABC

Project Name: ABC

Customer Name: Internal

| Serial No. | Item No. in FR | Item in FR | Sub-section Reference in FS | Sub-section Reference in SDD | Source Code Reference | Reference of Unit Test Cases | Reference of Integration and System Test Cases |
|---|---|---|---|---|---|---|---|
| 1 | G001 | Background highlighting of the field that has focus | Sec 3.1.1 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 2 | G002 | Warning if the user is navigating away from a page that has unsaved data | Sec 3.1.2 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 3 | G003 | Progress indicator for long operations | Sec 3.1.3 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 4 | G004 | Disabling of buttons during long operations | Sec 3.1.4 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 5 | G005 | Sort, filter and rearrange columns for data in a grid | Sec 3.1.5 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 8 | G008 | Clicking on the "close window" ("X") button to shut down application, logs out user | Sec 3.2.1 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 9 | G009 | Workflow (next, previous, cancel, finish) for complex operations | Sec 3.2.2 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 10 | G010 | A confirmation (summary) page at the final step for all Wizards | Sec 3.2.3 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 11 | G011 | Floating window for error messages | Sec 3.2.4 | ABCCorporateCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 12 | G012 | 'Report this' link on every alert for reporting errors and debugging info | Sec 3.3.1 | ABCResidentialCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 13 | C001 | Creation of a new Customer | Sec 3.3.2 | ABCCorporateCustomer_Creation_SD, | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 14 | C002 | Backdated customer creation | Sec 3.3.3 | ABCResidentialCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 15 | C003 | Future dated customer creation | Sec 3.3.4 | ABCResidentialCustomer_Creation_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |
| 16 | C004 | View Customer demographics | Sec 3.4.1 | ABCCorporateCustomer_Retrieval_SD , ABCResidentialCustomer_Retrieval_SD | ABCCCustomer.CPP | ABCCCustomer_UT.xls | ABCCCustomer_SI.xls |

### 5.3 Research Life cycle

The concept of a Life Cycle is central to software engineering methods. The purpose of a Product Development Life Cycle (PDLC) definition is to provide an understanding of the underlying software engineering processes so that those can be planned and monitored. There are many different representations of the related software product development life cycle models, which comprises of various phases. All product development projects must pass through these phases, with a different emphasis placed on each, depending on the type of the product being developed. Product Life Cycle (PLC) refers to the life cycle phases and activities relevant for the development, implementation and maintenance of a software product.

Typically, a PLC may be sub-divided into 3 broad phases:

- Product Development phase
- Product Delivery and Implementation phase
- Product Support and Maintenance phase.

Due to the nature of customer requirements and the priorities of the management, it was decided to use a new set of technologies to enable the delivery of the user experience over a web browser. The incremental model was chosen as Product Development Lifecycle Process for this project as it is the most appropriate choice. The Incremental Model combines the elements of Waterfall model with the philosophy of an iterative approach. As illustrated below, it applies the linear sequences in the Waterfall Model in a staggered manner as the calendar time progresses. Each linear sequence produces an incremental deliverable of the software. The first increment is often a core software system where the basic requirements are addressed, but many supplementary features remain undelivered. The core software system is reviewed in detail by the customer and may be even used. As a result of the detailed review and/or use of the core software system a plan is developed for the next increment. The plan addresses the modification of the core software system to better meet the needs of the customer and delivery of the additional features and functionality. This process is repeated following the delivery of each increment until the complete software system is developed. This has a number of distinct advantages over the traditional sequential development model. This is the best choice for projects that has high technical risks, and objective is achieved by breaking down the project organization and systems construction into manageable subprojects. The advantage of this model is that the development team understands customer’s expectations in gradual steps and gets the opportunity to implement changes in the same incremental steps. It is particularly useful when staffing is unavailable for a complete implementation of the full system by the project deadline. The core software system can be implemented with fewer staff that can be put to use by the user. If the core software system is well received by the user, additional staff is added to work on the subsequent increment(s).

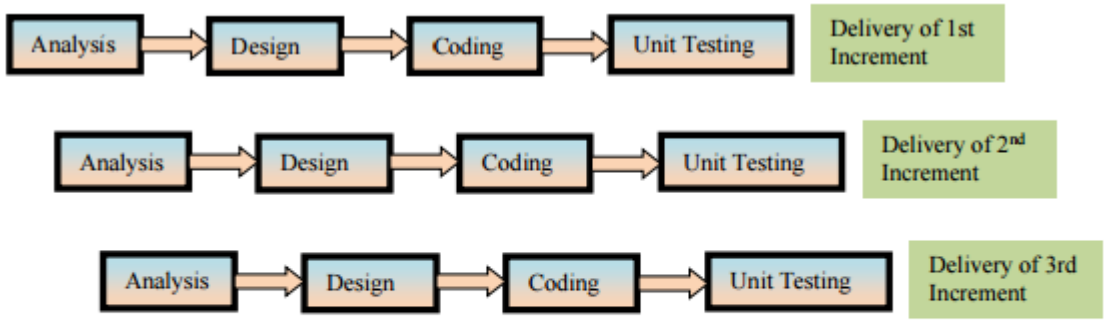



**Figure 3: Product Development Life Cycle – Incremental Model**

A series of activities was carried out as part of the project's defined process prior to starting work on the increments as per the incremental model. The activities identified are as follows:

1. Study of customer requirements

2. Study of existing functionalities

3. Enumerate generic features of certain modules Analysis Design Coding Unit Testing Delivery of 1st Increment Analysis Design Coding Unit Testing Delivery of 2nd Increment Analysis Design Coding Unit Testing Delivery of 3rd Increment

4. Identification of architectural attributes to be retained in the application.

5. Preparation of Functional specifications and incorporate new requirements identified in step 1

6. Identification of candidate technologies and tools for evaluation

7. Evaluation of identified alternative technologies and tools by prototyping

8. Selection of tool and technology set for delivering the subsequent increments

**Table 5: Inter Group Dependencies**

| SL. No. | Name of the Group | Nature of support needed | Date/Period when support is needed |
|---|---|---|---|
| 1 | Purchase | To provide hardware/software requirements for the development environment according to the indents raised for the project. | After prototyping phase |
| 2 | IS-HELPDESK | For any kind of assistance required in terms of infrastructure (related to hardware, software, database and network) IS-HELPDESK needs to be contacted. | Throughout the project span |
| 3 | Quality Audit Group | SQA facilitation, review and audit of the project as mutually agreed between PM & QAG. | For PPQA audit after prototype completion and delivery at each milestone. For IQA audits as scheduled by QAG |
| 4 | Sr. Management | Management Reviews, Authorize closure the projects, if required | Throughout the project span |
| 5 | Training | Trainings need to be arranged as per the training plan | AS per training plan |
| 6 | Project Office | Allocation of resources to the project is done through project office. | Throughout the project span |
| 7 | HR | Facilitation of employee induction, development review and compensation, leaves and attendances, other benefits, etc. | Throughout the project span |
| 8 | Travel desk | Arrangement of travel requirements, e.g. ticketing and booking, visa processing, initiation of per-diem disbursement, post-travel accounting, etc | Not applicable |
| 9 | Metrics Council | Analyzing the collected metrics. | As mentioned in the metrics plan |

**Risk Analysis:**

Risk is the probability of occurrence of an event which can hinder the project goals. While some of the risks are trivial, others could make a significant difference in the way projects are executed. Thus Risk Management is recognized as an essential process in any organization. Risk Management focuses mainly on minimizing threats and maximizing opportunities. It plays a very important role in optimizing the objective achievements. Ideal Risk Management minimizes the spending and maximizes the reduction of the negative effects of risk.

Hence, one of the key areas requiring proactive management within projects is risk. Risk in a project arises from a wide range of sources and has a broad scope of possible effects on the project. Given that the two dimensions associated with any project are the tasks to be performed and the risks inherent in the project environment, it is a key success factor for every project manager to predict and manage the project risks well. Risk management is therefore a process of identifying and assessing risks in a project. Additionally, it also entails ensuring that effective measures are planned and implemented to minimize the occurrence of these risks and to deliver the project in line with defined objectives.

**Table 2: Identification of Risks and Steps for their Mitigation**

Customer's Name: Internal Project Code, if any: ABC

Project Name: ABC

| | Risk Details | | | Forecast | | | Closure | | |
|---|---|---|---|---|---|---|---|---|---|
| Serial No. | Risk Item | Date Raised | Status | Probability of occurrence (H / M / L) | Impact (H / M/ L) | Risk Exposure | Provision for Risk (Rs.) | Mitigation Action Plan | Contingency Action Plan |
| 1 | Timely availability of inputs regarding look-and-feel and process flow from Task force | 8th April 2010 | Occurred | M | H | H | | Pre-sales and customer to be informed regarding inputs | No Contingency |
| 2 | Quality of inputs from external consultant | 8th April 2010 | Occurred | M | H | H | | Qualifications of External consultant to be defined and selection of external consultant to be done on basis of proven track record | No Contingency |
| 3 | Support for problems encountered due to usage of software from external sources | 8th April 2010 | Occurred | M | M | M | | Sources of External software to be vetted and support agreements to be put in place. | Seek support from online support forums and user groups |
| 4 | Timely availability of training for certain key technologies. | 8th April 2010 | Occurred | M | M | M | | Technology vendors to provide training with training materials. | Procure books and other public domain information. |
| 5 | Timely assignment of user documentation and training material preparation resources | 8th April 2010 | Occurred | L | L | L | | No Mitigation | No Contingency |

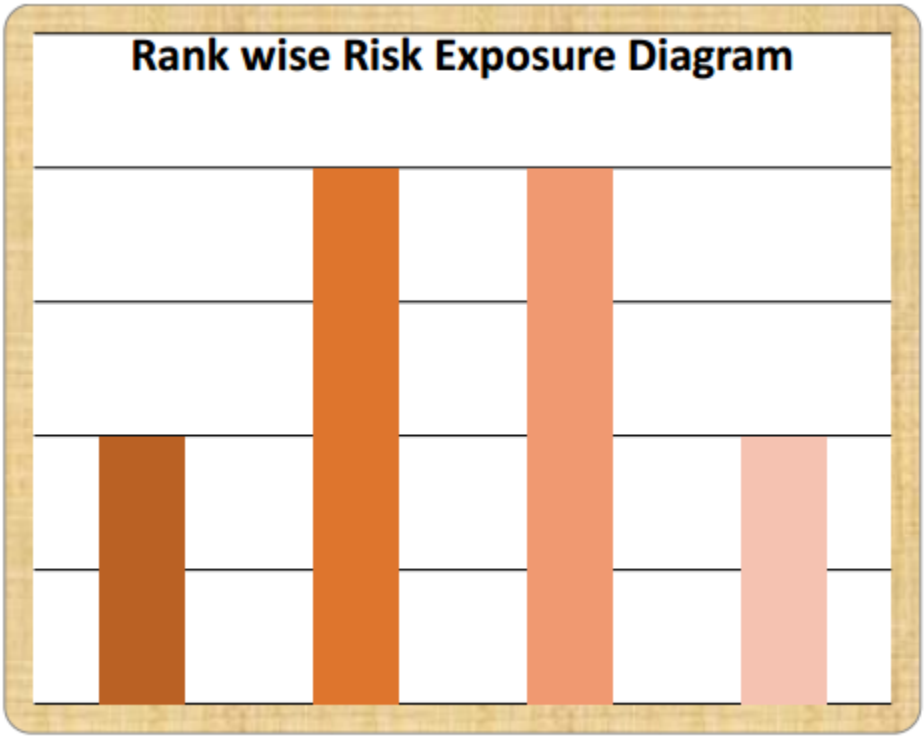



**Figure 4: Rank wise Risk diagram**

**Team Building:**

Team Building refers to a wide range of activities, presented to businesses designed for improving team performance. Team building is pursued via a variety of practices, and can range from simple bonding exercises to complex simulations and multi-day team building retreats designed to develop a team. It generally sits within the theory and practice of organizational development, but can also be applied to sports teams, school groups, and other contexts. Teambuilding is an important factor in any environment, its focus is to specialize in bringing out the best in a team to ensure self development, positive communication, leadership skills and the ability to work closely together as a team to problem solve. Work environments tend to focus on individuals and personal goals, with reward & recognition singling out the achievements of individual employees.

**Reasons for Team Building**

Reasons for Team Building include• Improving communication• Making the workplace more enjoyable• Motivating a team• Getting to know each other• Getting everyone "onto the same page", including goal setting• Teaching the team self-regulation strategies• Helping participants to learn more about themselves (strengths• and weaknesses) 50 Identifying and utilizing the strengths of team members• Improving team productivity• Practicing effective collaboration with team members•

| Level/ Job profile | Number | Necessary Competence | Desirable Competence |
|---|---|---|---|
| Software Project Manager | 1 | Project Management | Project Management |
| Configuration Controller | 1 | Configuration Control | Configuration Control |
| Senior Designers/Designer | 3 | Analysis and Design | Analysis and Design |
| Senior Developer | 4 | Core Java, JDBC, SQL, Oracle PL/SQL, hands on working ability, Java Debugging | Hibernate, Spring, XML, OOAD, Unit testing, Usage of configuration management tools like VSS, Spectrum, SDLC, Code reviews, Metrics, Technical Software Performance engineering |
| Developer | 3 | Core Java, JDBC, SQL, Oracle PL/SQL, UML, Unit testing, Usage of | Hibernate, Spring, XML, UML, OOAD, Unit testing, Usage of configuration management tools like VSS, Spectrum, SDLC, Code |

**Observation / Defect Analysis**

Defect analysis generally seeks to classify defects into categories and identify possible causes in order to direct process improvement efforts. Defect data is used and analyzed for continuous quality improvement. **Root Cause Analysis** (RCA) is a management process that seeks to locate the ultimate cause or 80/20 rule causes behind performance or process-related problems in a business or engineering environment, and then proceed to resolve the problem by treating these underlying causes. The advantage of Root Cause Analysis as a failure-management method over troubleshooting, for example, is that the latter is a knee-jerk reaction to the occurrence of some critical problem or failure. Some fire-fighting is carried out in order to handle and recover immediately. Since this expeditious approach deals with the patching up symptoms quickly, the problem seems temporarily solved. Over time, the problem is likely to recur, resulting in a similar knee-jerk troubleshooting process, racking up huge costs along the way. The benefits of Root Cause Analysis, as a result, are the deeper investigation into the reason for the occurrence in the first place. The root cause or causes 63 might be much deeper than outward symptoms reveal, and several layers may have to be pushed aside to reach the "root" cause. So, the focus is on analysis of this fabled "root cause" that propagated forward and manifested in the form of the

problem at hand, rather than exclusively treating the symptoms, as troubleshooting does. The resulting Ishikawa Diagram is then analyzed by the senior management to draw up a plan of action to root out the causal factors, so that the root causes can be solved. This is frequently done, by taking the enumerated causes, and measuring their occurrence in various processes. After recording these data for a specific period, the results are examined in a Pareto Chart, wherein the 80/20 rule makes it apparent where to invest the appropriate organizational effort to reduce the unwanted effects so analyzed in this process (or perhaps to increase intended positive effects). As can be seen above, the Cause and Effect exercise may be seen as the first step toward any quality management effort. Problem-solving techniques continue where this exercise leaves off. An innovation on the Ishikawa fishbone is the "lateral tree", which is supposed to have an edge over the former when it comes to handling more complicated scenarios involving causal branches of several depths. The latter strives to vertically align all items on the same causal level, thus providing more perspective to analysts.

| **Count of Root Cause** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **FNC: Function wrongly specified** | **INC: Incorrect information** | **IRF: Incorrect reference** | **IRR: Irrelevant information** | **LER: Lingual error** | **LGC: Incorrect processing** | **MIN: Missing/inadequate information** | **OTH: Others** | **STD: Standard Related** | **TDS: Template/doc std not followed** | **Grand Total** |
| R- PRS: Lacking technical know how/ domain expertise | | 5 | | | | | 2 | | | | 7 |
| R- PRS: Over sight | | 11 | 1 | | | | 1 | 1 | | | 14 |
| R- PRS: Time pressure | | | | | | | 2 | | | | 2 |
| R-FNC: Analyst did not know the requirement | | 1 | | | | | 1 | | | | 2 |
| R-FNC: Analyst/Coder requires training on Analysis / Design Technique | | | | 1 | | | | 2 | | | 3 |
| R-FNC: Analyst/Coder requires training to write the document | | | | 1 | 2 | | 2 | | | | 5 |
| R-FNC: Inadequate Requirement Analysis Document / SRS review not properly done | | | | | | | | 1 | | | 1 |
| R-FNC: Mapping of requirement could not be done | | 2 | | | | | | | | | 2 |
| R-FNC: Missed the functionality or kept incomplete by mistake | | 7 | | 1 | | | 20 | | | | 28 |
| R-FNC: Not aware of the implicit requirement | | 2 | | | 1 | | | 1 | | | 4 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R-INIP: Incorrect inputs provided | 1 | | | | | 1 | | | | | 2 |
| R-INIP: Insufficient specs. Provided | | | | | | | 1 | | | | 1 |
| R-LGC: Not covered or improperly specified in Design doc or Spec or Test Plan | | 3 | | | | | | 1 | | | 4 |
| R-OTH: Clarifications not provided in time | | | | 1 | | | 1 | | | | 2 |
| R-OTH: Time pressure | | | | | | | 2 | | | | 2 |
| R-STD: Did not understand standard | | | | | | | 2 | | | | 2 |
| R-STD: Standard itself is incorrect | | | | | | | | | 1 | 1 | 2 |
| R-STD: Standard not followed | | | | | | | | | | 2 | 2 |
| **Grand Total** | **1** | **34** | **1** | **6** | **3** | **1** | **40** | **6** | **1** | **3** | **96** |

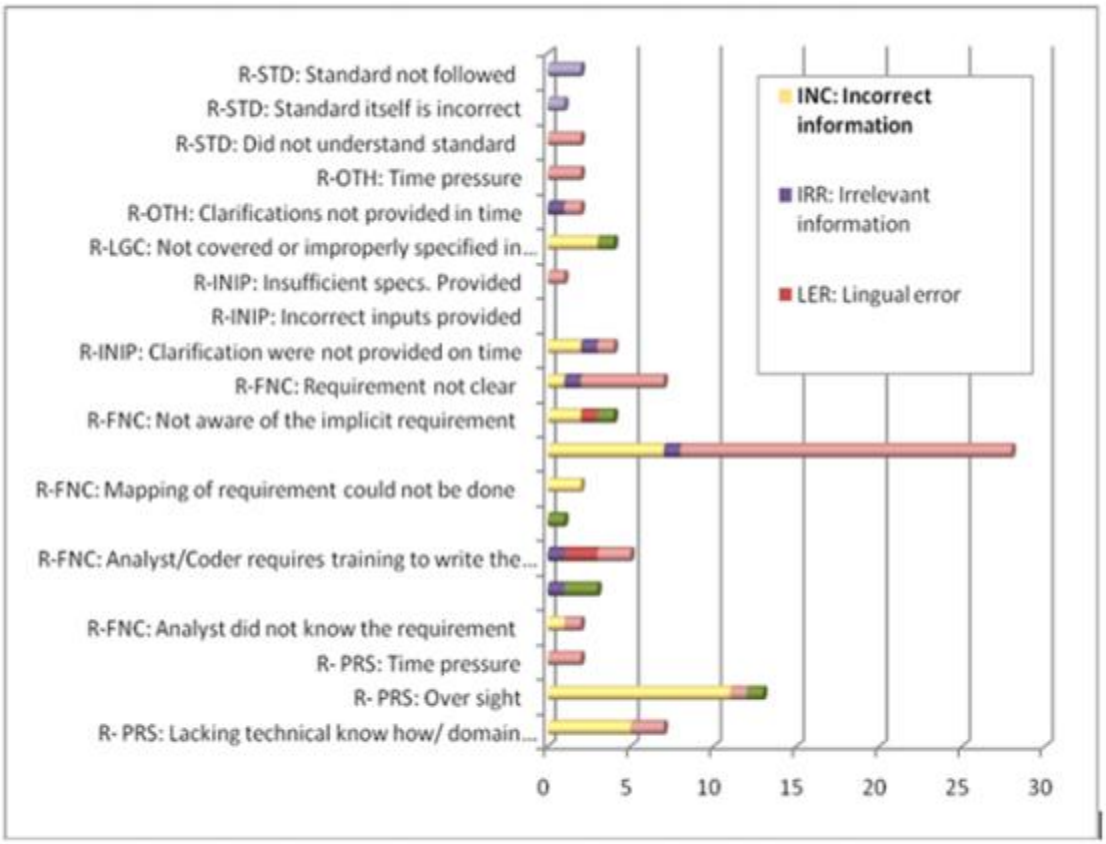



**Fig.5 Root cause wise No. of defects**

**Quality Management Plan & Audit Process:**

This Quality Management Process comprises of procedures being followed at the Company for Quality Management activities, viz. establishing the organizational policies for quality management and the management organization, defining and maintaining the Quality Management System, QMS performance reporting, and ensuring Corrective and Preventive actions for detected /reported non-conformities.

All these procedures facilitate continuous improvement of the company's products, services, operations, and the quality management system.

The objectives of defining and implementing the Quality Audit process are to:

- Standardize on the procedures which would be followed throughout the organization
- Determining the degree of conformance of the implemented Quality System with the documented Quality Management System through the audit process

- Facilitate continuous improvement

**Quality Control**

**Standards Applicable**

1. Java coding standard.
2. Documentation standard.
3. GUI standard as per customer representative input.

**Table 3: Product Review & Testing**

| SL. No. | Work Product/ Drawing/ Document | Type of Review / Testing planned | Proposed level of Reviewer / Tester |
|---|---|---|---|
| 1 | Project management plan, Project schedule, Risk analysis note, Project team organization | Independent Review | QAG, PG-Head, Customer representative |

| | | | |
|---|---|---|---|
| **2** | Functional Specifications, Design Document | Independent Review | Identified design board member |

**Table 4: Quality Audit Plan**

| SL. No. | Audit Type | Audit Item / Life Cycle activities Covered | Periodicity of Audit | Target Date of Audit | To be done by |
|---|---|---|---|---|---|
| 1 | IQA | Project initiation | Bi-Monthly | 16/04/2010 2/06/2010 | QAT |
| 2 | PPQA | Phase End | Phase End/Predelivery | Phase End | QAT |
| 3 | Configuration Audit | Configuration Item | Quarterly | 11/09/2010 | QAT |

**Table 5: Solution model quality audit report**

| SQA audit phase | Date | No. of NCs | No. of Observations | Mean time to close(in days) |
|---|---|---|---|---|
| IQA1 | 12/4/2010 | 2 | 0 | 10 |
| IQA2 | 2/6/2010 | 1 | 0 | 10 |

### 5.13 Configuration Management

Objective of configuration management is to ensure appropriate level of access control to the work products produced by projects, departments or groups. This process describes the Configuration Management Process that shall be followed for establishing and maintaining the integrity of the work products of the project throughout the project life cycle. Moreover, work products produced by different department or groups shall also be under configuration management process of the Company. The prime objective of the Configuration Management Process is to

- Plan configuration management activities
- Identify and control selected work products
- Control identified changes to the work products,
- Publish the status
- Distribute baselines to all the affected groups in the Company and
- Conduct audit in regular intervals over to ensure smooth operation of configuration management activities.

**Configuration Control Procedure**
This will be as per the Configuration Management Process defined in QMS, i.e.

***Identify the configurable Items***

***Maintaining a proper directory structure along with the accessrights of team members in the folders.***

***Standardize the naming convention of the files***

***Version maintenance***

***Change Request management***

***VSS tool is used for configuration control like access control, baselining and release of CI***

**Retention Period of each CI**
1 year after CI is OBSOLETE
**Procedure for base lining a CI**
Microsoft VSS is used to manage all CIs
Procedure for moving to a new baseline is:
Doing Change Management on the CI
Send new version for approval to relevant stakeholders
On-approval, update CI Register to incorporate new version as baseline.

### 5.14 Metrication Plan

A Measure is a quantitative value that indicates some characteristic aspect(s) of a project, product, or process. Typically a ratio of measures (even a distribution data) is referred to as a metric. Through proper analysis of metrics data we can have better control over a project, product quality, or a process. It helps the management to react proactively rather than reactively. To achieve the desirable product quality and process performance, proper implementation of the metrication program of the organization is essential.

### Setting Control Limits

When metrics data are being analyzed and plotted in a Control Chart, control limits need to be set to facilitate setting the organizational goals. The guidelines for setting the control limits shall be as given below. Let us assume X is the mean and σ is the standard deviation. Then, $X \pm 3\sigma$ is used in the organization to set the control limit. 73 The following is a list of desirable metrics for use by the projects in the organization.

### a) Customer Satisfaction Index (CSI)

This metrics is used to identify the customer satisfaction level over a period of time and taking appropriate measure for improving, if any gap is perceived. N: Total number of questions answered in the questionnaires. S: Total number derived, adding all the points against each question answered.

**Formula**
(Total number derived, adding all the points against each question answered (S))/ (Total number of questions answered in the questionnaires)

**Source, frequency and format of data capture**

Source: Customer Satisfaction Survey Questionnaire
Frequency: Quarterly
Data Capture: Data is captured through the defined format: Customer Satisfaction Survey Questionnaire

**Frequency of metrics data reporting and analysis**
After every three months of a Project tenure and also End of each project

**Method of metrics data analysis**

The figure in an ideal world should be 100. Once this figure is reached it is established that the customer requirements is truly satisfied. The collected figures are to be plotted and the figure is lying outside the control limits of organization need to be performed appropriate exploration.

**Benefits**
Measures can be taken to improve the CSI in case it's tending towards unfavorable figure

**b) Effort Variance – Original**

This metric helps in finding out the overall effort slippage in a project as compared to the original estimated effort during the execution stage and at the end of the project.

**A**: Actual effort spent in the project CTD (Cumulative Till Date)
**O**: Original total estimated effort
**E**: Effort to complete the balance work
**Formula**
[{(A+E) – O} * 100] / O
**Source, frequency and format of data capture**
Source: Time sheet
Frequency: Monthly
Data Capture: Data is captured through the Project Status Report
**Frequency of metrics data reporting and analysis**
Month end

**Method of metrics data analysis**

The figure ideally should be zero, which will prove that project has been completed as per initial estimation. If the figure is falling outside the control limits of organization then estimation process / techniques needs to be revisited or other associated process followed during execution of the project is required to be analyzed.

**Benefits**
Necessary measure can be taken and appropriate reason can be established for satisfying organization goal. Also it helps out for setting up new control limits.

**c) Schedule Variance – Original**

This metrics is useful for finding out the overall schedule slippage of a project as compared to the originally estimated scheduled duration during the execution stage and at the end of the project. Calculation of Schedule Variance is tricky and can often be misleading. To calculate this metric during the execution stage of a project, one would need to consider only the latest completed activity on only the Critical Path in the project schedule and compare it with the originally planned schedule using the formula below.

For projects which are completed, the formula II may be used.

**Ac:** Actual date of completion of the latest completed activity on Critical Path.
**A:** Actual duration of the project
**O:** Originally estimated project duration
**Formula:**
(A – O)*100 / O
**Source, frequency and format of data capture**
Source: Project Schedule
Frequency: Monthly
Data Capture: Data is captured through the Project Status Report 76
Frequency of metrics data reporting and analysis
- Monthly
- Project end

**Method of metrics data analysis**

The figure preferably should be zero. Once this figure is arrived then it is confirmed that project is running as per the originally estimated schedule.
If the figure is outside the control limits of organization then processes followed during execution of the needs to be analyzed in detail.

**Benefits**
This is very much useful for taking any corrective action during the execution stage to avoid any overrun. Also it helps out for setting up new control limits of the organization.

**d) Average Defect density - Pre-Release & Post-Release**
This metric aims to measure the quality of the product before and after delivery to the customer.
There may be several metrics under this category. The typical classification is Average pre-Release Defect Density and Average post- Release Defect Density.
These may be further classified by the severity of the defects found, e.g.
Average pre-Release Defect Density – Critical Defects
Average pre-Release Defect Density – Major Defects
Average pre-Release Defect Density – All Defects

Average post-Release Defect Density – Critical Defects
Average post-Release Defect Density – Major Defects
Average post-Release Defect Density – All Defects
Nn pre-release: Total number of defects of severity n (n can be critical, major, minor) detected before release of a product.
Nn post-release: Total number of defects of severity n (n can be critical, major, minor) detected after release of a product.
S: Latest estimated or measured size of the software product.

**Formula**
Average pre-Release Defect Density – Critical Defects = ((Nn prerelease)* 100) /S, where Nn pre-release is measured for n = critical
Average pre-Release Defect Density – Total Defects = ((Nn pre-release)*100)/S, where Nn pre-release is measured for n = all defects i.e. critical + major + minor defects
Average post-Release Defect Density – Critical Defects = ((Nn postrelease)* 100) /S, where Nn post-release is measured for n = critical
Average post-Release Defect Density – Total Defects = ((Nn postrelease)* 100) /S, where Nn post-release is measured for n = all defects i.e. critical + major + minor defects

**Source, frequency and format of data capture**
Source: Test Log, Review Report
Frequency: Phase wise
Data Capture: Data is captured through the Project Status Report
**Frequency of metrics data reporting and analysis**
Project end
**Method of metrics data analysis**
The numbers ideally should be zero it can be plotted for analysis.

**Benefits**
Appropriate reason can be established for satisfying organization goal, if there is any deviation. This is used for setting up new control limits for improvement.

**e) Defect Severity Ratio**

This metric gives an indication of the proportion of defects of a particular severity type with respect to the total number of defects. A high proportion of defects of severity Fatal or Serious is a great cause of concern. Causal analysis is to be done by the Project Manager/Project leader and preventive actions are to be taken to minimize the defects (in addition to the required corrective actions).

**Formula**

Defect Severity Ratio of severity n = Number of Defects of Severity n /
Number of Defects where n can be Critical, Major or Minor

**Source, frequency and format of data capture**

Source: Review Report/Defect Log Sheet
Frequency: As and when data review/testing is conducted

Format: Project Status Report

**Frequency of metrics data reporting and analysis**

The frequency of Metrics data reporting and analysis will be phase end/Project end.

**Method of metrics data analysis**

Histogram needs to be plotted for Defect Severity Ratio.

**Benefits**

Organization wide corrective measures can be taken to minimize the critical defects and recurring major defects, which can lead to critical defects later.

Defect Removal Efficiency (DRE %)

This metric gives an indication of how much defect has been removed from the product so that minimum defects are carried forward to post deliver stage.

**Formula**

Overall Defect Removal Efficiency (DRE) %=
(Total Number of defects prior to delivery X 100)/Total No of defects (Pre delivery and post delivery)

It can also be calculated / done at the end of each phase.

**Source, frequency and format of data capture**

Source: Review report/Defect Log Sheet
Frequency: As and when data review/testing is conducted
Format: Project Status Report

**Frequency of metrics data reporting and analysis**

The frequency of Metrics data reporting and analysis will be phase end/Project end.

**Method of metrics data analysis**

- Defects prior to delivery: All defects identified before the product is released to the client.
- Defects post delivery: All defects reported after the release to client.

These defects may originate from any source but after analysis are 80 attributed to the base version. A period of 1 year, following the release, will be considered to capture this metric.

**For all Customization Projects**

- Defects prior to delivery: All customization defects identified before the product is accepted to

the client (External Client)

• Defects post delivery: All defects reported after the acceptance of client (External Client). These defects may originate from any source but after analysis are attributed to the customized version. A period of 1 year, following the release, will be considered to capture this data.

**Benefits**

This indicates that how much defects are being delivered to the customer, which were not detected and fixed before delivery. Organization should strive to achieve DRE of 100%.

**f) Review Effectiveness (RE) %**

This metric gives an indication of the efficacy of the Review process.

**Formula**

Review Effectiveness Ratio (RE) %=

(Total Number of defects found during all reviews X 100) / Total number of defects

**Source, frequency and format of data capture**

Source: Review Notes

Frequency: As and when data review/testing is conducted

Format: Project Status Report 81

**Frequency of metrics data reporting and analysis**

The frequency of Metrics data reporting and analysis will be phase end/Project end.

**Method of metrics data analysis**

Histograms for individual projects are plotted against TE. It is compared with the Process Capability Baseline and Organization Goal. It should approach to100%.

**Benefits**

It gives us the scope for improvement of the testing process.

**g) Test Effectiveness (TE) %**

This metric gives an indication of the efficacy of the testing process.

**Formula**

Test Effectiveness Ratio (TE) %=

(Total Number of defects found during testing X 100) / Total number of defects

**Source, frequency and format of data capture**

Source: Defect Log Sheet

Frequency: As and when data review/testing is conducted

Format: Project Status Report

**Frequency of metrics data reporting and analysis**

The frequency of Metrics data reporting and analysis will be phase end/Project end.

**Method of metrics data analysis**

Histograms for individual projects are plotted against TE. It is compared with the Process Capability Baseline and Organization Goal. It should approach to100%.

**Benefits**

It gives us the scope for improvement of the testing process.

**Table 6: Metrics for the project and the corresponding goals to be achieved**

| Sl. No. | Metric Name | Organization Goal | Project's Goal | Periodicity of analysis & Review | Reasons for Deviation from Organization's Goal, if any |
|---|---|---|---|---|---|
| 1 | Effort Variance | 10% | 10% | Monthly | |
| 2 | Schedule Variance | 15% | 15% | Monthly | |
| 3 | Defect distribution phase / release wise | TBD | TBD | Phase end | |
| 4 | Defect Rate / Pre-release | TBD | TBD | Phase end | |
| 5 | Defect Rate / Post-release | TBD | TBD | Phase end | |
| 6 | Review Effectiveness | TBD | TBD | Phase end | |

**Table 7: Effort Variance (MM %)**

| Budget | Consumed | Required | Variance (%) |
|---|---|---|---|
| 72.5 | 57.92 | 15 | 1.28 |

**Table 8: Mean Time Taken To Respond (MTTRSP)**

| Priority | No of Issues | MTTRSP (In Hours) | MTTRSP (In Days) |
|---|---|---|---|
| P1 | 0 | - | |
| P2 | 11 | 0.01 | 0.00 |
| P3 | 17 | 0.02 | 0.00 |
| P4 | 6 | 0.02 | 0.00 |

**Table 9: Mean Time taken To Solve (MTFB)**

| Priority | No of Issues | MTFB (In Hours) | MTFB (In Days) |
|---|---|---|---|
| P1 | 0 | - | |
| P2 | 11 | 32.7 | 1.36 |
| P3 | 17 | 107.93 | 4.50 |
| P4 | 6 | 113.22 | 4.72 |

**Table 10: Defect Rate**

| | CR Effort (MM) | Critical | Major | Minor | Critical Rate | Total Rate | RE (%) | TE (%) |
|---|---|---|---|---|---|---|---|---|
| Testing | 4.63 | 0 | 2 | 3 | 0 | 2.59 | 58.33 | 41.67 |

**Table 11: Defect Rate (Post-release)**

| Defect Rate (Post-release) | | |
|---|---|---|
| No. of Defect Post-delivery | Total Effort Spent till Date | Defect Rate (%) |
| (DPS) | (TE) | (DPS/TE) |
| 8 | 206.28 | 0.038782238 |
| | | |
| | | |

**Table 12: Defect Rate (Pre-release)**

| Defect Rate (Pre-release) | | |
|---|---|---|
| No. of Defect Pre-delivery | Total Effort Spent till Date | Defect Rate (%) |
| (DPR) | TE | (DPR/TE) |
| 296 | 206.28 | 1.434942796 |
| | | |
| | | |

**Table 13: Defect Distribution (phase wise)**

| Phase | Critical Defects | Major defects | Minor Defects | # of Defects | Total # of Defects | % Distribution of defect |
|---|---|---|---|---|---|---|
| *(Phase when Defect Detected)* | | | | *(Number of defects Detected - N)* | *(Total Defects over all phases - T)* | *(N/T)*100* |
| | | | | | | |
| SOW/FR | 0 | 0 | 0 | 0 | 304 | 0% |
| FS | 0 | 0 | 0 | 0 | | 0% |
| Designing | 0 | 0 | 0 | 0 | | 0% |
| Development (Coding) | 0 | 0 | 0 | 0 | | 0% |
| SI/Functional Testing | 1 | 4 | 170 | 175 | | 58% |
| Release | 2 | 1 | 5 | 8 | | 3% |

**Table 14: Pre-Shipment Defect Severity Ratio**

| Defect Severity | # of Defects - n | Total # of Defects - N | Defect Severity Ratio - (n*100)/N |
|---|---|---|---|
| | | | |
| Critical | 1 | 16 | 6.25% |
| Major | 5 | | 31.25% |
| Minor | 10 | | 62.50% |
| | | | |

**Table 15: Post-Shipment Defect Severity Ratio**

| Defect Severity | # of Defects - n | Total # of Defects - N | Defect Severity Ratio - (n*100)/N |
|---|---|---|---|
| | | | |
| Critical | 1 | 16 | 6.25% |
| Major | 5 | | 31.25% |
| Minor | 10 | | 62.50% |
| | | | |

**Table 16: Total Defect Severity Ratio**

| Defect Severity | # of Defects - n | Total # of Defects - N | Defect Severity Ratio - (n*100)/N |
|---|---|---|---|
| | | | |
| Critical | 7 | 96 | 7.29% |
| Major | 34 | | 35.42% |
| Minor | 55 | | 57.29% |
| | | | |

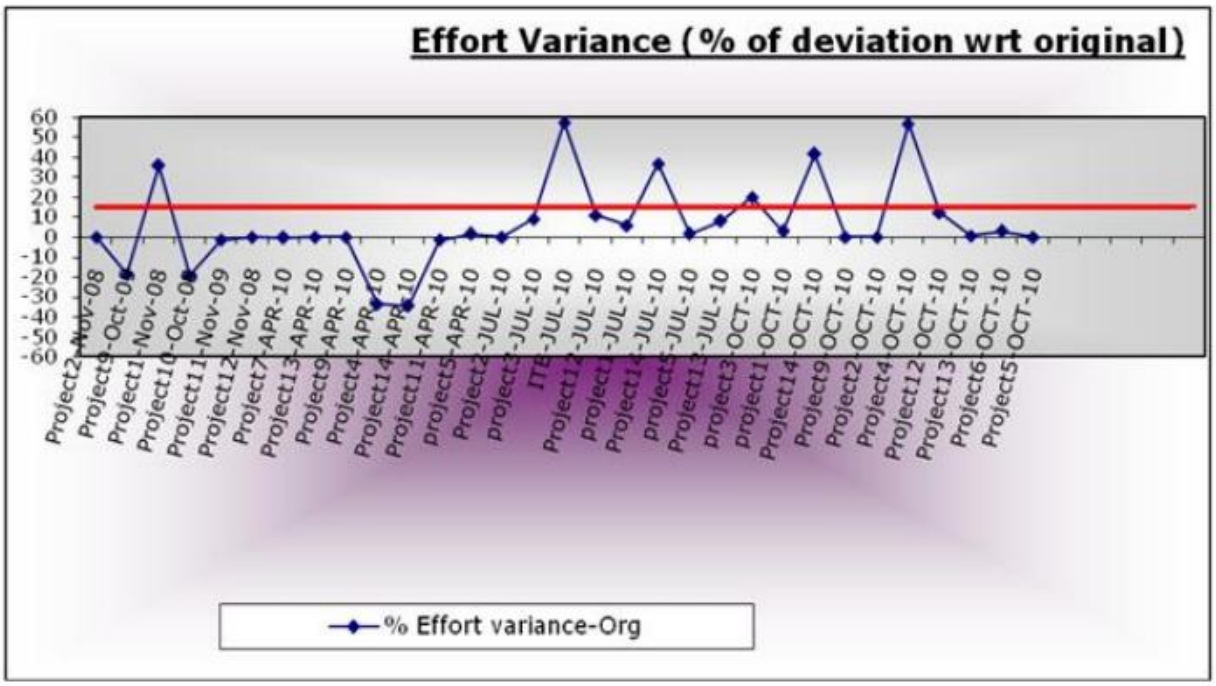



**Figure 06: Compare Effort Variance**

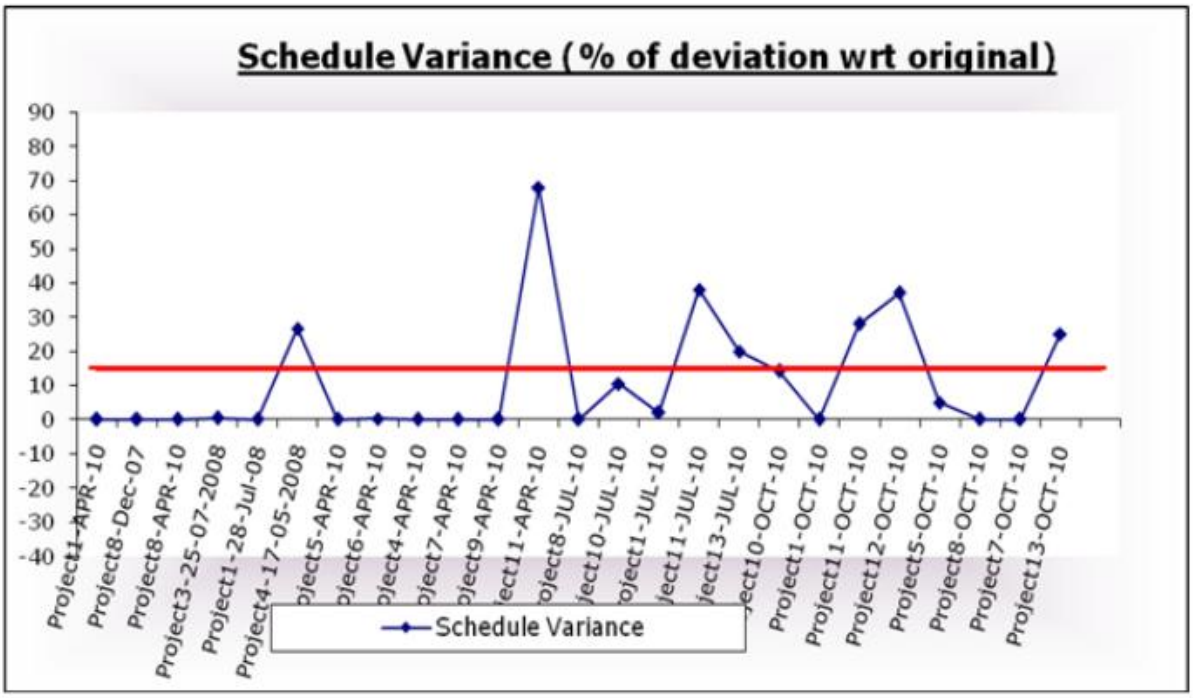



**Figure 7: Compare Schedule Variance**

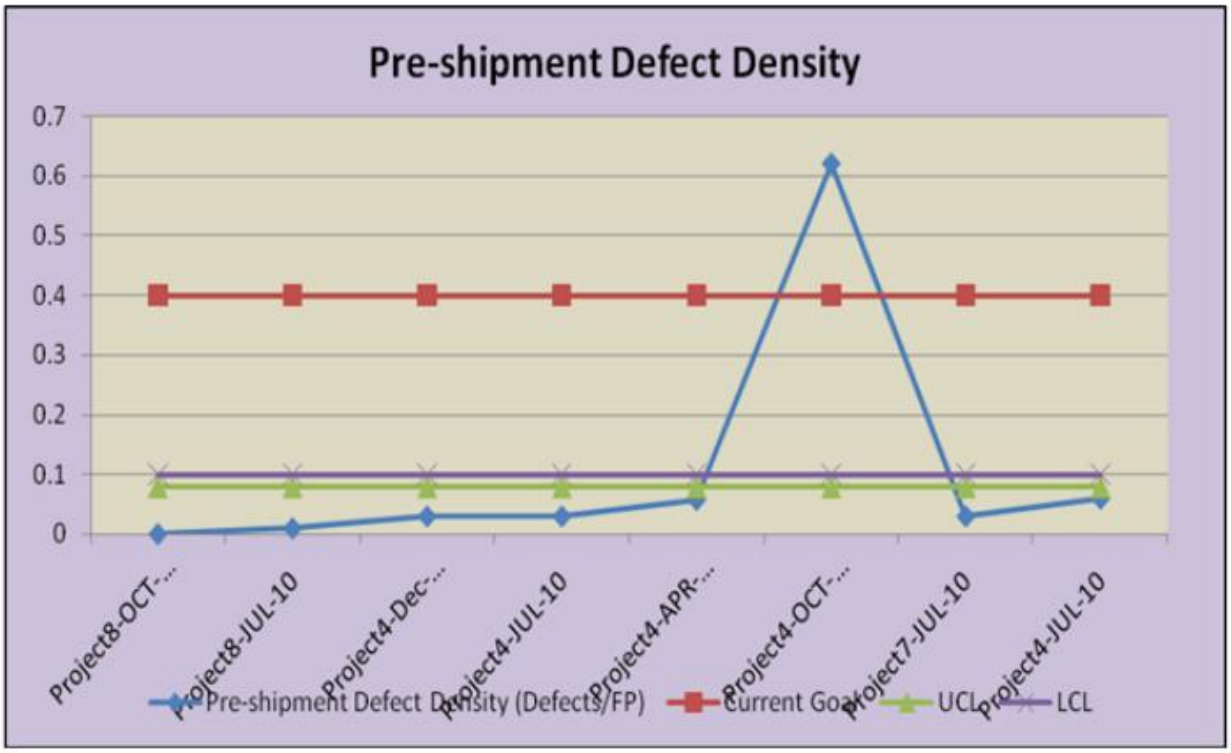



**Figure 8: Compare Pre-Shipment Defect Density**

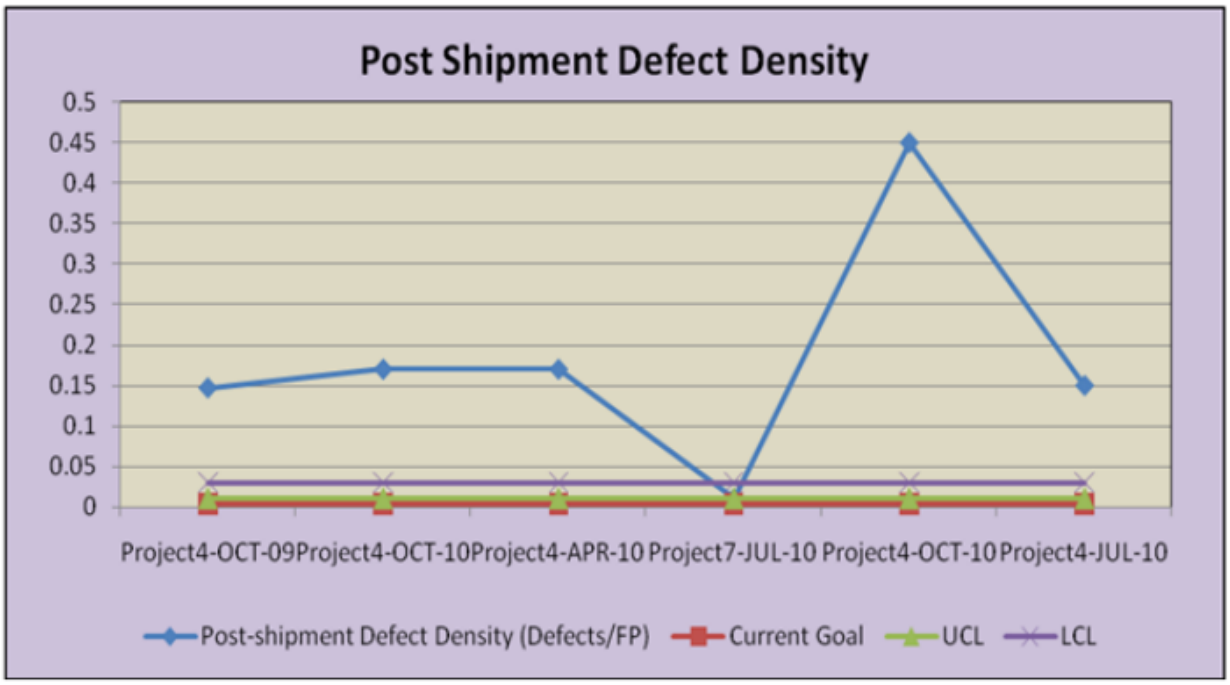



**Figure 9: Compare Post-Shipment Defect Density**

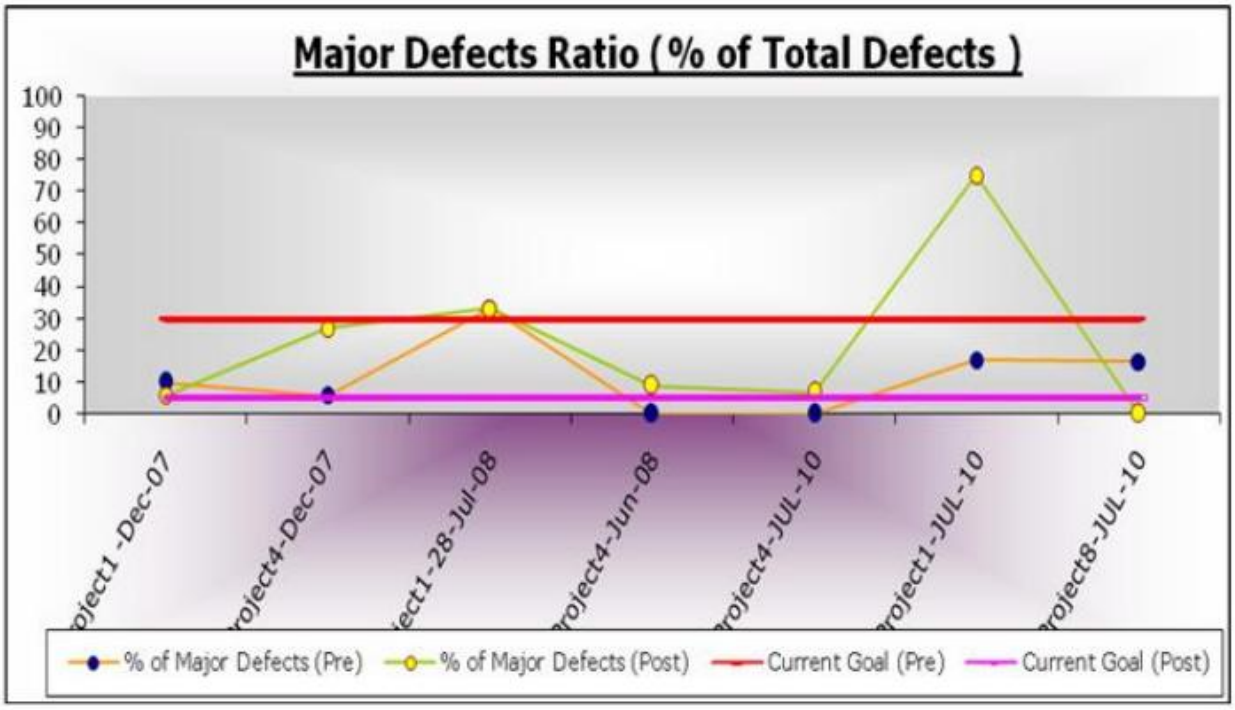



**Figure 10: Compare Major Defect Ratio**

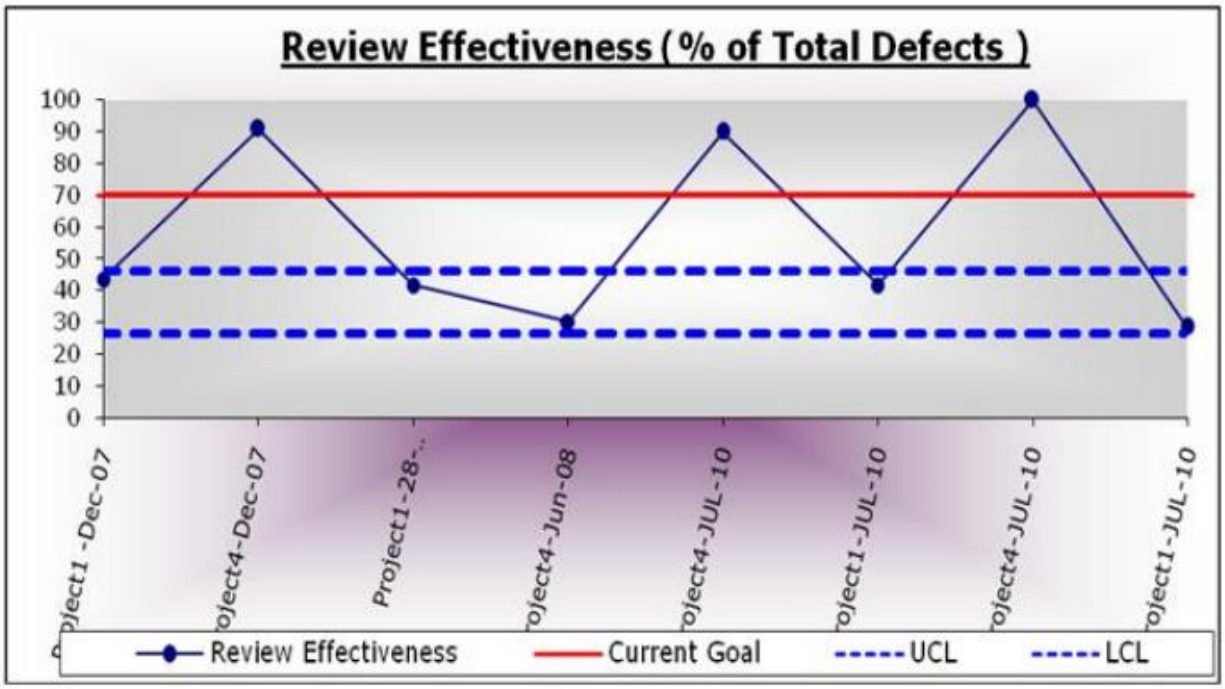



**Figure 11: Compare Review Effectiveness**

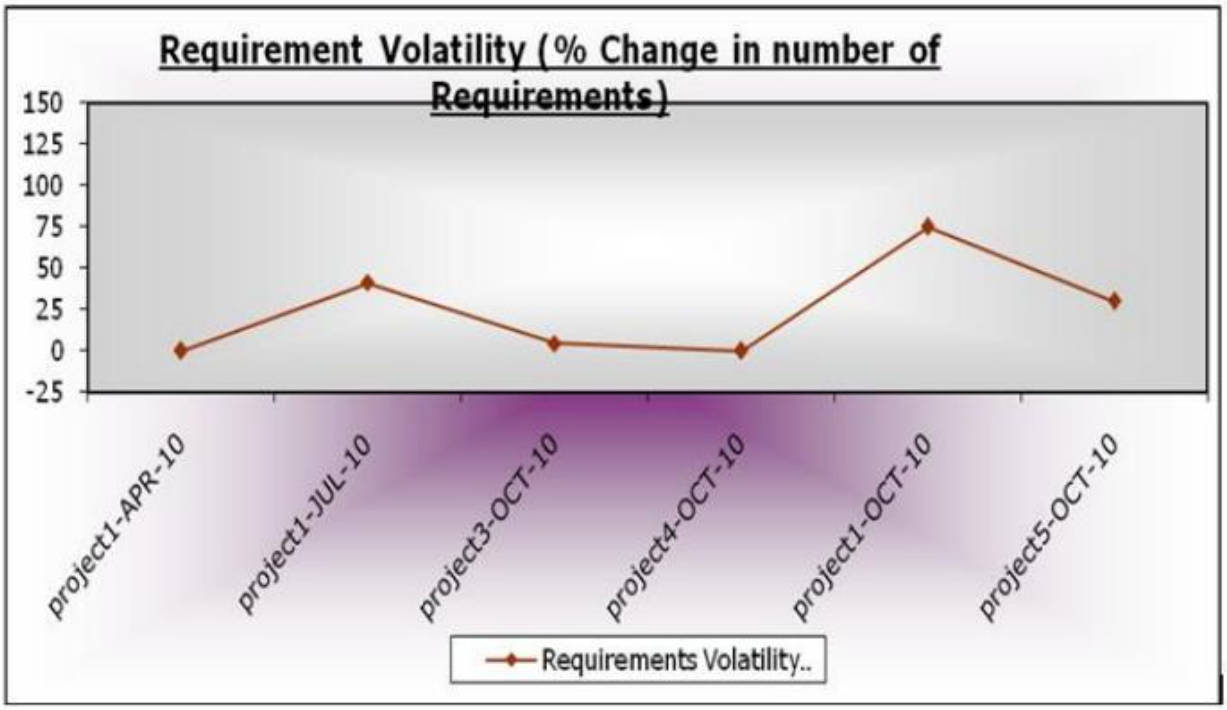



**Figure 12: Compare Requirement Volatility**

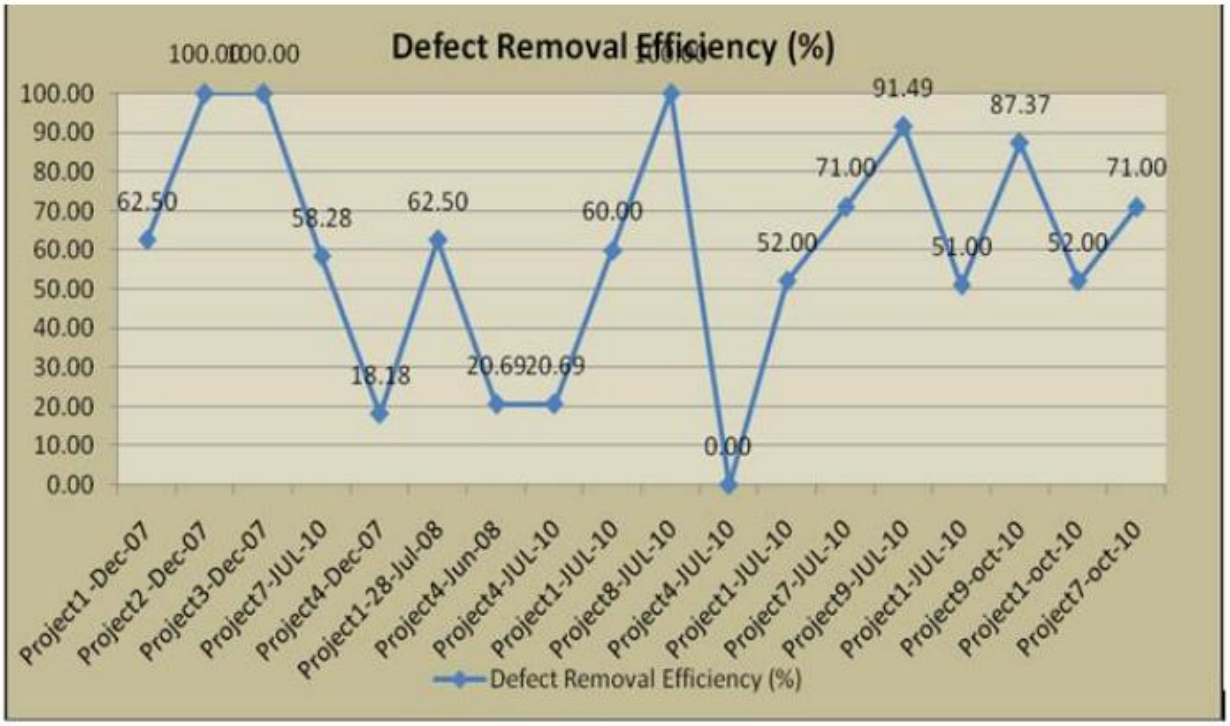



**Figure 13: Compare Defect Removal Efficiency**

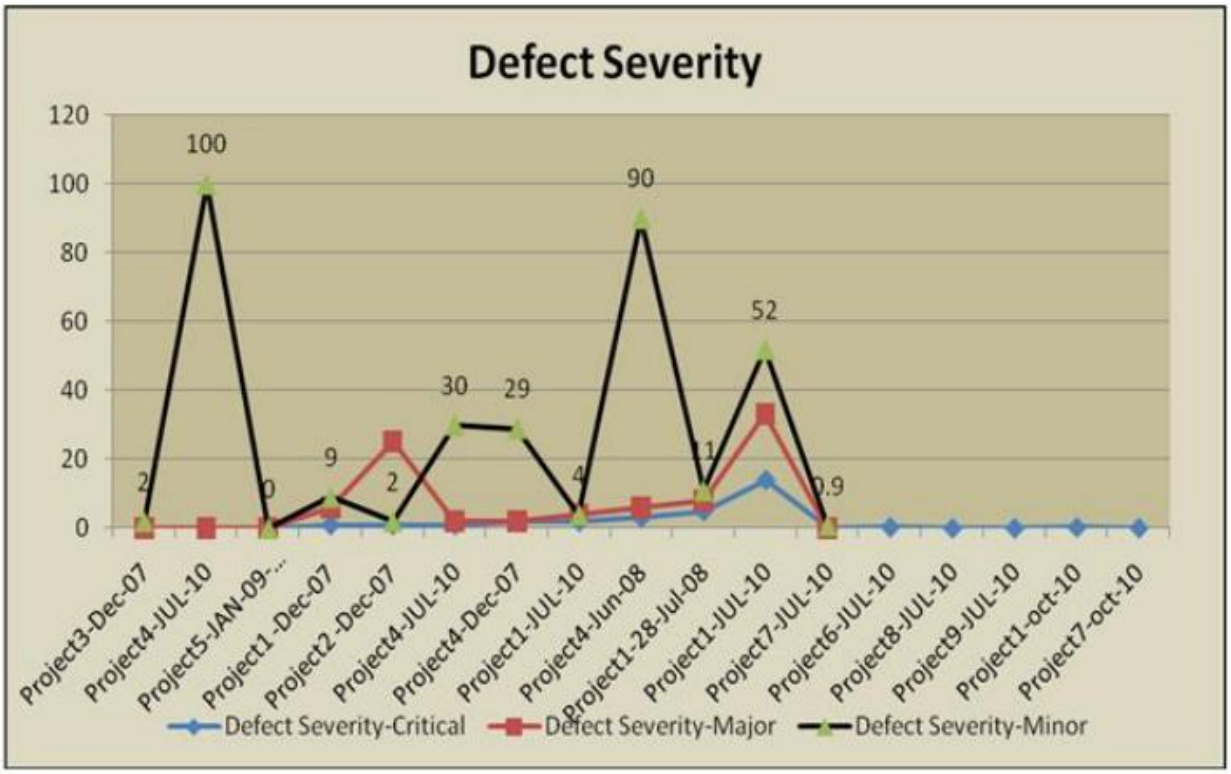



**Figure 14: Compare Defect Severity**

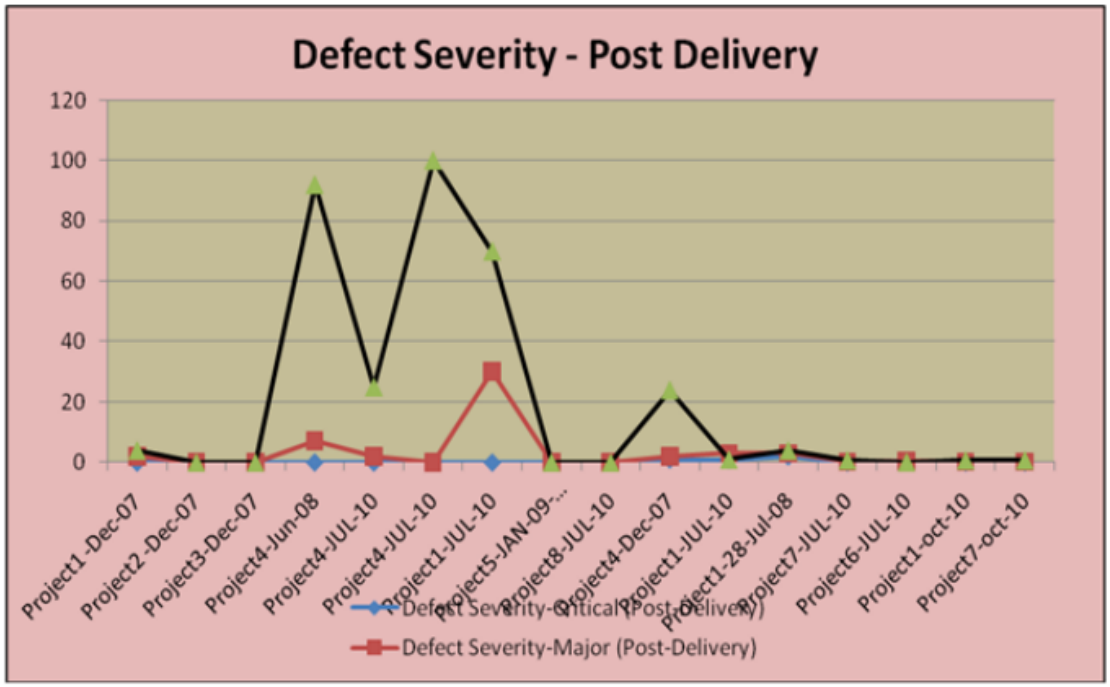



**Figure 15: Compare Defect Severity – Post Delivery**

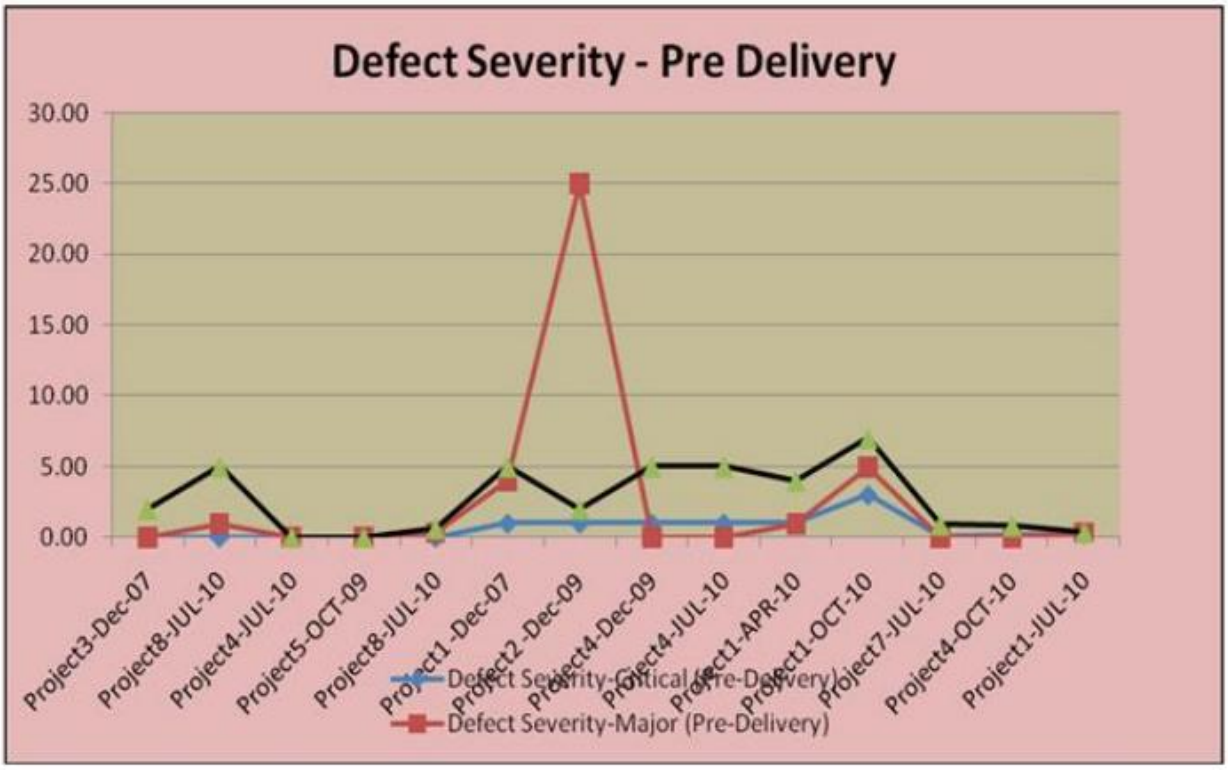



**Figure 16: Compare Defect Severity – Pre Delivery**

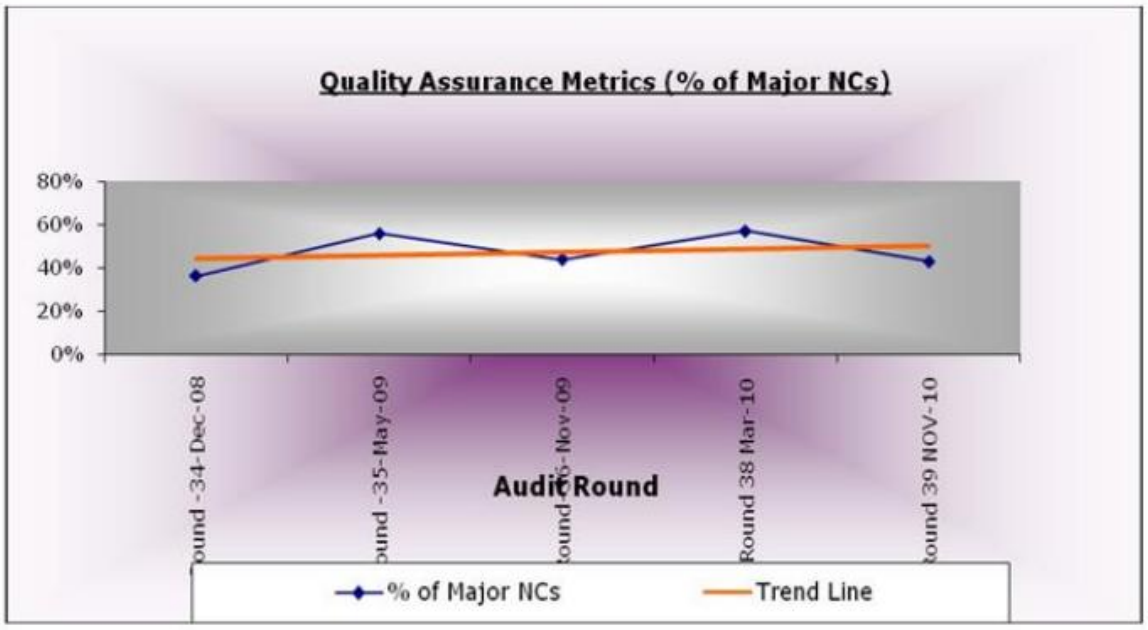



**Figure 17: Quality Assurance Metrics for different quarters**

## Analysis of Data

The goal of this Journal was to analyze current and future trends of the allied management disciplines that influence the sustainability of supporting from anywhere without bothering about any boundary. We asked project managers, team members and different stake-holders about the availability of knowledge and the potential impact of allied disciplines on project management. We were able to assess where the allied disciplines currently stand in terms of availability and impact as well as make predictions about the future. The thoughts and visions collected from this research provide valuable insights for identifying trends in the allied disciplines and their impact on the future of project management, as well as opportunities, challenges, and obstacles. Mainly different types of risks, metrics data related to effort, schedule, and different types of defects are analyzed to understand the performance of the project and try to find out the areas of improvement.

- A lack of standardization has been clearly understood to be existing in the project oriented organizations, which can be critical in time of perfect competitive scenario.

- Furthermore, the target being drawn by a typical project management team is often arbitrary (as no well defined industry guidelines could be identified in this context). This often creates to misunderstanding among the various project teams resulting in higher chances of time over-run.

- There is no serious effort to eradicate the "root causes". Though the teams are found to be hundred percent concerned about the efficacy of the end result (deliverables) but none are serious about the "defects" which are resultant by product.

- No standard risk registers/metric registers are available for different types of projects executed in the organization (as observed).

- Technological limitation (state-of-the-art) has been found to be existing within the organization which happens to be a problem in itself.

## 7.0 Conclusion & Recommendation

This paper clubbed with the field research provided a list of best practices/standards that can help improve in the success of a **Secure Border Less Environment**. By following these best practices, IT-Industries have a better chance of completing their project successfully. All the managers' have to know the recent trends in the project management in order to apply them to his problem solving methodology. A 94 problem may lead to another problem if not addressed properly. The focus should be to understand and follow these trends to tackle similar IT solution models today and tomorrow.

**Recommendation for further improvements**

**•Take actions on findings**

Root causes are identified for each and every defect but there is no evidence to rectify them. If PDCA Analysis and Resolution [CMMI ML5process] can be followed to identify causes of defects and other problems and take action to prevent them from occurring in the future, then the project can be managed even in better way to make it ultimate success. Here, Fish bone diagram can be used to find out the direction of exact root cause with cause & effect analysis by a brain storming session.

**•Availability of standard registers**

At present there is no standard risk register/metric list available for different types of projects executed in the organization. In most of the cases, Project managers are confused during selection of different risks/metrics for their project to measure the performance of different

activities. So, brain storming session is must and a pre-requisite activity once a new project is started in the organization.

**•Budget must be directly linked with effort**

There is no link of budget with estimated effort (in the above mentioned research data parametric). Hence, it has been observed that effort and budget were having a clear and logical gap. To take this into concern the above mentioned process needs to be given a relook and thought. Both 95 are maintained separately. If any effort variance occurred during execution of the project, there is no proper visibility of profit/loss to the Sr. management. MS-Project can be used to do this activity.

**•Go for CMMI Level 5 implementation**

The organization is certified for CMMI Level 3. There are some important processes & key practices available in CMMI Level 5 which can be used in all projects of the organization to control & monitor them in better way.

**•Synchronize Organization Goal with Industry Goal.**

There is no proper visibility of setting organization goal for each & every metrics with the goal setting by similar kind of industry. It would not be a case of over statement or mollified statement to state that the industry benchmark is clearly elusive so far as this research is concerned. The industry benchmark not being available had to be clearly ignored which might create some variable differences with that of the organization goal as well as industry goal. Therefore, it should be synchronized with other industries in equal aspect. In some cases project goal as well as organizational are not yet set.

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