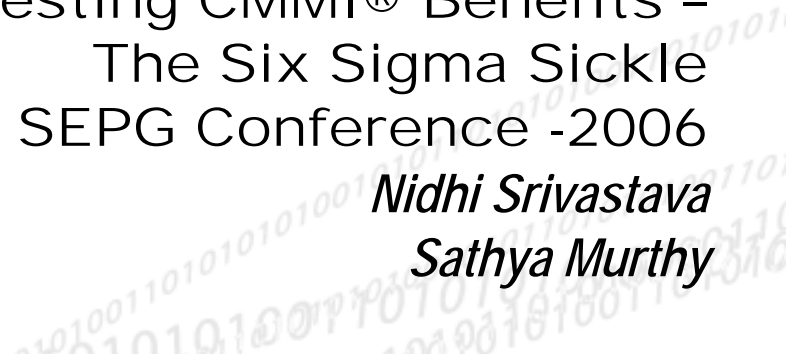


Harvesting CMMI® Benefits – The Six Sigma Sickle SEPG Conference -2006

Nidhi Srivastava
Sathya Murthy

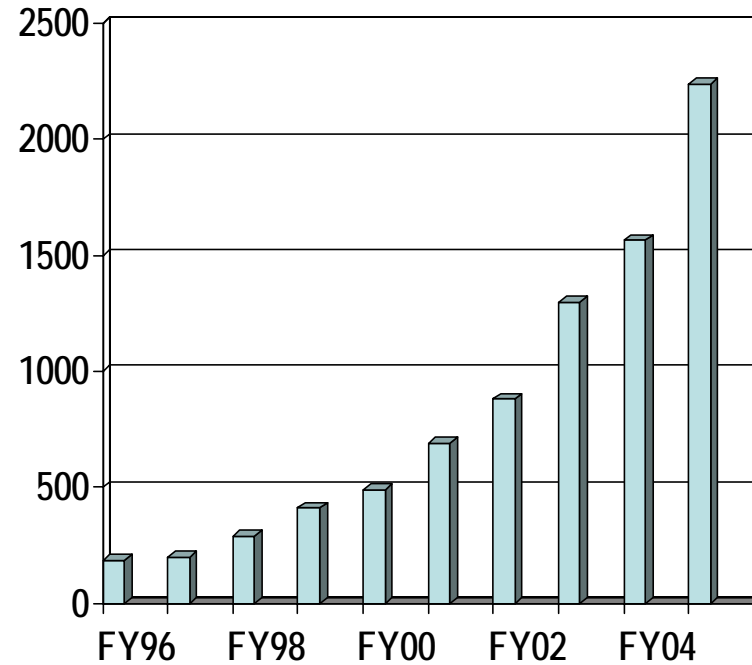


value infinite

Key Facts About Tata Consultancy Services (TCS)

- Established in 1968
- U.S. offices established in 1979
- More than 45,000 associates globally, with more than 9,000 in the U.S.
- FY 2004-2005 revenues of \$2.24 B (60% coming from North America)
- Publicly-held – Market cap of approx. \$12 B
- Global presence – Operations in 32 countries, 153 offices across the globe
- More than 50 locations in the U.S.

TCS Revenues in US \$ Millions

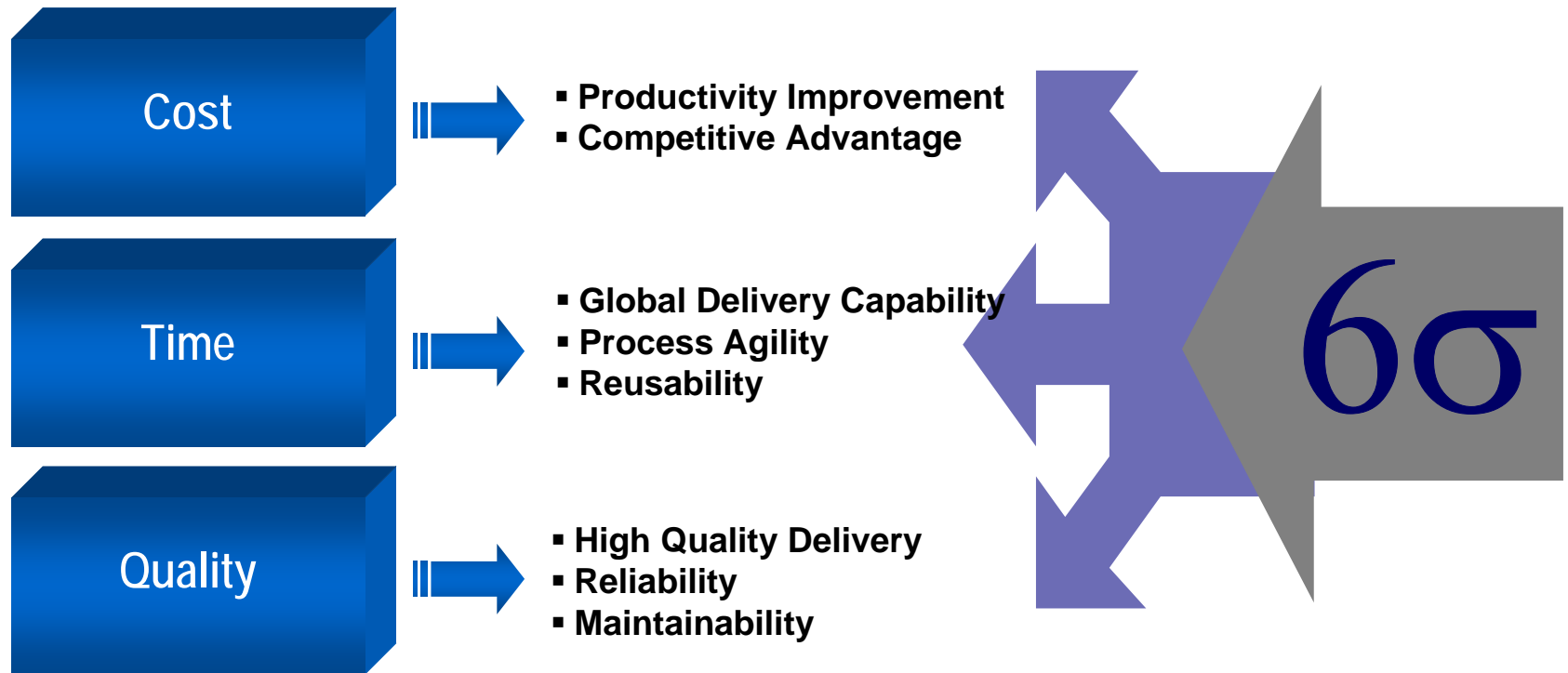


* All Figures as of April 19, 2005

“TCS has the size and reach unlike any other Indian software company.”

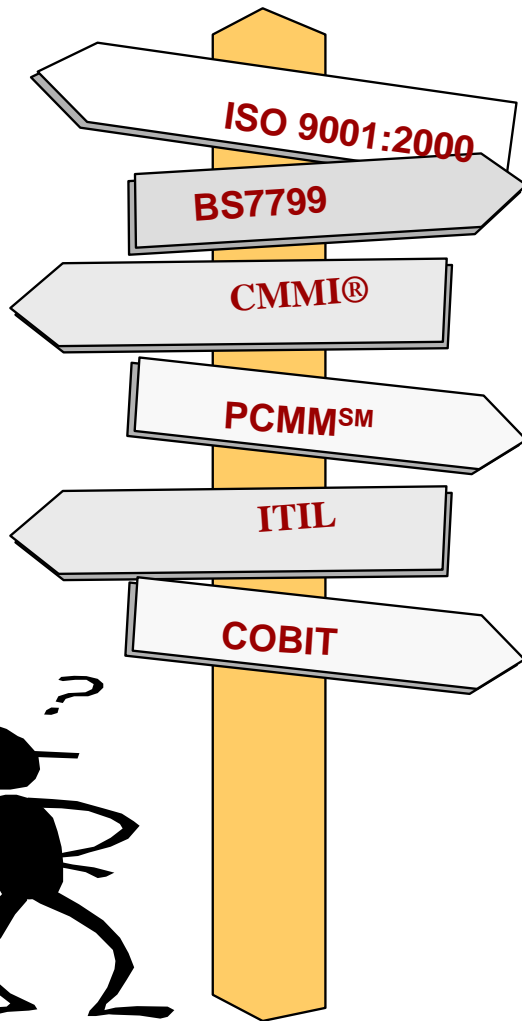
The Wall Street Journal – June 30, 2004

The Business Case for Process Improvement @ TCS – WHY



$$y = f(x)$$

The Critical Decision : Organization Process Framework

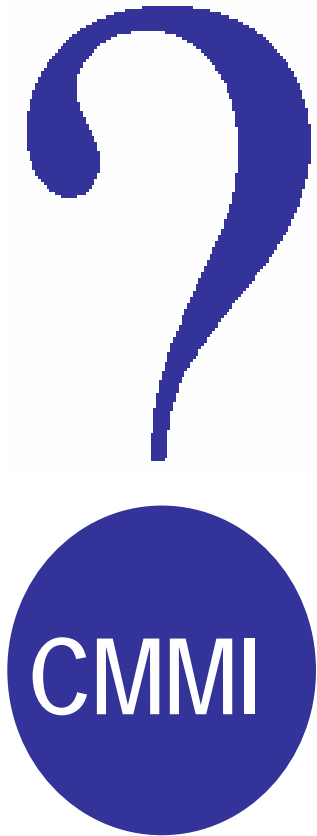


Factors for Framework Selection*	
General: Geographic Origin/ Spread Scientific Origin Development/ Stability Popularity Software Specific Prescriptive/ Descriptive Adaptability	Process: Assessment Assessor Process Improvement method Improvement Initiation Improvement Focus Analysis techniques
Organization: Actors/ Roles/ Stakeholders Improvement Focus Analysis techniques	Quality: Quality Perspective Progression

**Source: A Taxonomy to Compare Software Process Improvement Frameworks, 12th International Conference on Software Quality*

Best of People and Technology cannot guarantee best of the Products and Services unless the Processes are Effective

Why CMMI works for TCS

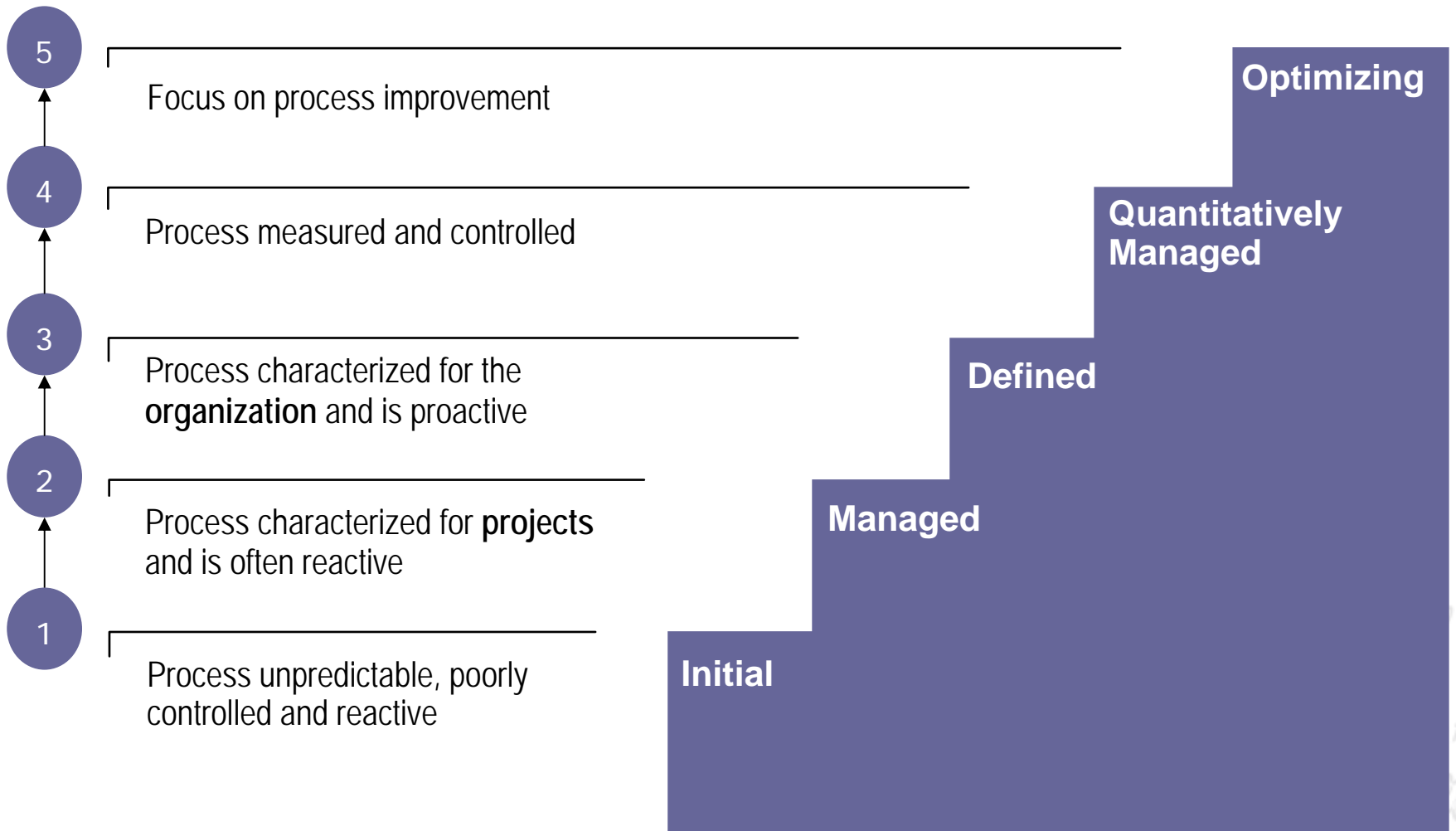


- Most endorsed benchmark for a process industry
- Focuses on ability to manage the development, acquisition, and maintenance of products and services
- Facilitates enterprise-wide process improvement
- Provides a consistent, enduring framework that accommodates new initiatives
- Comprehensive framework providing a clear roadmap to develop and optimize processes
- Can be adapted along with other Quality Models: ISO, TBEM, PCMM

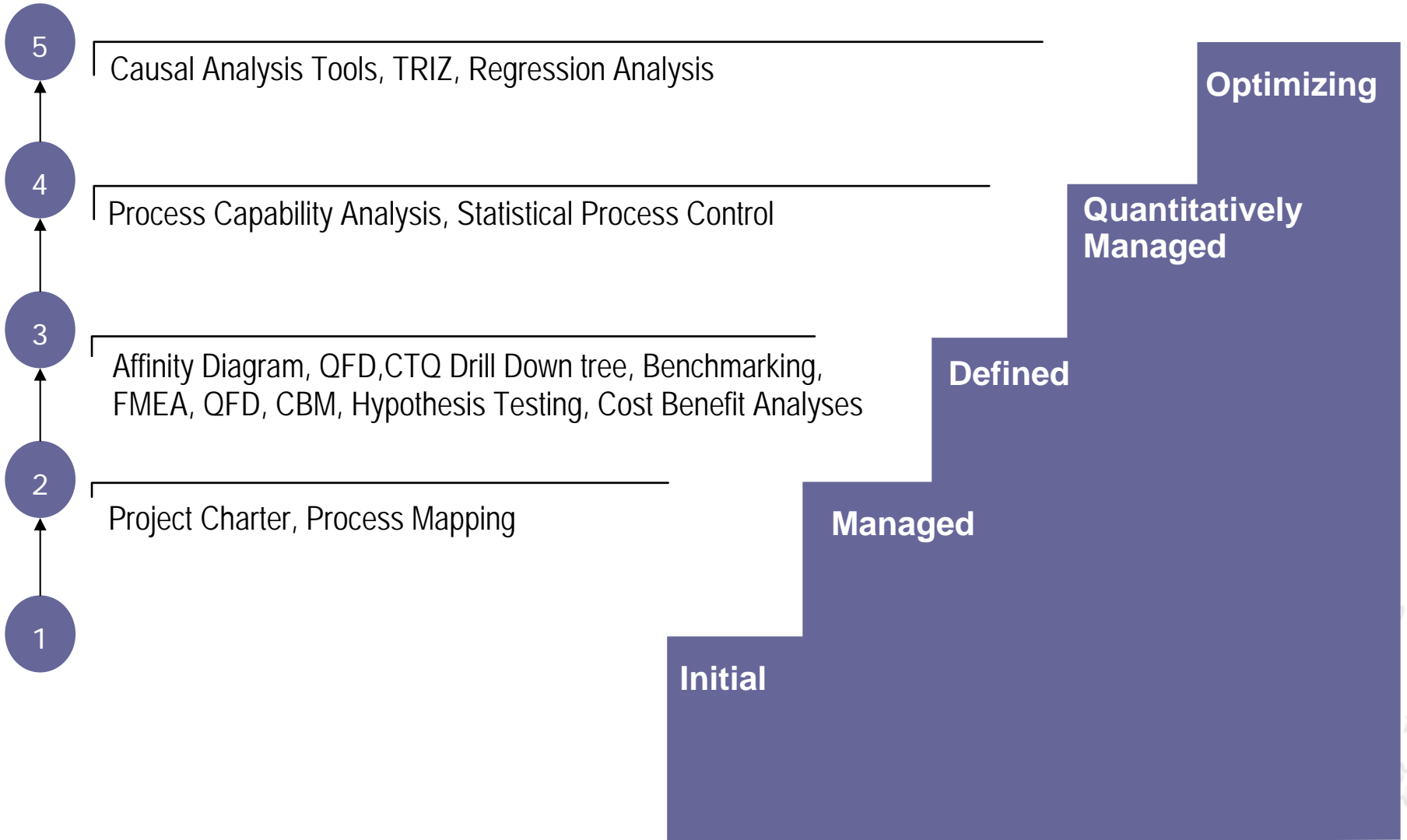
Capability Maturity Model and CMM®, CMMI® are registered in the US Patent and Trademark office by Carnegie Mellon University.
PCMM, SCAMPI and SEI are service marks of Carnegie Mellon University.

CMMI Maturity Levels

TCS has been assessed Enterprise wide to be operating at CMMI Level 5 in Sep 2004



Six Sigma Sickle : The Rigor for Success



Strategic Challenges @ TCS

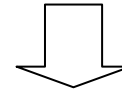
1. Accelerating Customer Acquisition

2. Building a Culture of Ownership, and Empowerment

3. Seamlessly integrating organizational processes

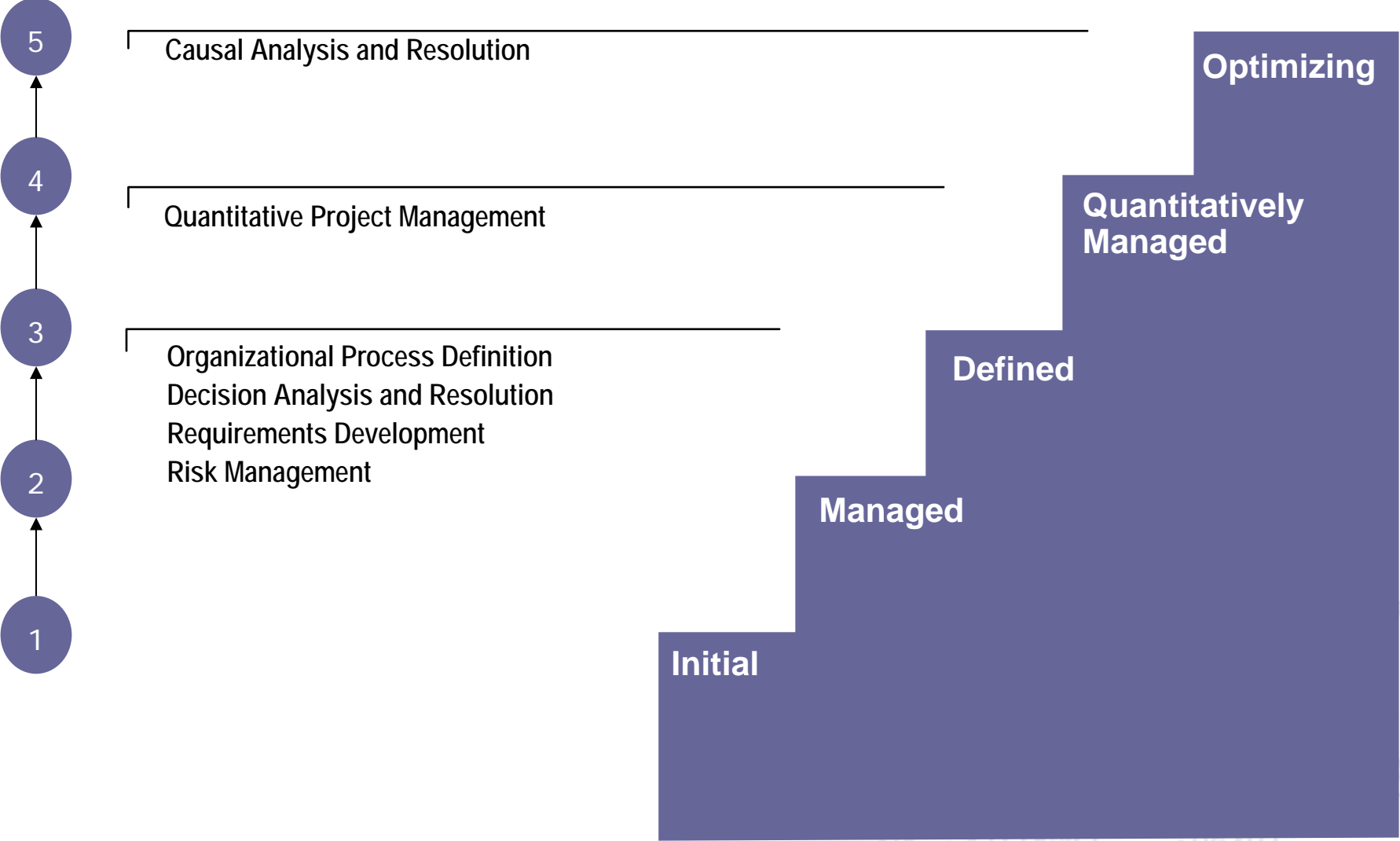
4. Accelerating Revenue Growth and Sustaining Profitability in the long term

- Bring in Customer driven excellence mind set
 - Customer Satisfaction Level
 - Customer Referral
- Quality in deliverables, do it first time.. Every time
 - Cost of Quality



Quality Framework - iQMS

CMMI know "WHAT"



CMMI know “WHAT” → Six Sigma know “HOW”

But do you know
how to do this?

Six Sigma tells
you How

“What”s of CMMI

- Causal Analysis and Resolution
- Quantitative Project Management
- Organizational Process Definition
- Risk Management
- Decision Analysis and Resolution
- Requirements Development

Know How with Six Sigma

- Ishikawa, Pareto Chart
- Control Charts
- Process Mapping
- Failure Mode Effect Analysis, PPA
- Criteria Based Matrix
- Affinity Diagram, QFD

Together, Six Sigma and CMMI help organizations improve marketplace competitiveness and achieve business goals faster

CMMI know “WHAT” → Six Sigma know “HOW” : Example

CMMI Process Areas (Example)

Causal Analysis and Resolution

PA of Maturity Level 5

The purpose of Causal Analysis and Resolution is to identify causes of defects and other problems and take action to prevent them from occurring in the future

Specific Goals

SG 1: Determine Causes of Defects

SG 2: Address Causes of Defects

Applicable Six Sigma Tools (Example)

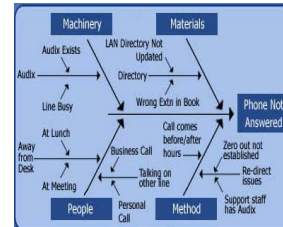
Ishikawa / Fishbone diagram

What is a Ishikawa Diagram?

A visual tool used to brainstorm and logically organize possible causes to address a specific problem or effect

How it is relevant?

Ishikawa Diagram helps addressing SG1 of Causal Analysis and Resolution as it helps in identifying the root causes



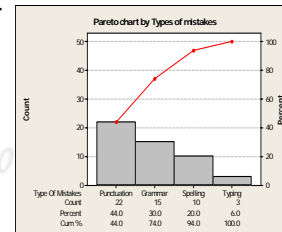
Pareto Chart

What is a Pareto?

Pareto chart is a vertical bar graph where a series of bars whose heights reflect the frequency or impact of problems are arranged in descending order of height from left to right

How it is relevant?

Pareto Chart helps addressing the PA Causal Analysis and Resolution as it helps in identifying the vital causes responsible for 80% of the defects.



CMMI know "WHAT" → Six Sigma know "HOW" : Example

CMMI Process Areas (Example)

Quantitative Project Management

PA of Maturity Level 4

The purpose of the Quantitative Project Management process area is to quantitatively manage the project's defined process to achieve the project's established quality and process-performance objectives

Specific Goals

- SG1: Quantitatively Manage the Project
- SG2: Statistically Manage Sub-process Performance

Applicable Six Sigma Tools (Example)

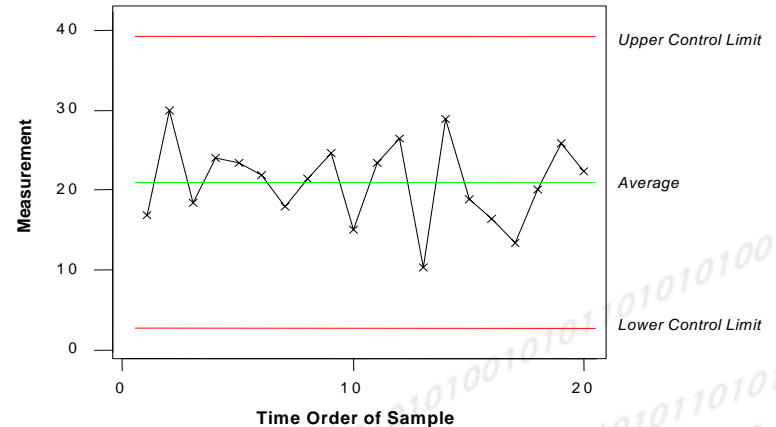
Control Charts

What are Control Charts?

A control chart is a graphical plot of a parameter over time used to identify special cause (assignable) variations and to make adjustments to the process being monitored.

How it is relevant?

Control Charts are the primary tools used for Statistical process Control and hence can be used to achieve the Specific Goal 2 of the PA Quantitative Project Management



CMMI know “WHAT” → Six Sigma know “HOW” : Example

CMMI Process Areas (Example)

Risk Management

PA of Maturity Level 3

The purpose of Risk Management is to identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

Specific Goals

- SG 1: Prepare for Risk Management
- SG 2: Identify and Analyze Risks
- SG 3: Mitigate Risks

Applicable Six Sigma Tools (Example)

Potential Problem Analysis (PPA)

What is PPA?

The potential-problem analysis method is designed to provide a challenging analysis of a developed idea or action in order to pre-empt any potential for going wrong

How it is relevant?

PPA helps in addressing the specific SG2 of Risk Management as it:

- lists possible causes for each potential problem
- develops preventive actions and contingency plan

Failure Mode Effect Analysis (FMEA)

What is FMEA?

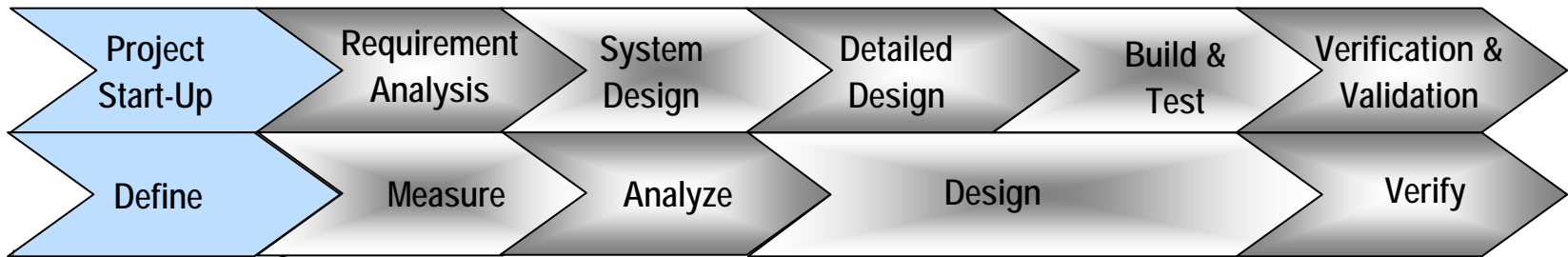
A tool to identify failure modes of a process or product, estimate the risks (severity, occurrence and detection) and prioritize actions to be taken

How it is relevant?

FMEA helps in achieving the specific goals of Risk Management PA as it:

- identifies potential failure modes and rates the severity of their effect
- offers an objective evaluation of the occurrence of causes and the ability to detect when those causes occur
- ranks the order of potential product and process deficiencies
- focuses on eliminating product and process concerns

Integrating Six Sigma with iQMS - Project Start Up



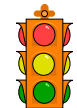
Deliverables :
 > Task Order
 > Project Plan

Pre-Start Up

Project Start Up

Project Planning and Management

Exit Criteria



Go

- ✓ Project Plan Released
- ✓ Work Order Authorized
- ✓ Signed Task Order

Six Sigma Tools

- COPIS
- Project Charter
- MGPP

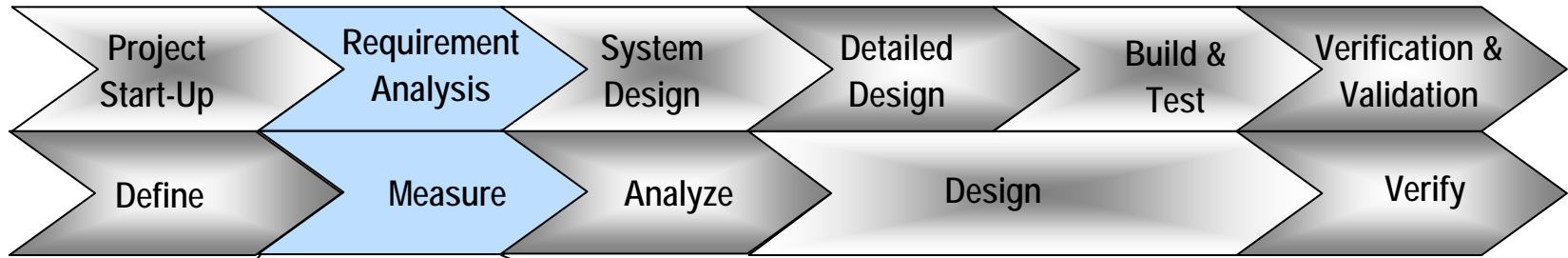
Templates

- Project Plan Template
- Status report Template
- Project Monitoring Review Report Template

Checklists

- Project Start Up Checklist
- Review Report for Contract
- Project Plan Review Checklist

Integrating Six Sigma with iQMS - Requirement Analysis



Deliverables :

- System Requirement Specification (SRS)
- Updated Project Plan



Six Sigma Tools

- Affinity Diagram
- QFD
- CTQ Drill Down Tree

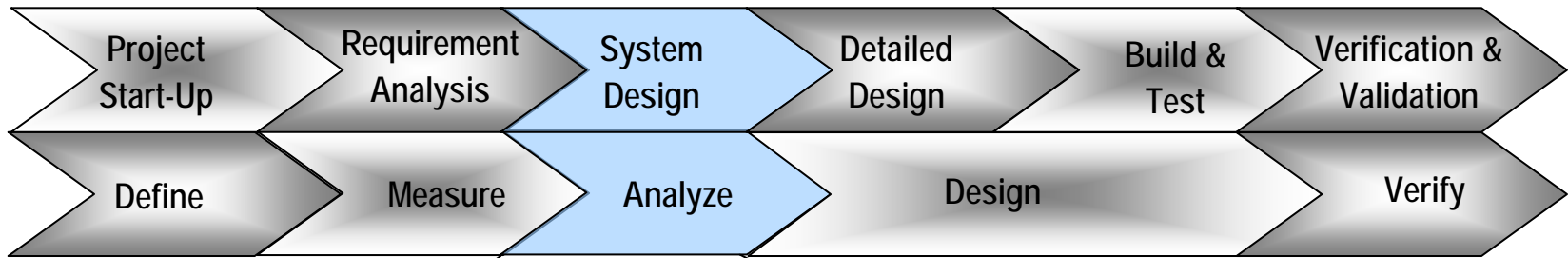
Templates

- Traceability Matrix Template
- System Requirement Specifications Template

Standards and Checklists

- Requirements Standards

Integrating Six Sigma with iQMS - System Design



- Deliverables :**
- High Level Design (HLD)
 - Usability Plan
 - Prototype

High Level Design Concepts

Design Specifications

Design Capability

- Exit Criteria
- ✓ HLD Released
 - ✓ Usability Plan Released
 - ✓ Reviewed prototype



Six Sigma Tools

- Use Cases
- Structure Diagrams
- Pugh Matrix
- Risk assessment

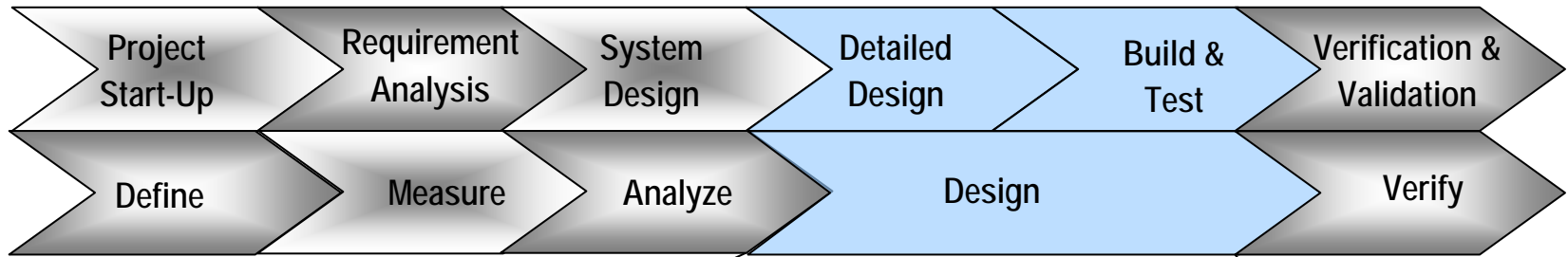
Templates

- Traceability Matrix Template
- Design Template

Standards & Checklists

- Standards for Design

Integrating Six Sigma with iQMS - Design, Build & Test



Deliverables :

- Low Level Design (LLD)
- Unit Test Plan (UTP), Unit Test Specifications (UTS)
- System Test Plan (STP), System Test Specifications (STS)
- Code



Develop Detailed Design

Test Plan

Construction and Testing

- Exit Criteria**
- ✓ LLD Released
 - ✓ UTP, UTS Released
 - ✓ STP, STS available
 - ✓ Reviewed and unit tested code

Six Sigma Tools

- Control Impact Matrix
- Cost Benefit Analysis
- Design of Experiments
- Simulation and Modeling
- FMEA
- Validation Plans

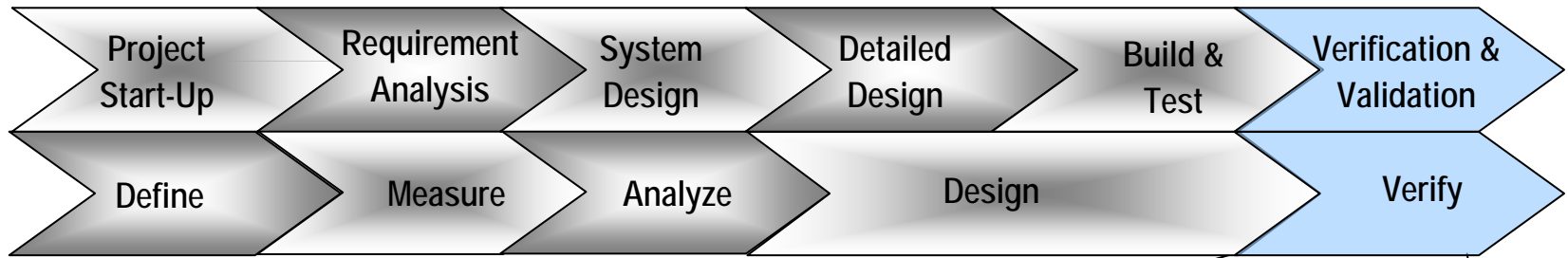
Templates

- Traceability Matrix Template
- Low Level Design Template
- Test Plan Template

Standards and Checklists

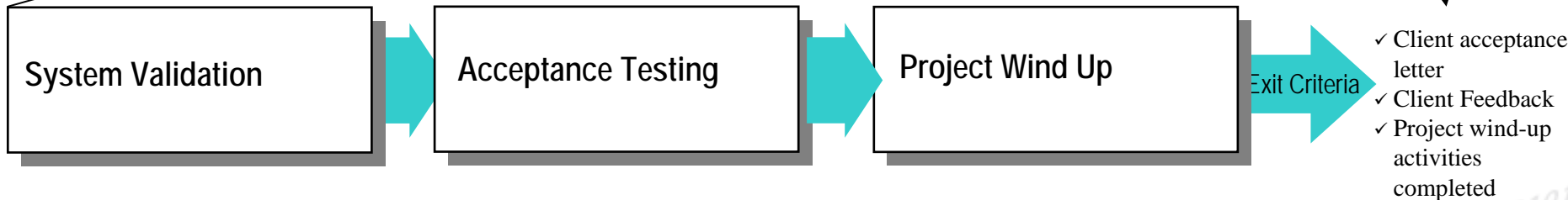
- Standards for Design
- Coding Standards
- Code Review Checklists
- Final Inspection Checklist

Integrating Six Sigma with iQMS - Verification & Validation



Deliverables :

- Acceptance letter from Client
- Client Feedback
- Project Wind-up Note



Six Sigma Tools

- Risk Management
- FMEA
- Control Charts
- Process Management Charts

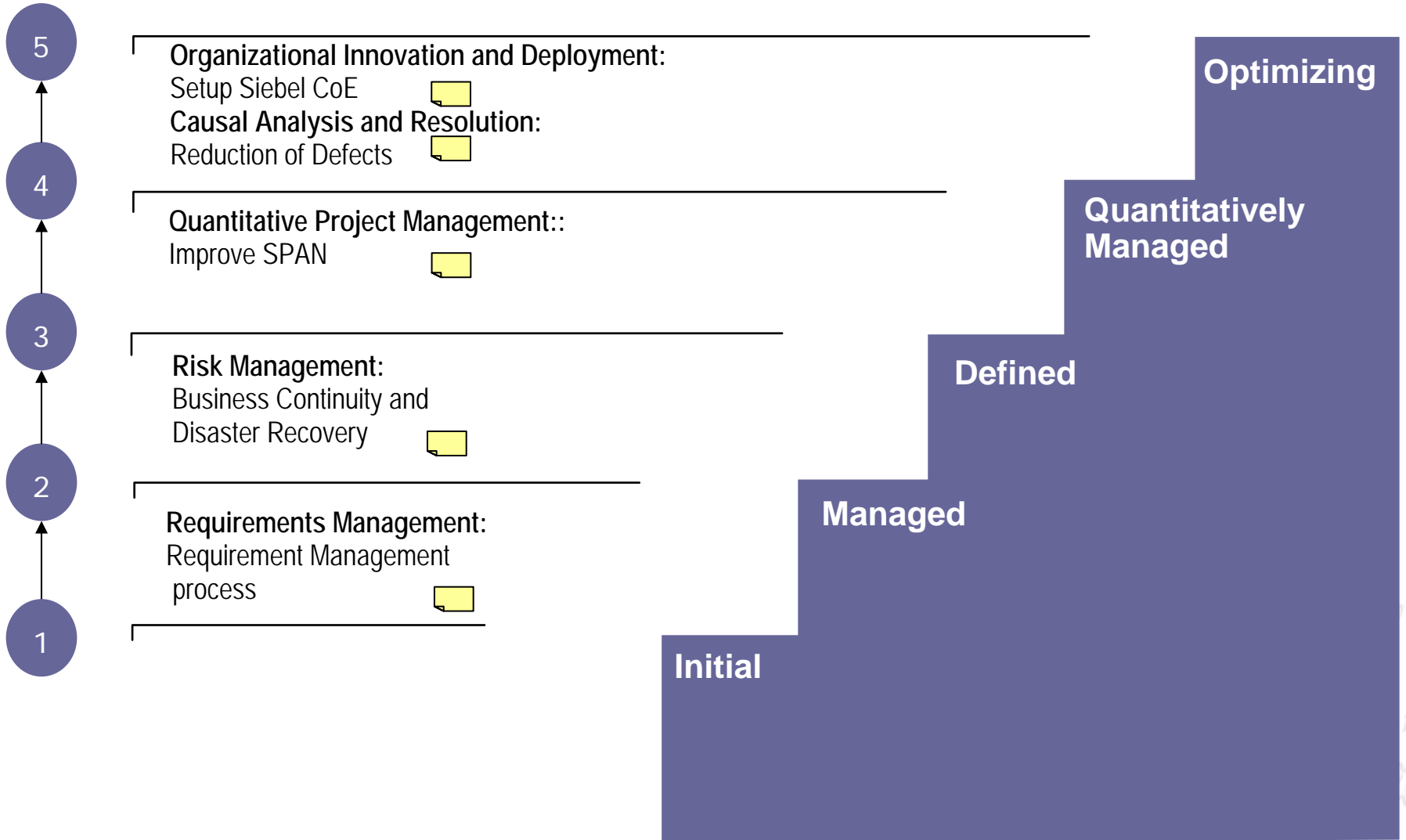
Templates

- Traceability Matrix Template
- Wind Up Note Template
- Client Feedback Template

Standards and Checklists

- Standards for Testing
- Branch Metrics Standards

Six Sigma Sickle : Harvesting for Success



Requirements Process– Requirements Management

Define

Business Case / Project Needs:

The Data-Dynamics group at offshore are getting requirements and modification details through email/Tcons. Whenever any new changes comes for existing mapping or SP, the developer first gathers all the design documents and modification history. This requirement gathering process is extremely time consuming and prone to errors. With the increasing number of mappings, the requirement gathering process is getting difficult day by day.

Problem Statement:

In the last 6 months, the data dynamics team of CPQ Selectica Project at offshore. On an average a developer takes 30 mins to 2 hours to gather all requirements related to any deliverable. This leads to delayed output from the offshore team.

Goal Statement:

To reduce the time taken to gather information for any deliverable at offshore to less than 10 mins by FW44.

MGPP:

Phase 1

1. Specify CTQs

2. Develop

Phase 2

1. Design New Process

2. Implement

3. Implementation

Analyze

High Level process map :



• The Data-Dynamics group at offsite was receiving Requirements via emails or tele-cons and keeping track of requirements/designs docs/modification histories was a huge challenge

• Six Sigma DMADV rigor was used to identify stakeholder needs

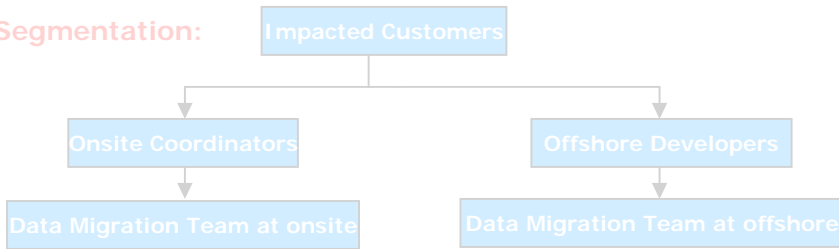
• Requirements Management system was developed as part of the improvement

• Actual results from the collected data after the implementation of the monitoring system indicated 100% efficiency in requirement management

1. Details Design for improvement of Requirement Management process.
 2. Risk analysis with FMEA
- The time taken to retrieve information about a deliverable .
- ### Alternating Architecture :
- Two different architectures were available:
1. Client-Server Architecture
 2. Distributed Architecture

Measure

Customer Segmentation:

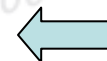


Verify

Design Evaluation - Actual results: Actual results from the collected data after the implementation of the monitoring system indicated 100% efficiency in database monitoring

CTO Measures:

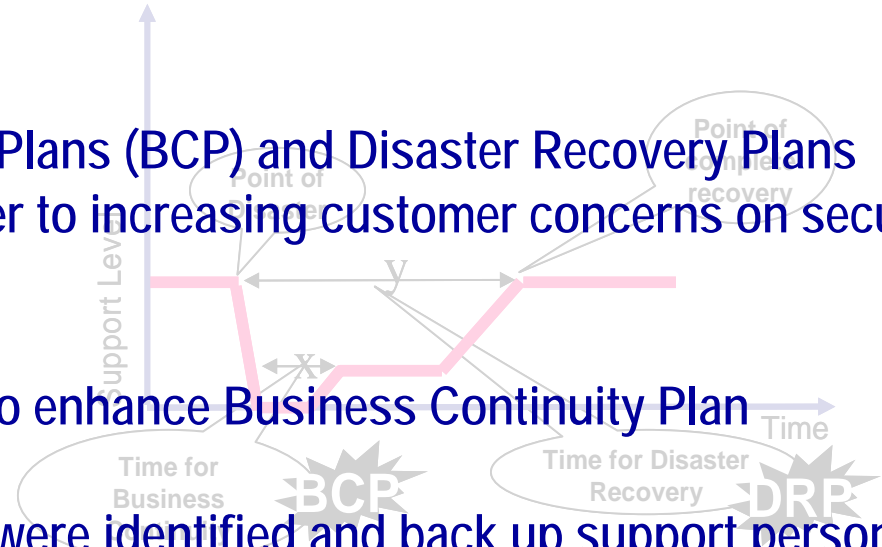
- Ensuring 100% execution of Improvement of Requirement Management Process.



Business Continuity and Disaster Recovery: Risk Management

Business situation

- After Sept 11, existing business continuity plans were inadequate to cater to increasing customer concerns on security and continuity
- Existing Business Continuity Plans (BCP) and Disaster Recovery Plans (DRP) were inadequate to cater to increasing customer concerns on security and continuity
- There was a need to re-engineer current processes in continuing support services both pre and post a disaster situation
- Six Sigma DMAIC rigor used to enhance Business Continuity Plan
- Mission Critical applications were identified and back up support personnel created at alternate locations



Goal:

- BCP and DRP made mandatory part of Risk Management for every maintenance project

Measure:

The two Critical Recovery Timeframes were :

x, Business Continuity

y, Disaster Recovery

Analyze:

- The disaster scenarios and its root causes were analyzed
- The impact of the disaster in terms of service outage and cost of failure were determined

Improve and Control:

- BCP enhanced
- Mission critical applications (MCAs) identified
- Backup support personnel at alternate locations for MCAs created
- Processes for role transition of backup personnel documented
- Mock drills conducted to assess readiness for disasters



Reduction of Defects – Causal Analysis and Resolution

PA- Causal Analysis and Resolution:

To identify causes of defects and other problems and take action to prevent them from occurring in future.

- A high level study of operational metrics in Defect Tracker indicated that

Define: Business Process

A high level study of operational metrics in Defect Tracker for business website indicated that roughly 50% of the cases reported were either defects in delivery or production problem and the cycle time for fixing defects was unpredictable.

- Causal Analysis techniques were used to identify vital causes and solutions to address them were identified using Six Sigma rigor

Goal Statement:

To reduce the number of defects and production problems reported, by 50%.
To fix 100% defects reported, within an acceptable and agreed upon time frame, with a tolerance of 5 %

Measure: CTQ

CTQ	All	Mean	Standard Deviation	Process Sigma
Number of Defects (%)	All	45.12	11.65	0
Cycle Time – Response Time (Days)	Severity1	4.84	4.49	0.699
	Severity2	6.22	8.29	0.899
	Severity3	13.69	11.68	1.0
	Severity4	51.6	17.3	-0.899
Cycle Time – Resolution Time (Days)	Severity1	7.55	7.39	0.699
	Severity2	8.61	10.68	0.899
	Severity3	19.38	19.24	1.3
	Severity4	58.6	39.93	0.8

Improvements across the board

Net Revenues signed off by Customer: \$125,000

Analyze & Improve: Vital X's and Solutions

CTQ	Vital X (In Control)	Improvement Plan
Reduction of Defects	1. Inconsistency in Testing	1. Dedicated Quality Assurance Team 2. New Testing Process
Cycle Time - Response Time (Days)	1. Time to Assign Change 2. Time for Clarification 3. Time for Estimation	1. Separate Team for Defect Change Requests 2. Remove Estimation and Approval cycle
Cycle Time - Resolution Time (Days)	1. Time to Schedule Development 3. Time for Deployment	Defect Change Requests 2. Quality Assurance Build from offshore

Measure: CTQ

CTQ	All	Mean	Standard Deviation	Process Sigma
Number of Defects (%)	All	13.67	9.29	2.2
Cycle Time – Response Time (Days)	Severity1	0.5	0.707	2.2
	Severity2	0.833	0.408	1.9
	Severity3	3.0	3.98	2.6
	Severity4	3.63	5.83	2.6
Cycle Time – Resolution Time (Days)	Severity1	0.5	0.707	2.2
	Severity2	1.0	0.632	3.0
	Severity3	4.38	3.93	4.2
	Severity4	16.12	18.71	2.2

Setup Siebel CoE – Organizational Innovation and Deployment

PA- Organizational Innovation and Deployment:

To select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process-performance objectives as derived from the organization's business objectives

Define:

Problem Statement:

In the past due to shortage of Siebel skilled resources, Customer had to use high cost alternatives

Goal Statement:

Establish a high performing Siebel Center of Excellence (CoE) by deploying ODC team Siebel Certified, SLAs defined and reported using "Fixed Price" pricing model and achieving high offshore leverage.

MGPP:

Phase 1: Settling of Siebel Release in 3 months.

Phase 2: On-Site Siebel Certified, ODC team Siebel Certified, SLAs defined and reported

Measure:

- Customers Satisfaction
 - Technology Team
 - Business Leader Super Users
 - Sales Representatives (End Users / Daily Siebel User)
- CBM was used to prioritize CTOs

Customer	Project	Start	End	Phase	Team	Resources	Cost	SLA	Performance	Satisfaction
Customer A	Project A	2008-01-01	2008-03-31	Phase 1	Team A	10	100,000	30 days	95%	4.5
Customer B	Project B	2008-04-01	2008-06-30	Phase 2	Team B	15	150,000	45 days	98%	4.8
Customer C	Project C	2008-07-01	2008-09-30	Phase 1	Team C	8	80,000	25 days	92%	4.2
Customer D	Project D	2008-10-01	2008-12-31	Phase 2	Team D	12	120,000	35 days	96%	4.6

Measures of Success:

- Compliance of the SLA between ODC Support team and IT Team
- Customer satisfaction index as expected
- Siebel Application performance meets SLAs with End Users

Analyze:

- High Level Process Map was prepared
- Scorecard developed to monitor the CoE

"Quarterly Tracking Sheet"

Activities	Responsibility	Jan-Nov 01 (Baseline)	Dec-01	Q1 - 02 Planned	Q1 - 02 Actual	Q2 - 02 Planned	Q2 - 02 Actual	Q3 - 02 Planned	Q3 - 02 Actual	Q4 - 02 Planned	Q4 - 02 Actual
Business	GE	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Requirements	GE - ON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Design	GE	70%	70%	70%	70%	70%	70%	70%	70%	70%	70%
	GE - ON	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Development	GE	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	GE - ON	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Testing	GE	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	GE - ON	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Deployment	GE	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Knowledge Transfer	GE - ON	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Documentation	GE	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
	GE - ON	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R&D / Analysis	GE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - ON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Support Issues	GE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - ON	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - OFF	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Resources	GE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	GE - ON	2	2	2	2	2	2	2	2	2	2
	GE - OFF	1	1	1	1	1	1	1	1	1	1

Using Six Sigma DMADV rigor a Siebel Center of Excellence was developed at GDC

Members of the CoE were deployed for the customer projects

Customer signed off savings of USD 581,250 incurred through the improvements

Achieved First Time Right and On Time Delivery by the Center of Excellence team

Design:

PVCS Tracker – process flow

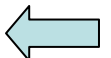


Verify:

FTR and OTD SLAs met by the ODC Team

Benefits sign-off by Customer Quality Leader

Cost Savings: (Contractor) – (Fixed Price Cost)
(US \$) 791,250 – 210,000 = 581,250



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