Applying CMMI[SM] In Information Technology Organizations

SEPG 2003

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

Objectives

- Establish “systems thinking” approach to IT management
- Understand how the CMMI applies to different levels of IT systems management
- Examine different interpretations for CMMI Specific Practices in an IT context

Agenda

- Introduction
- Setting the context
- CMMI in software teams
- CMMI in infrastructure and operations teams
- Summary

Introduction

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

Assumptions that Confuse Interpretation

- CMMI applies only to large new systems development projects
- CMMI is intended only for DoD weapon system development
- CMMI only directly fits where there is hardware with embedded software

What We Will Cover

- Application of systems thinking to IT organizations
- An approach to understanding CMMI where the focus is not new systems development
- Interpretation of potentially confusing Specific Practices in an IT context
  - Project Management PAs
  - Engineering PAs
  - Support PAs
- Three real client cases to illustrate points

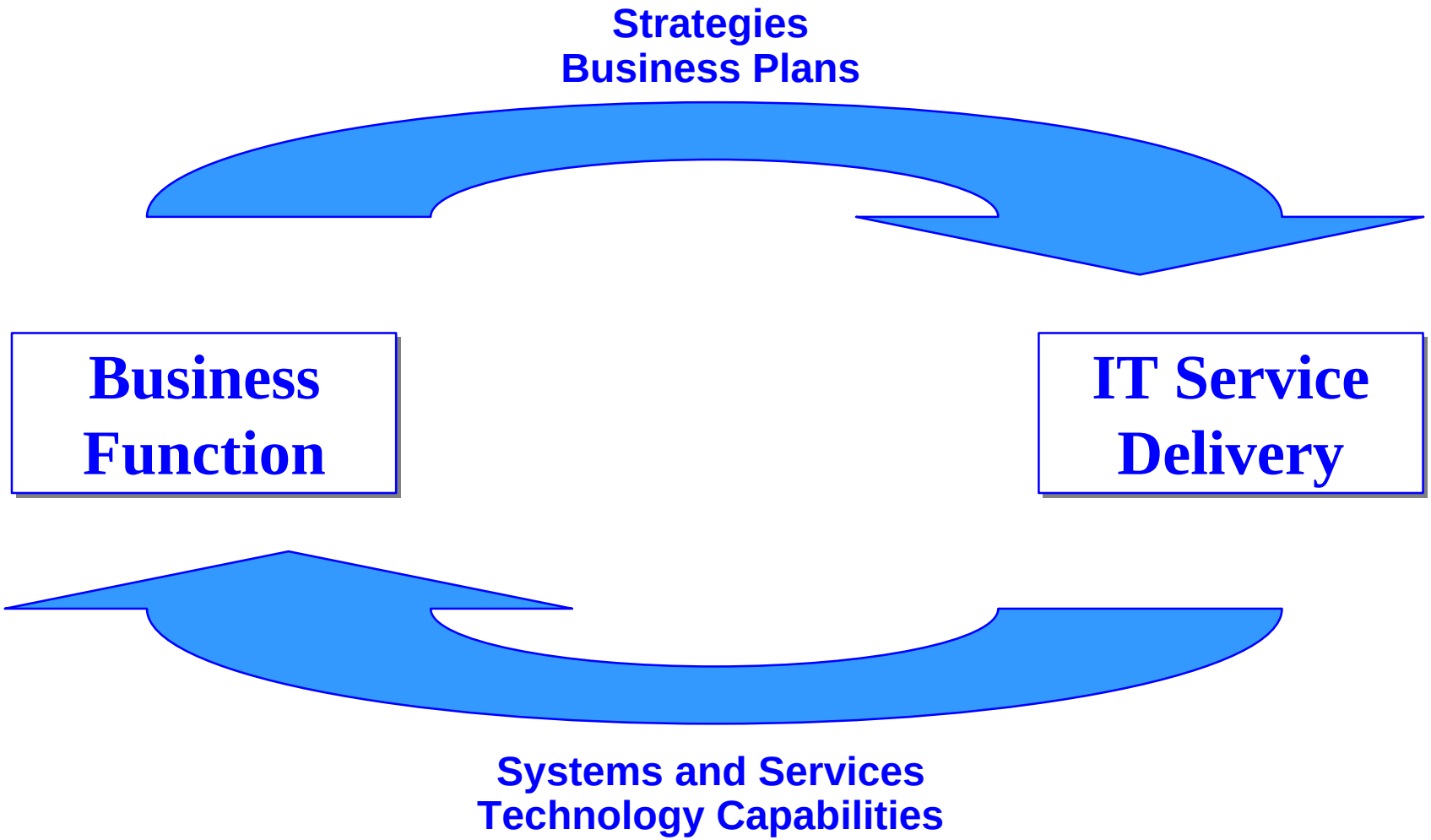
What We Will Not Cover

- Whether the CMMI is better or worse than the Software CMM
- What is different between CMMI and Software CMM
- Whether the Staged Representation is better or worse than the Continuous Representation

Setting the Context

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

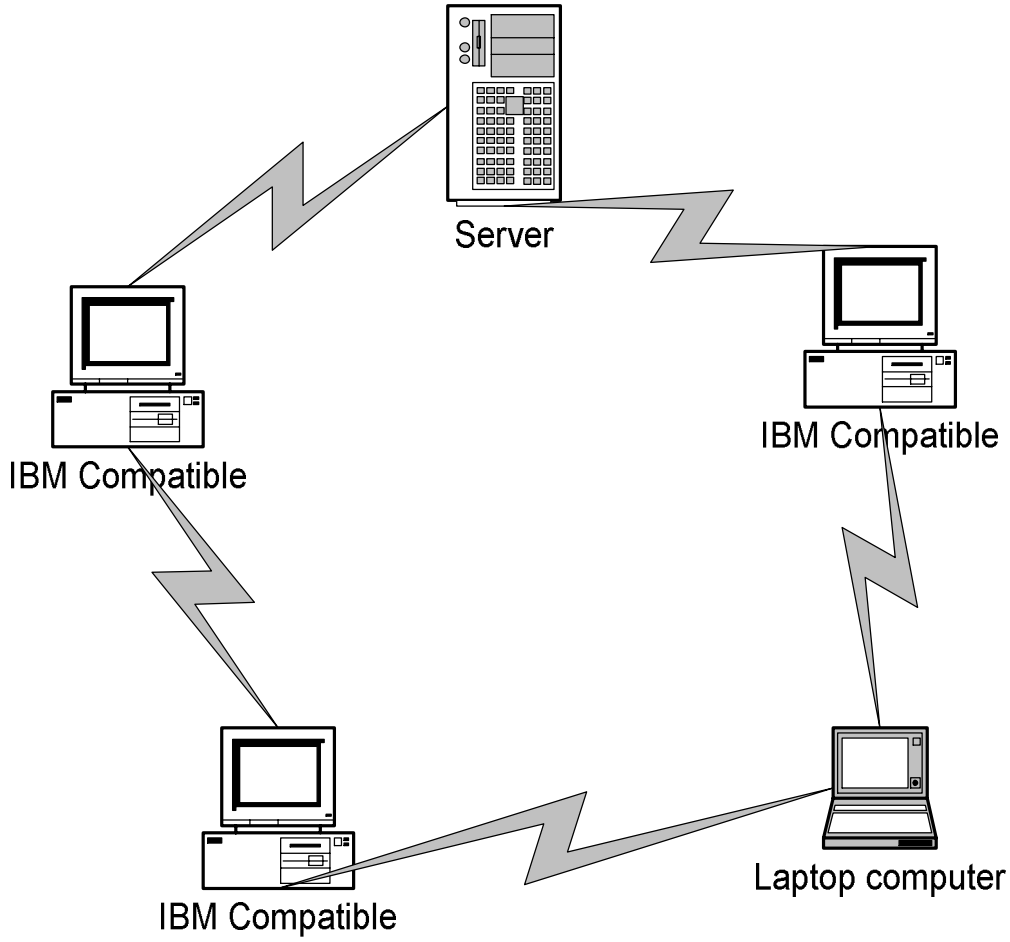
IT in Context



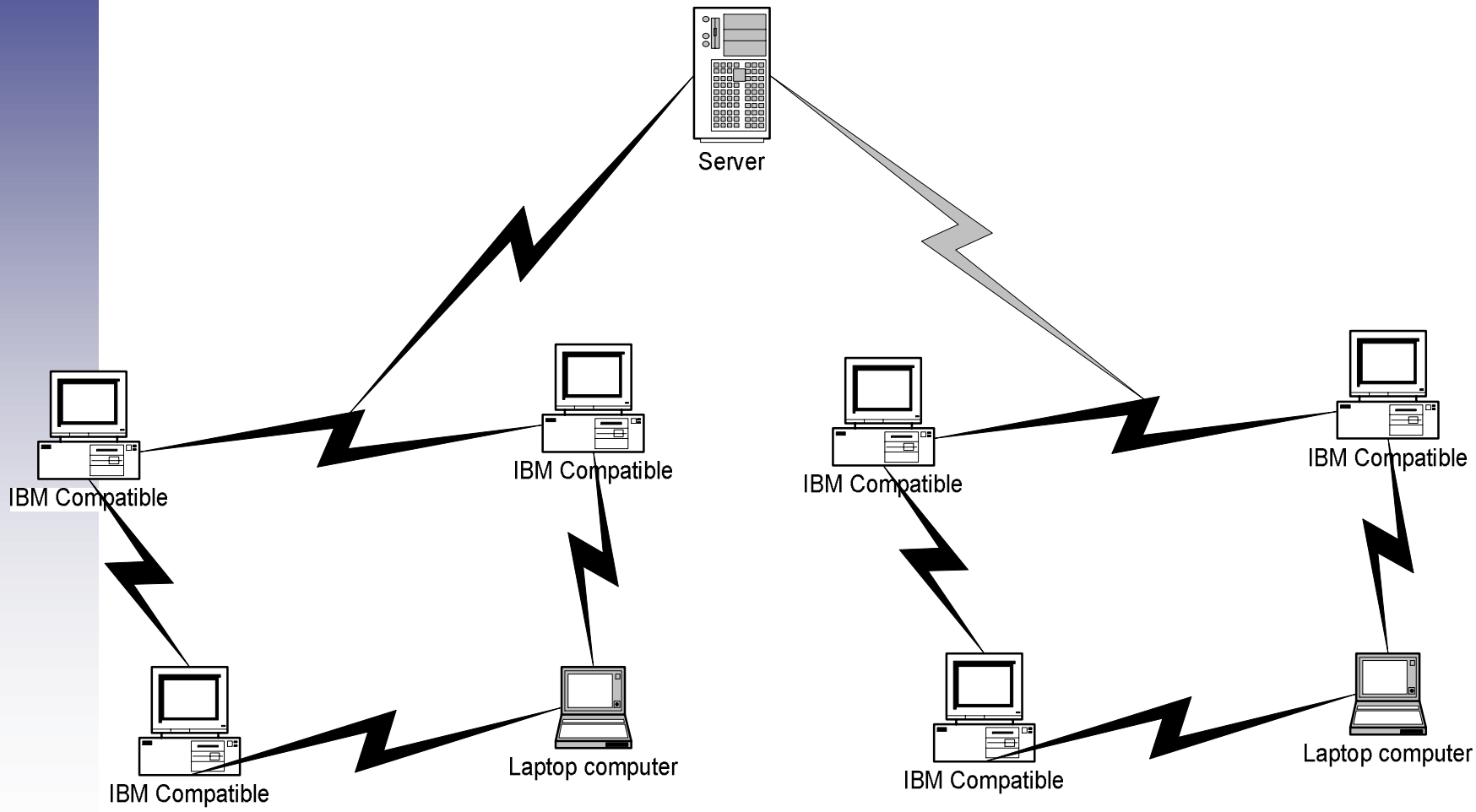
Hardware Systems in IT Components

- Mainframes
- Servers
- Desktops
- Laptops
- Routers
- Switches
- Hubs
- Internet
- Intranet
- DNS
- Voice Communications
- Cabling

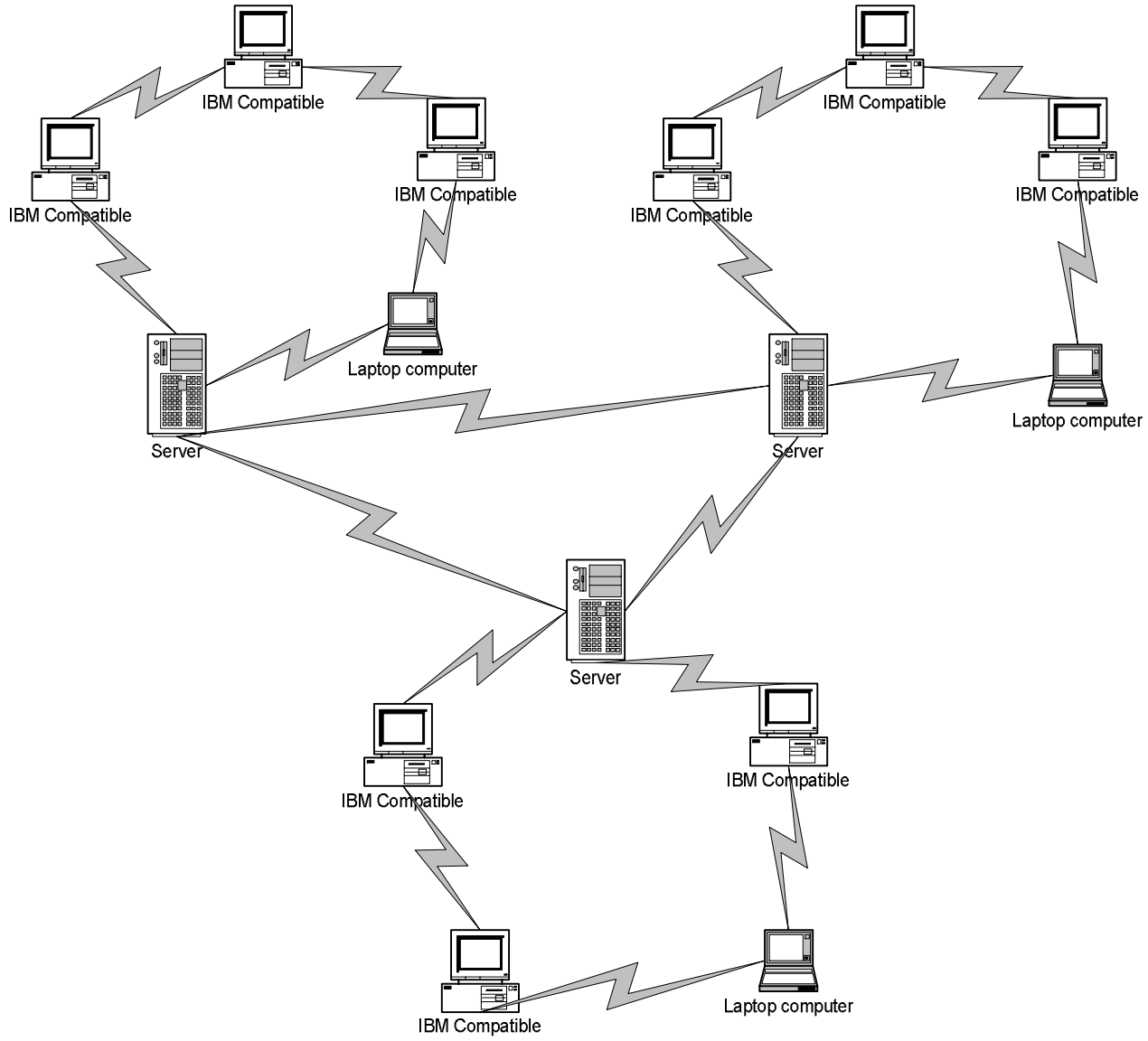
Hardware Systems in IT
Application Server



Hardware Systems in IT
Application Server Groups



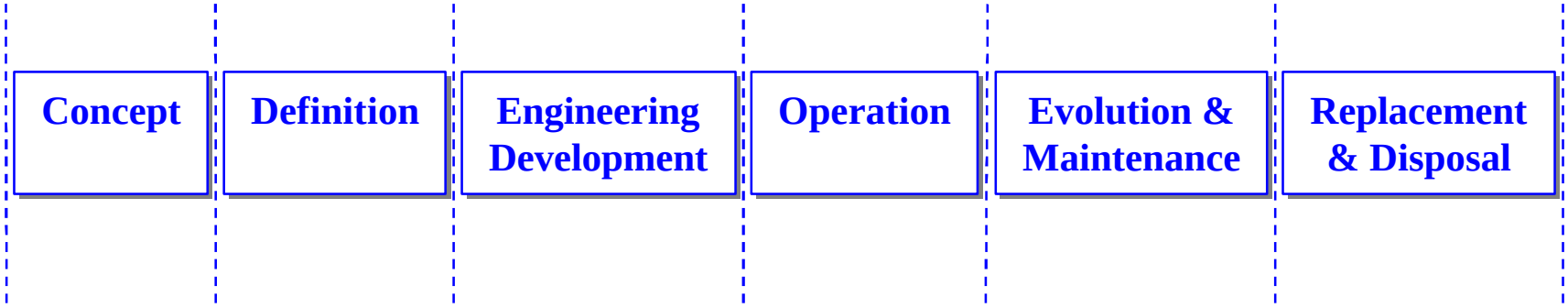
Hardware Systems in IT Server Groups



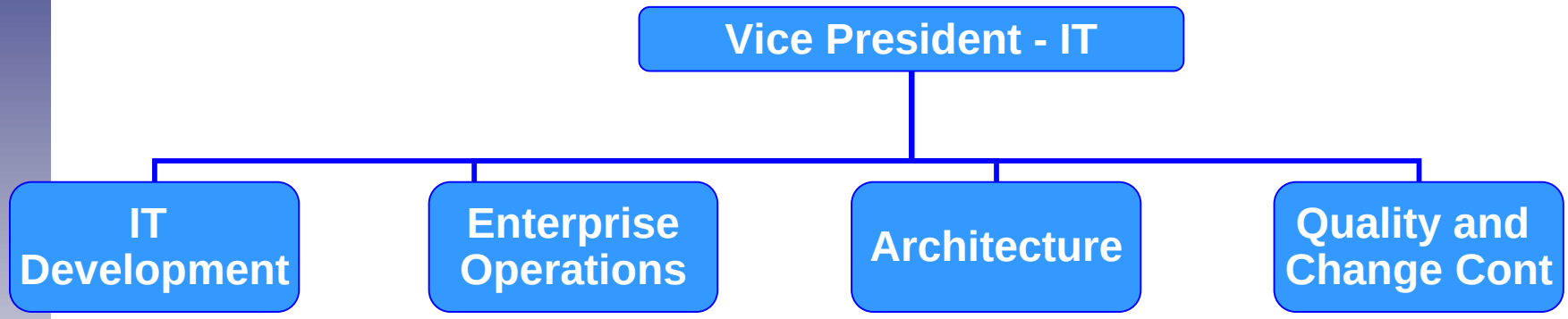
Software Systems in IT

- Business Applications
  - Financial
  - Sales
  - Data warehousing
  - Personnel
  - Internet web
  - Intranet web
  - ...
- Help desk
- Systems management

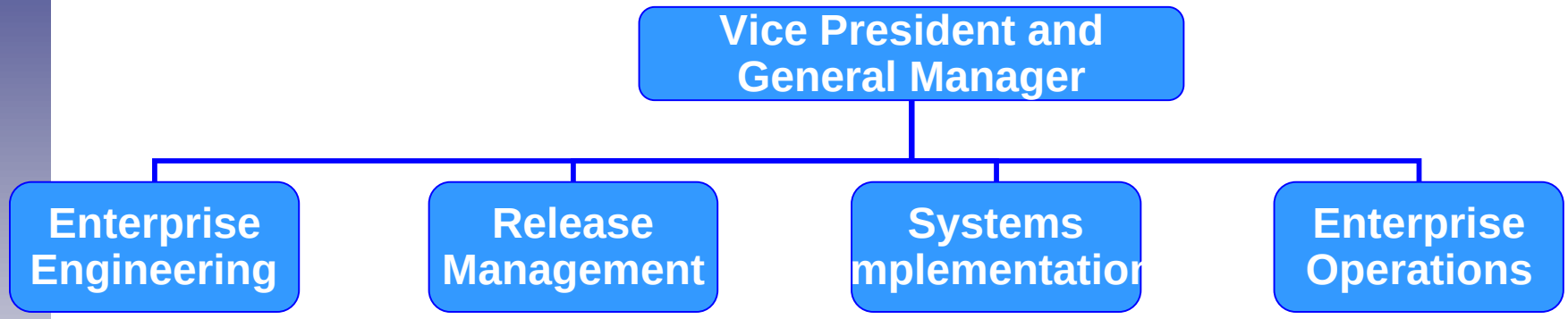
Systems Engineering Product Life Cycle



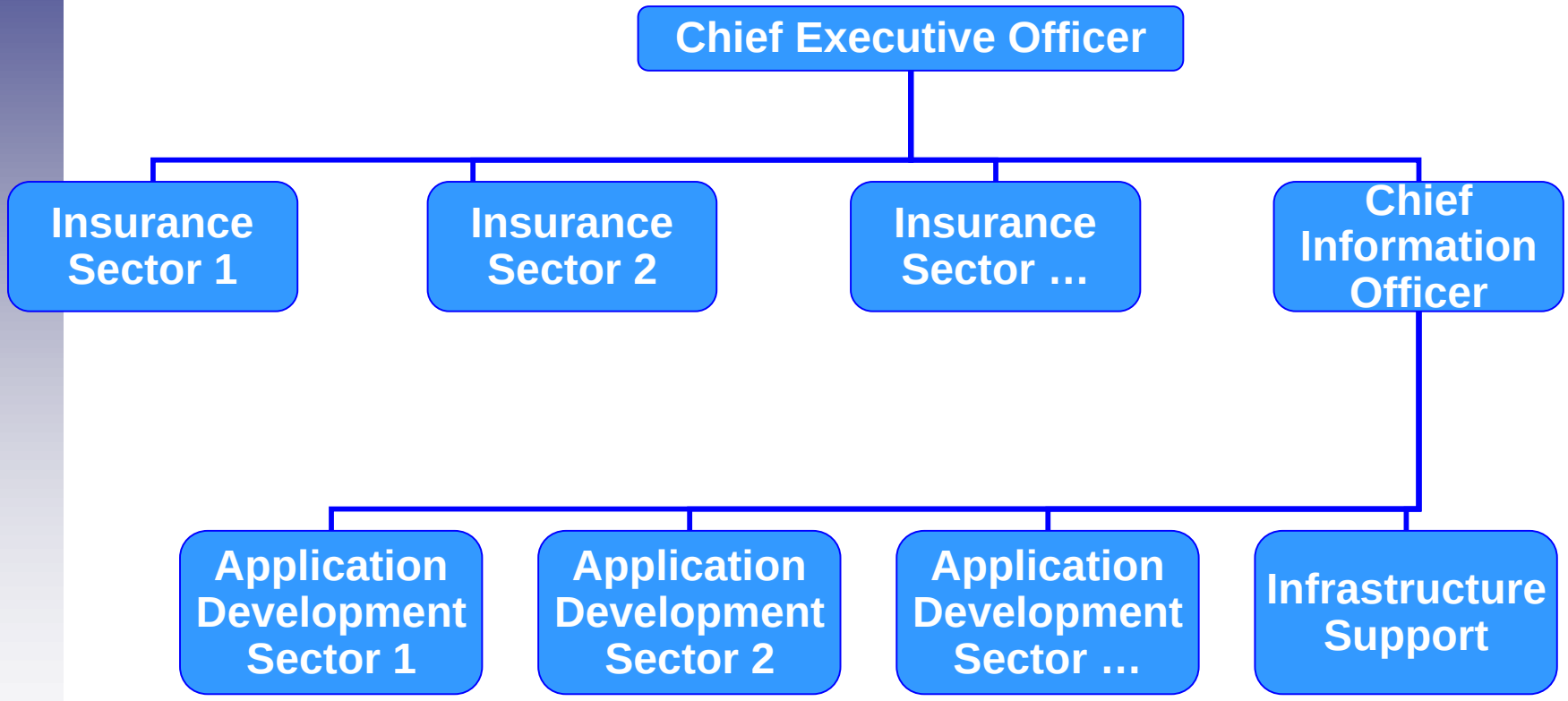
Company #1
Internet Service Provider



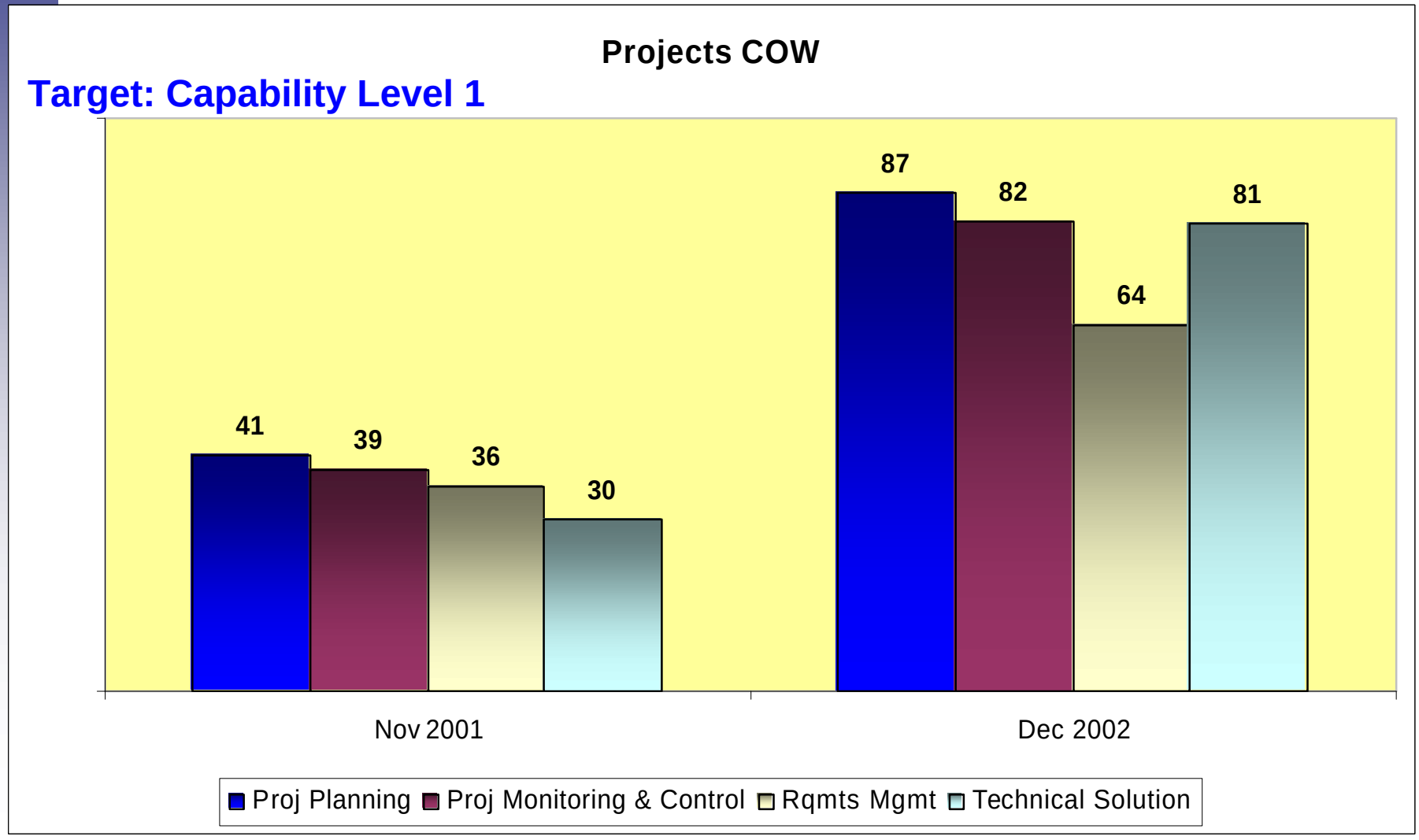
Company #2
IT Support Contractor



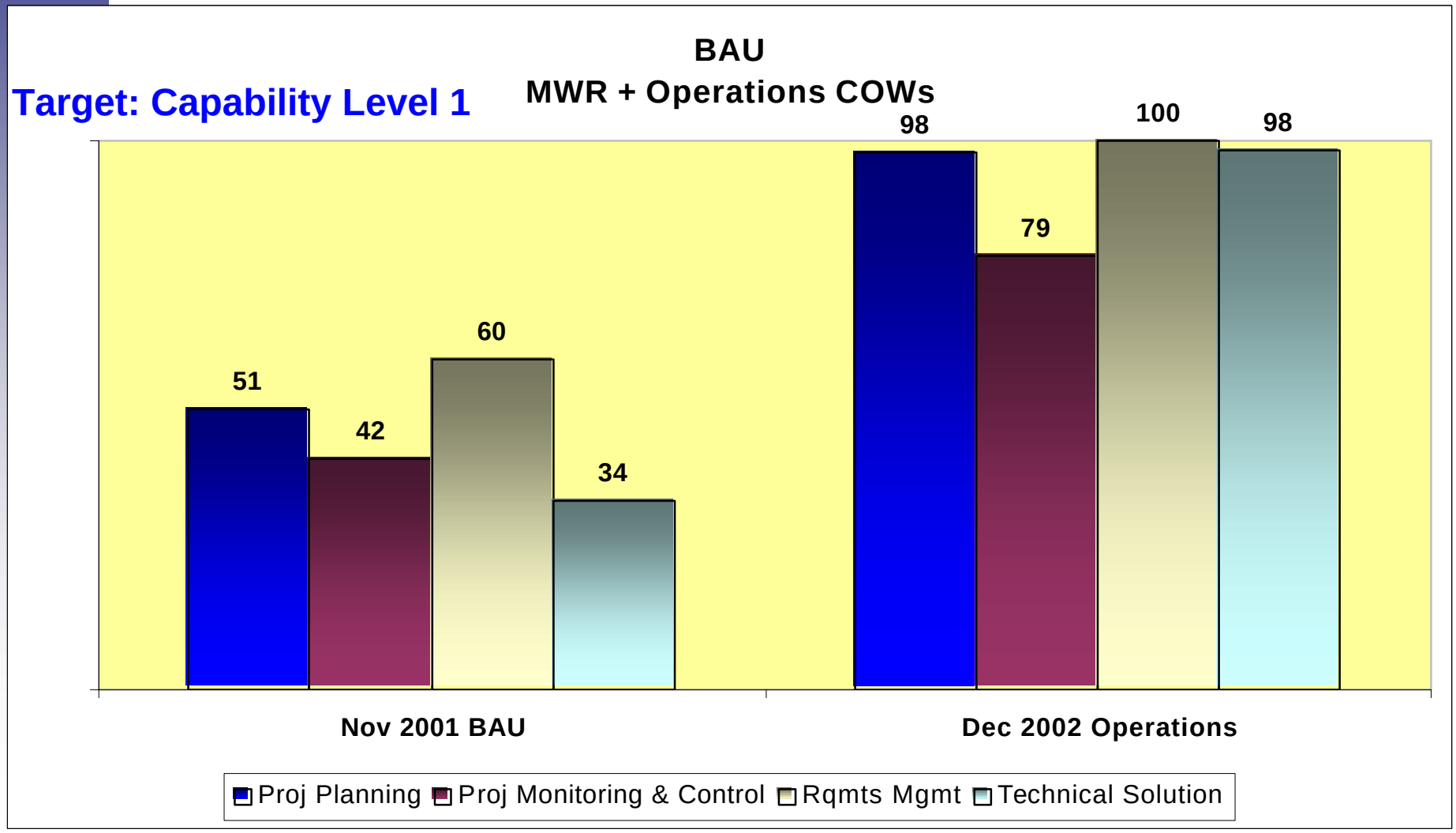
Company #3
Insurance Company



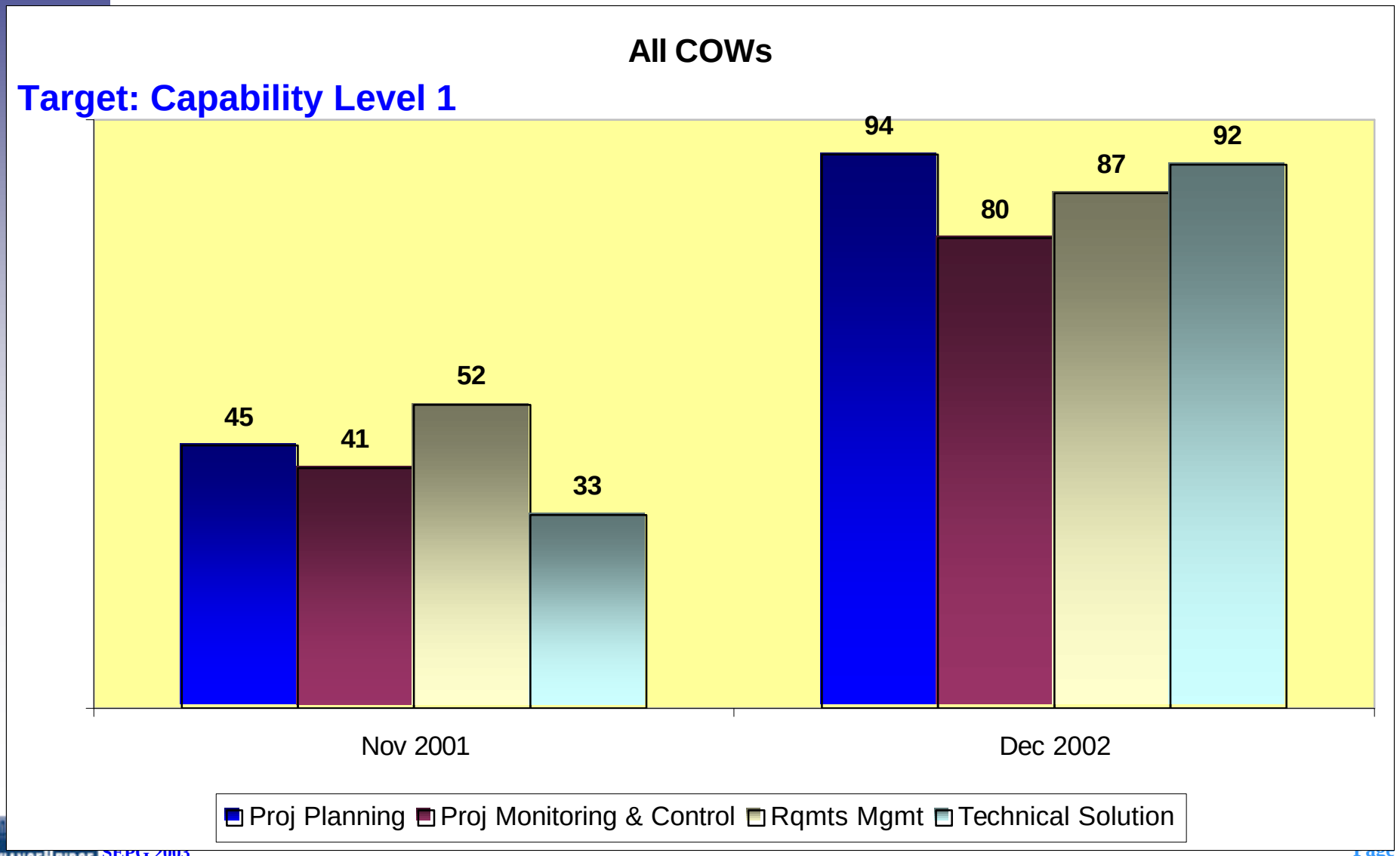
Projects COW



MWR + Operations COWs CMMI Rating



All Categories of Work CMMI Rating



CMMI in Software Teams

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

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Types of Work

- New system development
- Existing system evolution
  - Maintenance
  - Enhancement
  - Replacement
- Vendor management
  - COTS
  - Custom
  - Combination
- System integration

Project Planning PA Definitions

- **Project**
  - **Delivery of one or more products to the customer, with a defined start and end**

Project Planning PA
SP 1.1

- Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.
- Top level set of tasks, phases, cycles, etc. used to establish a starting picture of scope
- Project may be a:
  - A new system development effort
  - A maintenance and/or additional functionality release
  - A COTS integration or implementation
  - A combination of the above

Project Planning PA
SP 1.2

- Establish and maintain estimates of the attributes of the work products and tasks.

- Attributes of work products
  - Counts of items
  - Complexity
  - Risk

- Attributes of tasks
  - Counts of types of task
  - Complexity
  - Risk

Project Planning
SP 1.3

- Define the project life-cycle phases upon which to scope the planning effort.

- Life cycle phases define the major task synchronization points and how they relate

  - Requirements, Design, Code, Integrate, System test, User acceptance, etc.

  - Waterfall
  - Spiral
  - Evolutionary
  - Incremental

Project Planning PA
SP 1.4

- Estimate the project effort and cost for the work products and tasks based on estimation rationale.
- Use SP 1.1 – 1.3, plus rationale, to estimate effort and cost
- If end date is fixed, adjust scope and resources
- If resources are fixed, adjust scope and end date
- If scope is fixed, adjust resources and end date

Project Planning PA
SP 2.1

- Establish and maintain the project's budget and schedule.

- Budget and schedule are approved based on
  - Estimates
  - Review and reconciliation with stakeholders
  - Reasonableness of plan

Project Planning PA
SP 2.2

- Identify and analyze project risks.
- Risks to success of project:
  - Product
  - Project
  - System
- Do not need full risk management at this point

Project Planning PA
SP 2.3

- Plan for the management of project data.
- Project data includes:
  - Configuration items
  - Internal work products
  - Meeting minutes
  - Status reports
  - Presentations
  - Demonstrations
  - Etc.
- Planning for project data involves identifying storage, approval, communication methods

Project Planning PA
SP 2.4

- Plan for necessary resources to perform the project.

- Resources include:
  - Test labs
  - Development equipment
  - Facilities
  - People

Project Planning PA
SP 2.6

- Plan the involvement of identified stakeholders.

- Identify stakeholders
  - Users
  - Managers
  - Others

- Ensure that their involvement points are identified in the plan

Project Planning PA
SP 3.1

- Review all plans that affect the project to understand project commitments.

- Other plans include:
  - Configuration Management
  - Quality Assurance
  - Infrastructure support
  - Stakeholders

Project Monitoring and Control

- Monitor items identified in Project Planning
- Analyze and take corrective action
- Manage corrective action to successful completion

Project Monitoring and Control PA SP 1.1

- Monitor the actual values of the project planning parameters against the project plan.

- Planned vs. actual comparison to determine progress
  - Attributes of work products and tasks
  - Effort
  - Cost
  - Budget
  - Schedule

Supplier Agreement Management

- **Suppliers include:**
  - COTS vendors
  - Contracted development and maintenance
  - Body shops
  - Internal teams
    - Infrastructure
    - Other product teams

Supplier Agreement Management PA SP 1.1

- Determine the type of acquisition for each product or product component to be acquired.

- Types of acquisition
  - Internal agreement
  - Memoranda of agreement
  - Contracts
  - COTS
  - Staff augmentation
  - Custom delivery
  - Services

Supplier Agreement Management PA SP 1.2

- Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.

- Established criteria
  - Management considerations
  - Preferred suppliers
  - Company standards

Requirements Management PA SP 1.1

- Develop an understanding with the requirements providers on the meaning of the requirements.

- Requirements providers include:
  - Infrastructure teams
  - Corporate architects
  - Users and business partners
  - System managers
  - Vendors

Requirements Development PA SP 1.1

- Elicit stakeholder needs, expectations, constraints, and interfaces for all phases of the product life cycle.
- Stakeholders include requirements providers
- Elicitation techniques are those commonly used for requirements analysis

Requirements Development PA SP 1.2

- Transform stakeholder needs, expectations, constraints, and interfaces into customer requirements.
- Output is typically a requirements specification
  - May take many forms
  - May evolve during iterative/evolutionary/spiral phases

Requirements Development PA SP 2.1

- Establish and maintain product and product-component requirements, which are based on the customer requirements.
- Output is typically a functional description
  - May take many forms
  - May evolve during iterative/evolutionary/spiral phases

Requirements Development PA SP 3.1

- Establish and maintain operational concepts and associated scenarios.

- Can take many forms
  - Use cases
  - Users manuals
  - Operating instructions

Technical Solution PA
SP 1.1

- Develop alternative solutions and selection criteria.
- For existing systems, typically the alternative solution space is very limited
  - Implementation approaches
  - Addition of components
  - Custom versus COTS
- Architecture is established
  - Options relate to impact of change on existing architecture

Technical Solution PA
SP 2.2

- Establish and maintain a technical data package.

- Technical data package may include
  - Evolved use cases
  - Design specifications
  - Test specifications
  - Performance requirements

Technical Solution PA
SP 2.4

- Evaluate whether the product components should be developed, purchased, or reused based on established criteria.
- Make/buy typically applies to new systems only
- Reuse may apply in all situations
  - Existing code libraries
  - Purchased object classes

Product Integration SP 1.1

- Determine the product-component integration sequence.
- Typically done during test planning
  - Integration sequence
  - Levels of testing

Product Integration PA
SP 1.2

- Establish and maintain the environment needed to support the integration of the product components.

- Ensure that appropriate test environments exist

  - Development
  - System / integration
  - User acceptance

Product Integration PA
SP 1.3

- Establish and maintain procedures and criteria for integration of the product components.

- This is test planning
  - Test procedures
  - Scenarios
  - Scripts
  - Test data

Product Integration PA
SP 2.1

- Review interface descriptions for coverage and completeness.
- Ensure that software component interfaces are correct

Product Integration
SP 3.1

- Confirm, prior to assembly, that each product component required to assemble the product has been properly identified, functions according to its description, and that the product-component interfaces comply with the interface descriptions.

- Ensure that each component has passed its level of review and/or testing prior to beginning next level of build and test

Product Integration PA
SP 3.2

- Assemble product components according to the product integration sequence and available procedures.
- Perform the build

Product Integration PA
SP 3.4

- Package the assembled product or product component and deliver it to the appropriate customer.
- Deploy the system into the production environment

Verification PA

- Work product reviews on documentary items to ensure satisfaction of requirements
- Various levels of testing, most likely performed as a part of (or driver for) product integration

Validation PA
SP 1.1

- Select products and product components to be validated and the validation methods that will be used for each.
- Identify the level of component or system that will be validated in its operational environment

Validation PA
SP 1.3

- Establish and maintain procedures and criteria for validation.
- Identify how operational testing will be performed
  - Test planning
  - Scenarios
  - Support mechanisms
- Ensure facilities are available to revert to prior production versions

Measurement and Analysis PA

- Addresses mechanisms for managing the IT software group against a defined set of objectives

- Setting up the program
  - Establishing objectives
  - Specifying data collection, analysis and storage mechanisms
  - Defining reporting and usage

- Implementing the program
  - Measures are typically generated as a part of
    - Status reporting
    - System evolution
    - Business priorities

CMMI in Infrastructure and Operations Teams

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

The Big Six
Generic, Major Functions of an Operations / Shared Services Organization

- Platforms
- Operations
- Network
- Voice / Security / Infrastructure Applications
- Configuration / Asset Management
- Customer Service
  - Help Desk
  - Problem Management)

Important Note:
This is a generic grouping used solely to facilitate discussion.
Actual organization structure and groupings will vary.

Sample Core Services

Platforms

- Mainframe
- Server
- Desktop
- Mobile and Hand held
- Database
- Internet, Intranet, B2B

Operations

- Batch / Daemon / Job Queues
- Enterprise Business Application Support
- Backup / Restore
- Disaster Recovery
- Facilities Mgmt
- Production Env. Monitoring

Network

- Network Engineering
- Middleware Mgmt
- Network Monitoring

Voice / Security / Apps

- Voice Engineering / Apps
- Telephony Support
- Security Engineering
- Security Monitoring and Prevention
- Tools and Internal Applications Support

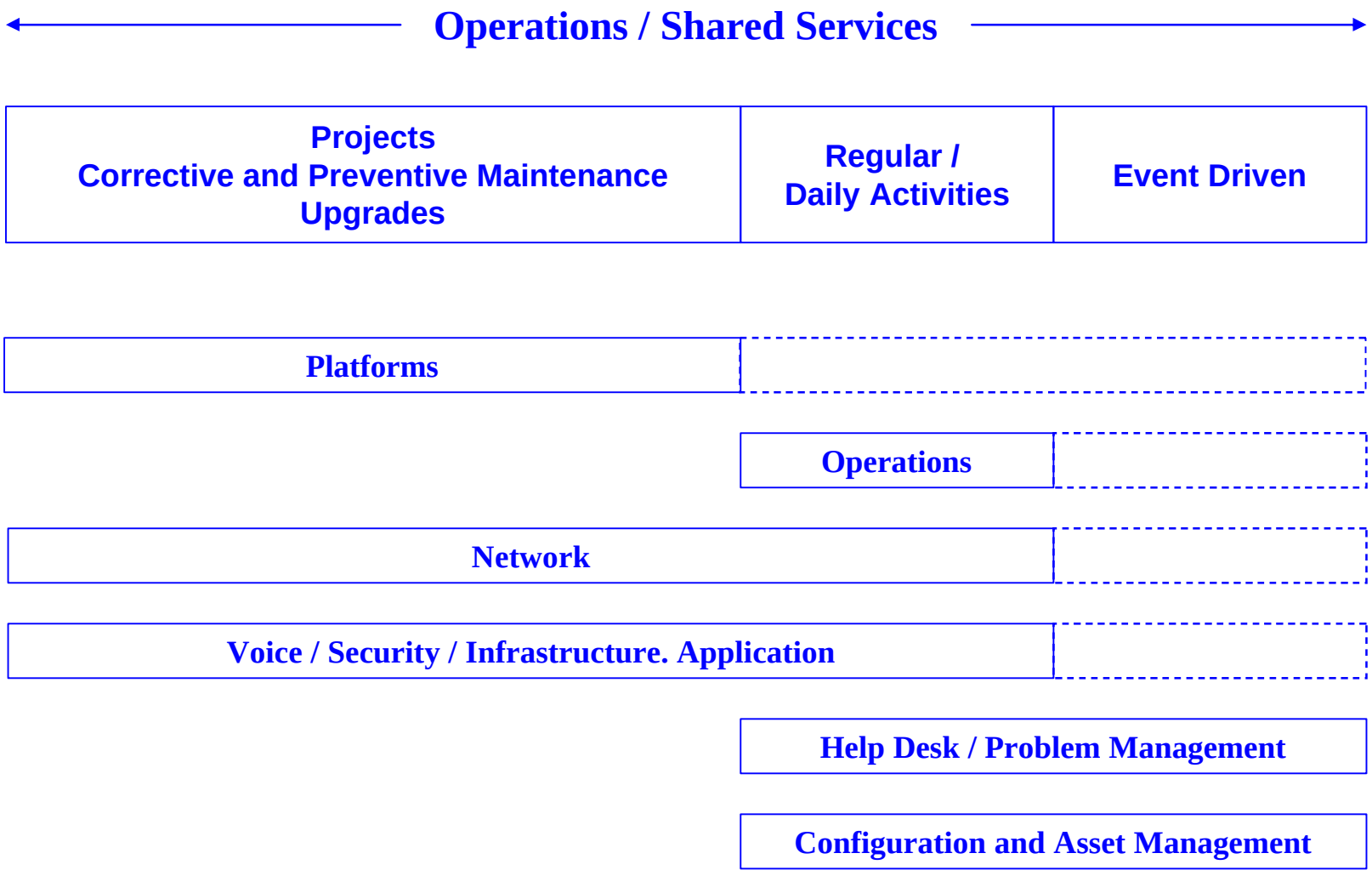
Customer Service

- Help Desk / Call Center
- Problem Management
- Customer Service Request Routing

Config and Asset Mgmt

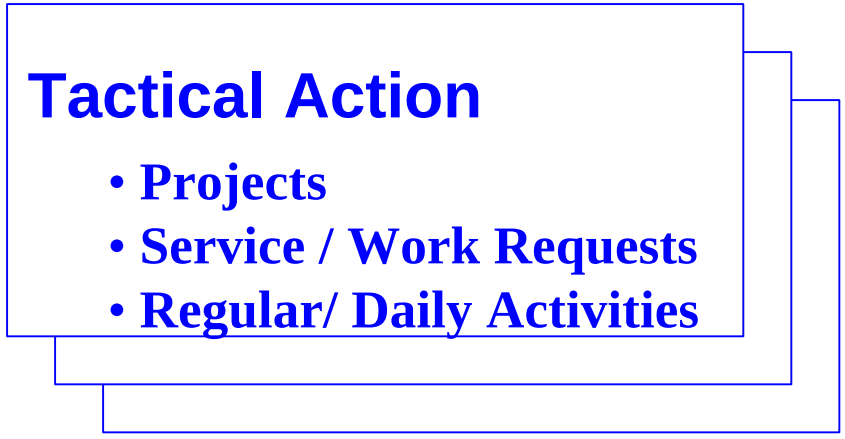
- Asset Mgmt
- Configuration Mgmt
- Production Env. Control
- Enterprise SW Distribution
- Documentation Mgmt

The Six Functions Span the Workload Spectrum (Primary Allocation Shown with solid line)



Consider the Continuum of Work

Forward Thinking vs. Immediate Delivery



You Must Understand the Work

- Business does not exist in a vacuum, nor do
  - Projects
  - Software Applications and Products
  - IS Operations
- Each major piece of the continuum has its own lifecycle
  - Tasks
  - Decision Points
  - Deliverables
- Level of Engineering and Management rigor varies for each
- Need for process rigor varies accordingly

Map the CMMI to the Work - 1

- **Projects**
  - One to one mapping of applicable Process Areas
- **Work requests**
  - Consider Process Areas as spanning bundles of work requests
- **Daily / Regular Work**
  - Most effective to map Process Areas across entirety of the function
  - For example, the annual planning for help desk resources and SLAs is like a “project”

Map the CMMI to the Work - 2

- Many of the six generic Ops/SS areas have projects
  - Upgrades projects (Database, server, network components)
  - New technology projects (Active Directory, .NET, bringing in LINUX or AIX)
  - Migration projects (Sybase to Oracle or vice versa)
- Projects are easiest to map to CMMI

Map the CMMI to the Work - 3

- Use criteria to distinguish project types (“big” vs. “small”)
  - New or existing technology
  - Effort hours
  - Duration
  - Cost
- Many infrastructure projects have a high cost component but relatively low effort/risk
  - A criteria combining cost/effort works well
- Set low end of criteria to distinguish projects
  - From Work / Service Requests
  - From Regular / Daily Activities
- Directly map CMMI Process Areas to your project processes

Map the CMMI to the Work - 4

- Now we're left with the tougher mapping
  - Work / Service Requests
  - Regular / Daily Activities
- CMMI is a robust, granular model for projects
  - "All models are wrong, some are useful" – George Box
- CMMI is too granular to apply directly to the remaining work types, but ...
- … it can be beneficial to apply CMMI across these work types

Certain CMMI Process Areas Fit Well

- Project Management
  - Project Planning
  - Project Monitoring and Control
  - Supplier Agreement Management
  - Risk Management
- Engineering
  - Requirements Management
  - Technical Solution
  - Product Integration
- Support
  - Configuration Management
  - Process and Product Quality Assurance
  - Measurement and Analysis

Mapping Discussion

- Following slides will highlight difficult or potentially bureaucratic specific practice mapping
- Please keep in mind we're talking about work requests and regular activities
- Format
  - Selected Specific Practice (SP) wording and intent
  - Example(s) of applying the SP to Ops/SS functions
  - Real world issues / recommendations

Project Planning PA

- SP 1.1-1 Estimate the Scope of the Project
  - Communicate and agree to scope/schedule/cost triangle
- SP 1.2-1 Establish Estimates of Work Product and Task Attributes
  - Identify key deliverables, milestones and resource/skills needed
- SP 1.3-1 Define Project Life Cycle
  - Identify groupings of major milestones, associated activities, deliverables and decision points
- SP 2.1-1 Establish the Budget and Schedule
  - Apply resources, task dependencies, adjust plans to meet milestones based upon capacity

Project Planning PA Mapping

- Operations
  - Plan resources needed to run batch jobs
  - Identify and monitor production and maintenance windows
  - Plan skills needed to handle production exceptions
  - Plan resources for printing, stuffing, distribution
  - Plan for necessary consumables (paper, print cartridges, tapes)
- Help Desk
  - Performance SLAs
  - Usually entails call tracking/problem workflow tool such as Remedy
  - Plan for training and cross-training (skills needed to answer variety of questions)

Project Planning PA Recommendations

- Translate “WBS” to “Useful groupings of work components and associates tasks”
- Plan according to annual budget cycle: skills needed, anticipated growth, SLAs, monthly metrics reporting
- Plan for regular stakeholder communications

Project Monitoring and Control PA

- SP 1.1-1 Monitor Project Planning Parameters
  - Objective visibility into progress (scope, schedule, cost) and re-planning
- Let the workflow toll track individual calls
- Track aggregate performance and trends
- Adjust resources, training and SLAs accordingly
- Capture data for future budgeting

Project Monitoring and Control PA Mapping

- Help Desk
  - Execute and monitor metrics against SLAs
  - Monitor usage of staff capacity and adjust staffing
  - Problem queue backlog
  - Customer feedback surveys

Project Monitoring and Control PA Recommendations

- Let the workflow toll track individual calls
- Track aggregate performance and trends
- Adjust resources, training and SLAs accordingly
- Capture data for future budgeting

Supplier Agreement Management PA

- **SP 1.1-1 Determine Acquisition Type**
  - Types of skills needed and why, plan for oversight needed
- **SP 1.3-1 Establish Supplier Agreements**

Supplier Agreement Management PA Mapping

- **Operations**
  - Printing / Stuffing / Mailing of bills and reports to customers
  - Billing may be performed in-house by different department or outsourced completely
  - Disaster recovery related backup and storage suppliers

Supplier Agreement Management PA Recommendations

- Remember SAM applies to internal and external suppliers
- Establish appropriate SLAs
- Negotiate appropriate testing and oversight into activities based upon risk
- Ensure objective performance metrics are used for management decisions

Risk Management PA

- **SP 1.3-1 Establish a Risk Management Strategy**
  - Establish the scope of the risk effort and your risk taxonomy

Risk Management PA Mapping

- All six functions

Risk Management PA Recommendations

- Apply risk management across the entirety of each function
- Part of the overall organization governance

Requirements Management PA

- **SP 1.1-1 Obtain an Understanding of Requirements**
  - Ensure requirements are documented and agreed by affected groups
- **SP 1.4-2 Maintain Bidirectional Traceability of Requirements**
  - Be able to demonstrate how intermediate and final work products satisfy requirements

Requirements Management PA Mapping

- Help Desk
  - Individuals call events vs. the entire help desk function

Requirements Management PA Recommendations

- The “requirements” of the help desk function:
  - Meeting SLAs,
  - Call volumes
  - Handling surge (e.g. , major outage)
  - Backlog
- The “requirements” of an individual call are captured within the workflow tool
- Better value add to apply SPs across the entire help desk function (vs. an individual call or problem event)

Technical Solution PA Recommendations

- Do not map this process area to smaller work efforts

Product Integration PA

- **SP 1.1-1 Determine Integration Sequence**
  - Assemble product components logically and efficiently
- **SP 2.2-1 Manage Interfaces**
  - Ensure only acceptable disruptions to existing system/service interfaces

Product Integration PA Mapping

- Configuration and Asset Management
  - Production Environment Control

Product Integration PA Recommendations

- Establish procedures for production environment control
- Use standard production migration procedures across the organization
- Plan ahead: provide regular windows for production environment changes

Configuration Management PA

- **SP 1.1-1 Identify Configuration Items**
  - Ensure appropriate level of control and comprehensiveness
- **SP 1.3-1 Create or Release Baselines**
  - Ensure appropriate controls for critical baselines/environments
- **SP 2.1-1 Track Change Requests**
  - Provide effective and efficient change control

Configuration Management PA Mapping

- Configuration and Asset Management
  - Changes to production environment, software distribution/updates
- Operations (Facilities) and Platforms
  - New offices, changes to facilities, changes to existing platform configurations
- Problem Management
  - Changes to production environment

Configuration Management PA Recommendations

- Establish procedures, use automated tools where possible
- Anticipate need for structured, well managed verification effort

Process and Product Quality Assurance PA

- **SP 1.1-1 Objectively Evaluate Processes**
  - Fact based indications of conformance and performance
- **SP 1.2-1 Objectively Evaluate Work Products and Services**
  - Similar to 1.1-1

Process and Product Quality Assurance PA Mapping

- All six functions

Process and Product Quality Assurance PA Recommendations

- Classic recommendations:
  - Use the right people, focus on the right priorities
  - Apply to critical needs and typically problematic areas (asset management, production control, creative platform folks acting like cowboys)
- Plan for QA across the entire function (all of help desk)
- Use representative sampling for objective evidence (actual call events across shifts, platform types, etc)

Measurement and Analysis PA

- **SP 1.1-1 Establish Measurement Objectives**
  - Know what you want to measure and why, use metrics intelligently

Measurement and Analysis PA Mapping

- Operations
  - Batch performance measures, resource expenditures
- Help Desk
  - Call volumes, average response and call times, backlog data

Measurement and Analysis PA Recommendations

- Classic: Understand the needs of the stakeholders involved and objectives of measurement program(s)
- Trend over time
- Use metrics for the larger planning and budgeting cycle

Summary

Mark Servello, Vice President
Jim Gibson, Senior Consultant
ChangeBridge, Incorporated

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Summary

- The CMMI is a valid tool for process management in Corporate IT organizations
- You must understand your system of systems
  - Each hardware or software system has a "product life"
  - The evolution of each system is not performed in isolation
- You must interpret the CMMI based on
  - Organization structure
  - Criticality of system
  - Type of product or service

Contact Information

- **Mark Servello, Vice President**
  703-378-0975 voice
  Mark.Servello@changebridge.com

- **Jim Gibson, Senior Consultant**
  803-749-0714 voice
  Jim.Gibson@changebridge.com