Models for Software Quality

The Capability Maturity Model Integrated for Systems Engineering and Software Engineering, Version 1.1

Integrated Project Management (IPM): The CMMI and collaborative product development

Course Guide

Version 6 (Slides Version 16)

About SSQC and Its Services

Since 1990, SSQC has specialized in supporting organizations in the definition and implementation of Software Engineering Practices, Software Quality Assurance and Testing, Business Process Reengineering, ISO 9000 Registration and CMM implementation. SSQC is an official SEI transition partner licensed to provide SCAMPI appraisal services and the SEI's *Introduction to Capability Maturity Model Integration.*

SSQC also offers HM^2, a unique, hybrid appraisal method that defines and correlates the position of an organization with respect to both ISO 9001 and the CMM. HM^2 grew out of SSQC's ground-breaking 1993 paper *Comparing, contrasting ISO 9001 and the SEI Capability Maturity Model*, which was published in IEEE **Computer.** The results of an HM2 assessment are a plan and framework for improving software engineering processes and for implementing the requirements of the two models.

The principals of Software Systems Quality Consulting are William J. Deibler and Robert C. Bamford.

William J. Deibler II has an MSc. in Computer Science and over 20 years experience in the computer industry, primarily in the areas of software and systems development, software testing, and software quality assurance. Bill has extensive experience in managing and implementing CMM- and ISO 9001-based process improvement in software engineering environments. Bill is an SEI Authorized CBA IPI Lead Assessor and SCAMPI Lead Appraiser for CMMI.

Robert C. Bamford has an MA in mathematics, and has managed training development, technical publications, professional services, and third-party software development. His over 20 years of experience include the facilitating the definition and implementation of management processes, designing and instructing courses, and managing engineering teams.

Bob and Bill have developed and published numerous training courses, auditing tools, research papers, and articles on interpreting and applying the ISO 9000 standards and guidelines and the SEI Capability Maturity Model for Software. Their articles have appeared in McGraw Hill's **Quality Systems Update**, **IEEE COMPUTER**, McGraw Hill's **ISO 9000 Handbook**, **CrossTALK**, and **Software Marketing Journal**. They were the principal authors and project editors of **A Guide to Software Quality System Registration under ISO 9001**.

They have presented research papers at numerous national and international conferences, including those sponsored by the American Society for Quality (ASQ), Pacific Northwest Software Quality (PNSQC), the Software Publishers Association (SPA), Software Technology Support Center (STSC), the Software Engineering Institute (SEI) and Software Research Inc.. Their courses have been attended by software engineering professionals from many of the world's leading technology companies. Their courses, have been sponsored for their members by professional associations, including the ASQ, CSU Long Beach's Software Engineering Forum for Training, Semiconductor Equipment and Materials International (SEMI), Software Engineering Institute (SEI), UC Berkeley and UC Santa Cruz.

They have been active United States TAG members in the ISO/IEC JTC1 SC7 - Software Engineering Standards subcommittee which is responsible for the development and maintenance of ISO 12207 and ISO 15504 (SPICE). Their software development clients have successfully achieved ISO registration and advanced CMM maturity levels.

They have also performed ISO 9000 registration and TickIT audits as external resources under contract to the British Standards Institution (BSi).

Relationship with the SEI

Since 1993, when SSQC received permission from the SEI to reproduce various SEI CMM 1.1 technical reports for resale to the public, SSQC has maintained a close relationship with the SEI. Since 1996, SSQC has offered a variety of presentations and tutorials at the annual SEI-sponsored conferences (SEPG) and symposia in both the US and Europe (ESEPG). SSQC has presented numerous tutorials and presentations at local SPINs in the Silicon Valley.

Since early 1999, SSQC courses, tutorials, presentations, and panels have been successfully promoting the CMMI transition efforts (both staged and continuous representations) at a variety of conferences to include ESEPG 1999-2002, SEPG 1999-2002, Quality Week 1999-2001, PNSQC 1999-2000.

Integrated Project Management (IPM)

The CMMI and collaborative product development

Getting started

- About the presenters
- Audience
  - Some level of familiarity with the Software Capability Maturity Model Version 1.1
    - Maintaining SW CMM 1.1 or migrating to CMMI
- Experience breeds … , well, opinions, concerns, etc.

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Project management: prioritized issues

- Develop an individual list of the challenges your organization needs to address in **managing projects or programs**
  - On-going problems
  - Impending needs
- Prioritize individual list
- Develop a single prioritized list of five items as a team
- Pick a representative who will present list in 3 minutes
- Ensure course addresses your concerns to greatest possible extent

About the rest of the presentation

- Brief orientation
  - Structure of CMMI SE/SW Staged - Representation v1.1
    - Process Areas, Goals, Practices, and Process Categories
  - Chasing levels
- Integrated Project Management (IPM)
  - Metrics, models, Key Performance Indicators
  - IPM and the Project Management Category Process Areas
    - Project Planning (PP)
    - Process Monitoring and Control (PMC)
    - Team exercise: Case study
    - Risk Management (RM)
  - IPM and the Process Management Process Category Process Areas
  - IPM and the Support Process Category Process Areas
  - IPM and the Engineering Process Category Process Areas
- Integrated Product and Process Development (IPPD)
- Tools, tips, checklists and implementation opportunities

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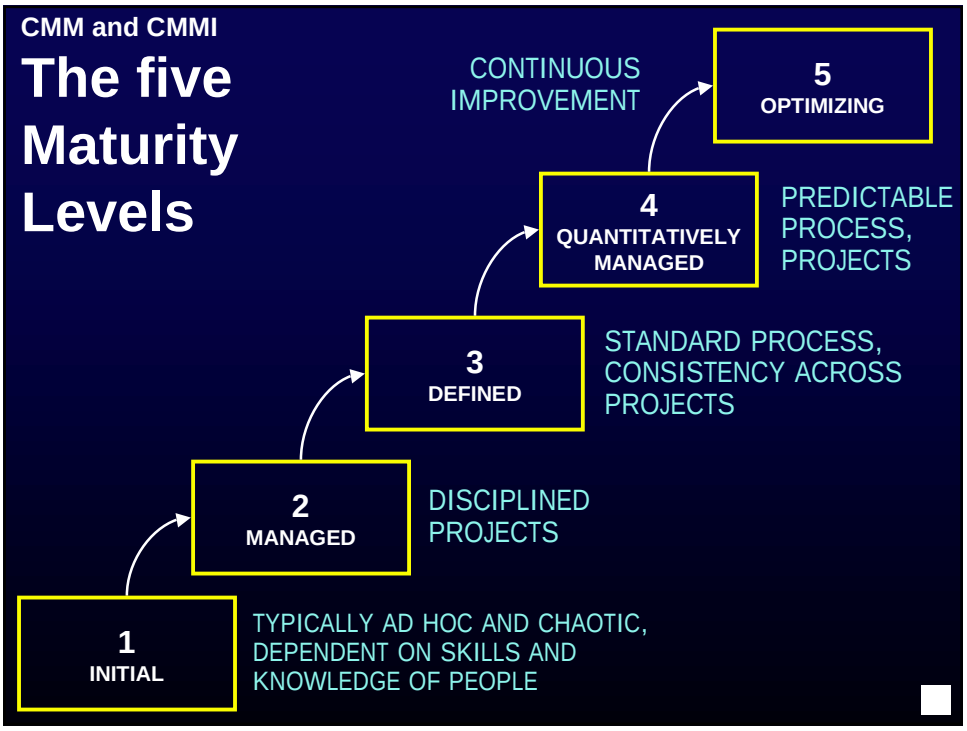

CMMI Process Areas by Maturity Level

Maturity Level 2: Managed	Maturity Level 3: Defined
▪ Requirements Management ▪ Project Planning ▪ Project Monitoring and Control ▪ Supplier Agreement Management ▪ Measurement and Analysis ▪ Process and Product Quality Assurance ▪ Configuration Management	▪ Requirements Development ▪ Technical Solution ▪ Product Integration ▪ Verification ▪ Validation ▪ Organizational Process Focus ▪ Organizational Process Definition ▪ Organizational Training ▪ Integrated Project Management ▪ Risk Management ▪ Decision Analysis and Resolution

Maturity Level 4: Quantitatively Managed	Maturity Level 5: Optimizing
▪ Organizational Process Performance ▪ Quantitative Project Management	▪ Organizational Innovation and Deployment ▪ Causal Analysis and Resolution

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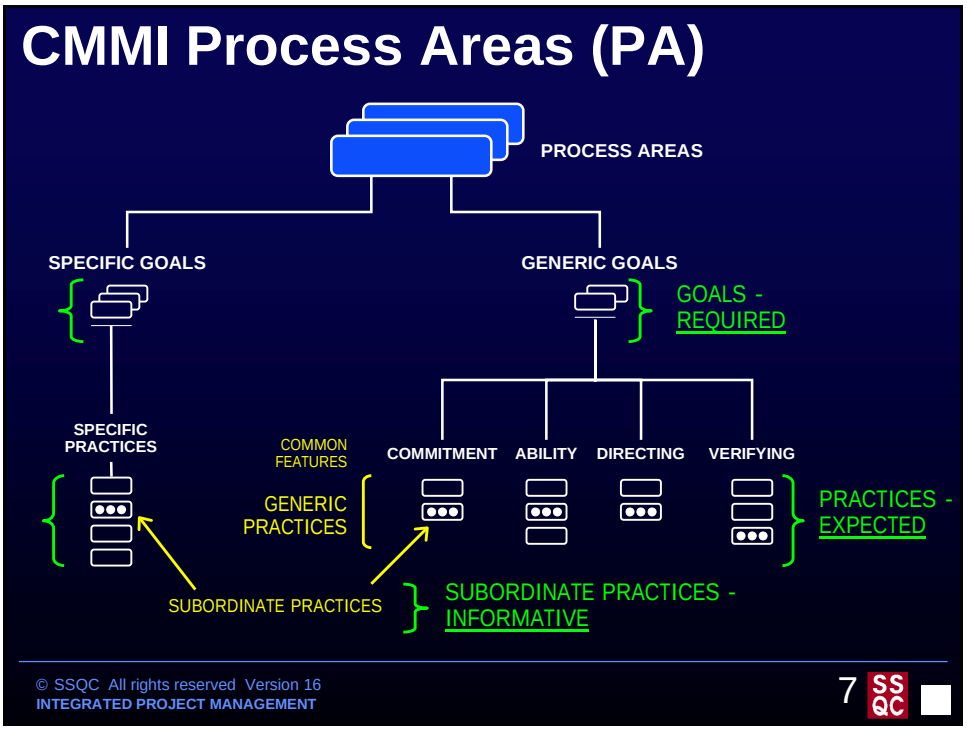
CMMI Process Areas (PA)
PROCESS AREAS
SPECIFIC GOALS
GENERIC GOALS
GOALS - REQUIRED
SPECIFIC PRACTICES
COMMON FEATURES
COMMITMENT
ABILITY
DIRECTING
VERIFYING
GENERIC PRACTICES
PRACTICES - EXPECTED
SUBORDINATE PRACTICES
SUBORDINATE PRACTICES - INFORMATIVE
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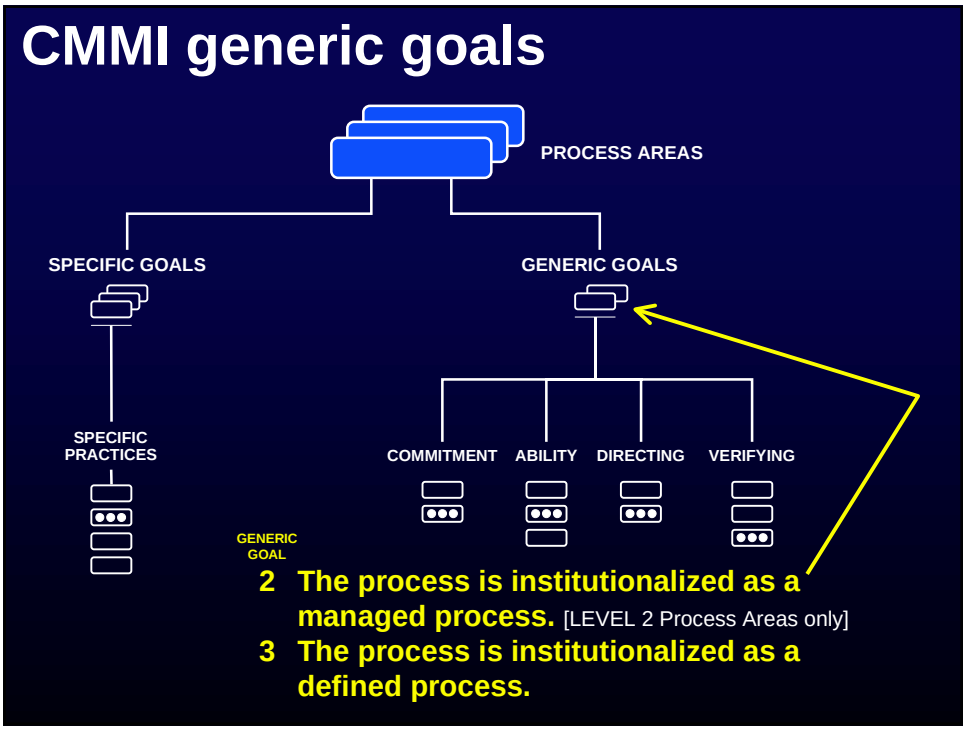
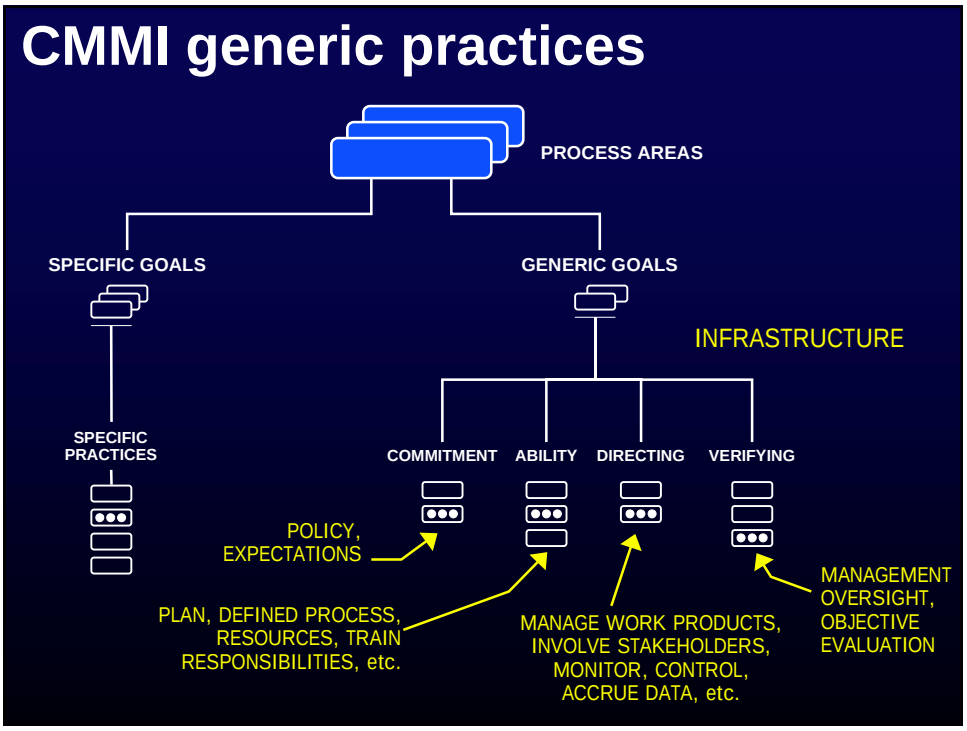
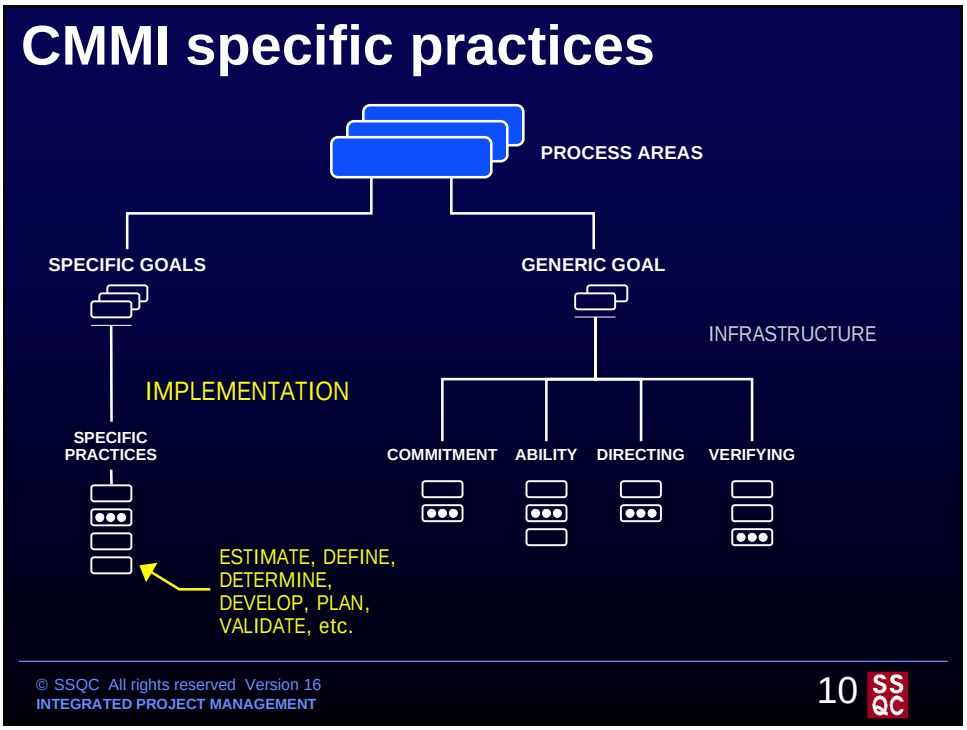

CMMI generic goals
PROCESS AREAS
SPECIFIC GOALS
GENERIC GOALS
SPECIFIC PRACTICES
COMMITMENT
ABILITY
DIRECTING
VERIFYING
GENERIC GOAL
2 The process is institutionalized as a managed process. [LEVEL 2 Process Areas only]
3 The process is institutionalized as a defined process.


CMMI generic practices
PROCESS AREAS
SPECIFIC GOALS
GENERIC GOALS
INFRASTRUCTURE
SPECIFIC PRACTICES
COMMITMENT
ABILITY
DIRECTING
VERIFYING
POLICY, EXPECTATIONS
PLAN, DEFINED PROCESS, RESOURCES, TRAIN RESPONSIBILITIES, etc.
MANAGE WORK PRODUCTS, INVOLVE STAKEHOLDERS, MONITOR, CONTROL, ACCRUE DATA, etc.
MANAGEMENT OVERSIGHT, OBJECTIVE EVALUATION


CMMI specific practices
PROCESS AREAS
SPECIFIC GOALS
GENERIC GOAL
INFRASTRUCTURE
IMPLEMENTATION
SPECIFIC PRACTICES
COMMITMENT
ABILITY
DIRECTING
VERIFYING
ESTIMATE, DEFINE, DETERMINE, DEVELOP, PLAN, VALIDATE, etc.
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CMMI Process categories: primary interactions

(but not the only interactions)

Category	Type	Level	Process Area
Process Management	Basic	3	Organizational Process Focus
		3	Organizational Process Definition
		3	Organizational Training
	Advanced	4	Organizational Process Performance
		5	Organizational Innovation and Deployment
Project Management	Basic	2	Project Planning
		2	Project Monitoring and Control
		2	Supplier Agreement Management
	Advanced	3	Integrated Project Management for IPPD
		3	Risk Management
		4	Quantitative Project Management
Engineering		2	Requirements Management
		3	Requirements Development
		3	Technical Solution
		3	Product Integration
		3	Verification
		3	Validation
Support	Basic	2	Measurement and Analysis
		2	Process and Product Quality Assurance
		2	Configuration Management
	Advanced	3	Decision Analysis and Resolution
		5	Causal Analysis and Resolution

Chasing levels

Maturity levels are measured by the the achievement of the specific and generic goals that apply to each pre-defined set of process areas. [2000-TR-30, paragraph 2, p. 23]

Conformance with a process area means that in the planned and implemented processes there is an associated process (or processes) that addresses either the specific and generic practices of the process area or alternatives that clearly and unequivocally accomplish a result that meets the goal associated with that specific or generic practice. [2000-TR-30, paragraph 2, p. 26]

… trying to skip maturity levels is usually counter-productive. [2000-TR-30, paragraph 2, p. 24]

Why Integrated Project Management (IPM)?

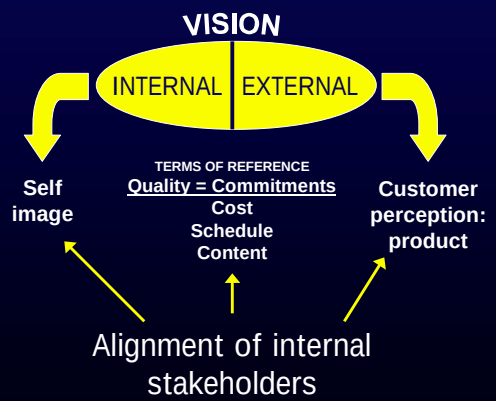
- Shouldn't I wait until Level 3?
- For small organizations, small projects, level 3 PAs can be set as the initial goal
  - Support for cross-functional teams
  - Significant benefits in going beyond monitoring and control (Level 2)
- S/W CMM v1.1 - transition, inspiration
- Because sometimes skipping levels is productive
  - **Or, because sometimes not skipping levels is counterproductive**

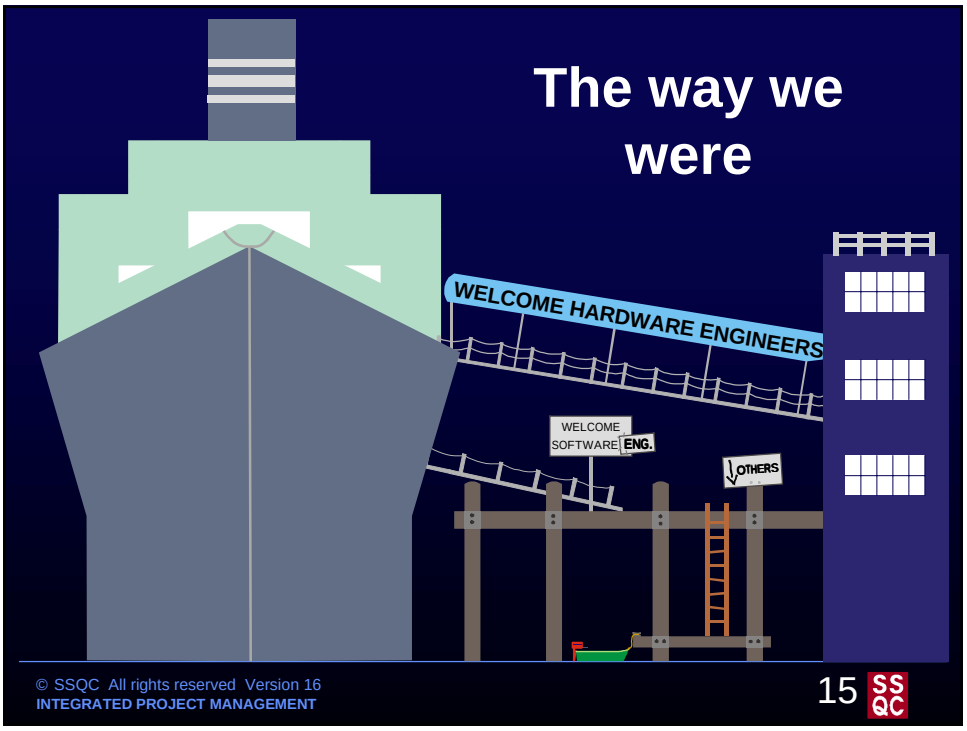
Importance TO PROCESS IMPROVEMENT
Support FOR VISION AND BUSINESS OBJECTIVES

IPM is a cornerstone of process improvement. It enhances every Engineering, Support, and Project Management PA.

It enables continuous, systematic alignment of resources, activities, and business objectives - converging on customer value.

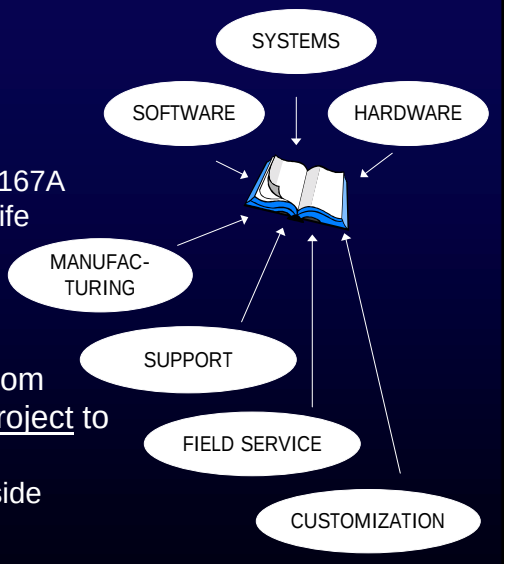
Establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process
[v1.1, IPM, Purpose]





CMMI: Opportunities beyond the S/W CMM

- Integrate engineering disciplines - one "book"
  - Reduce influence and language of MIL-STD-2167A
  - Appears more flexible, life cycle independent
  - More content for engineering
- IPPD - Expands scope from (software) engineering project to product delivery
  - Inclusion of groups outside engineering is explicit



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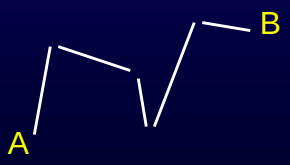
Benefits TO THE ORGANIZATION

Since the defined process of each project is tailored from the organization's set of standard processes, variability among projects is typically reduced and projects can more easily share process assets, data, and lessons learned. [v1.1, IPM, Introductory Notes]

Reduced variability and a systematic multi-discipline view of product delivery translates directly into satisfying commitments to all stakeholders, including customers.



Enforced reuse of assets minimizes the cost of reinvention and lays a stable foundation for continuous improvement.

Relationships and dependencies
WITHIN THE PROJECT MANAGEMENT CATEGORY

Integrated Project Management (IPM) ...

- Relies on Project Planning (PP) and Project Monitoring and Control (PMC) for basic project planning and management.
  - Adds requirements for systematic coordination.
  - Incorporates data to drive decisions.
- Integrates Supplier Agreement Management (SAM) to support outsourcing development.

IPM + PP + PMC

IPM: Specific goals and practices

SPECIFIC GOALS

SG 1 The project is conducted using a defined process that is tailored from the organization's set of standard processes.

SG 2 Coordination and collaboration of the project with relevant stakeholders is conducted.

SPECIFIC PRACTICES

SP1.1 Establish, maintain the project's defined process.

SP 1.2 Use the organizational process assets and measurement repository for estimating and planning the project's activities.

SP 1.3 Integrate the project plan and the other plans that affect the project to describe the project's defined process.

SP 1.4 Manage the project using the project plan, the other plans that affect the project, and the project's defined process.

SP1.5 Contribute work products, measures, and documented experiences to the organizational process assets.

A critical specific practice

SPECIFIC PRACTICE

1.4 Manage the project using the integrated plans

WHY: **product delivery** is beyond any one group's capabilities, responsibilities

SIGNIFICANT INDICATOR(S):
SP1.3, SubPractice 5, peer reviews
SP1.4, SubPractice 2, thresholds

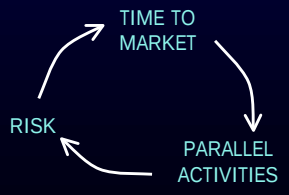
AFFECTED STAKEHOLDERS:
Project team (Mktg … Mfg)

RESISTANCE:
Accountability - being measured, reporting progress

SPECIAL APPRAISAL CONSIDERATIONS AND CHALLENGES: Prepare, prepare, and prepare - Ensure there is adequate preparation time to review the volume of documentation

RECOMMENDATIONS:
Pilot - pick your project wisely

- New Product Introduction
- Support
- Manufacturing Engineering
- Training
- Technology Transfer
- Manufacturing Master Plan



Specific practice 1.4, subpractice 2

2. **Monitor and control the project's activities and work products using the project's defined process, project plan, and other plans that affect the project.**

   This task typically includes the following:

   - Using the defined entry and exit criteria to authorize the initiation and determine the completion of the tasks
   - Monitoring the activities that could significantly affect the actual values of the project's planning parameters
   - Tracking the project's planning parameters using measurable thresholds that will trigger investigation and appropriate actions
   - Monitoring product and project interface risks
   - Managing external and internal commitments based on the plans for the tasks and work products of implementing the project's defined process.

Project management

- Metrics - track
- Models - predict
- Key performance indicators

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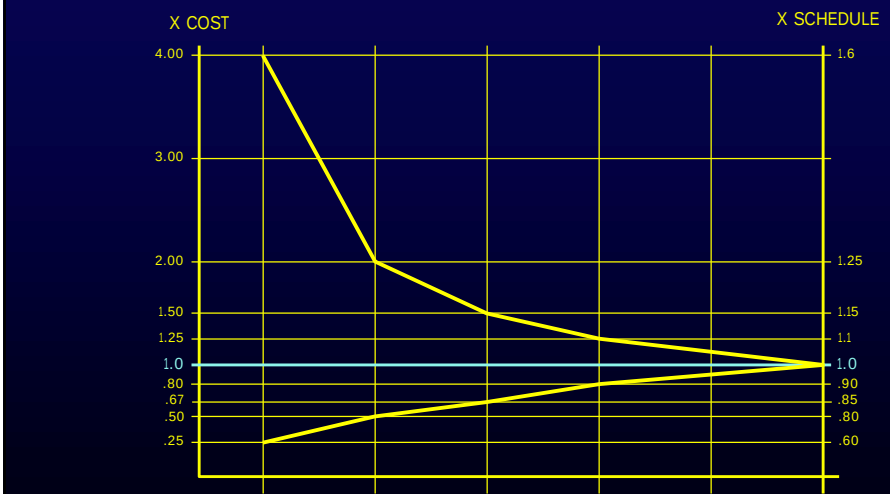
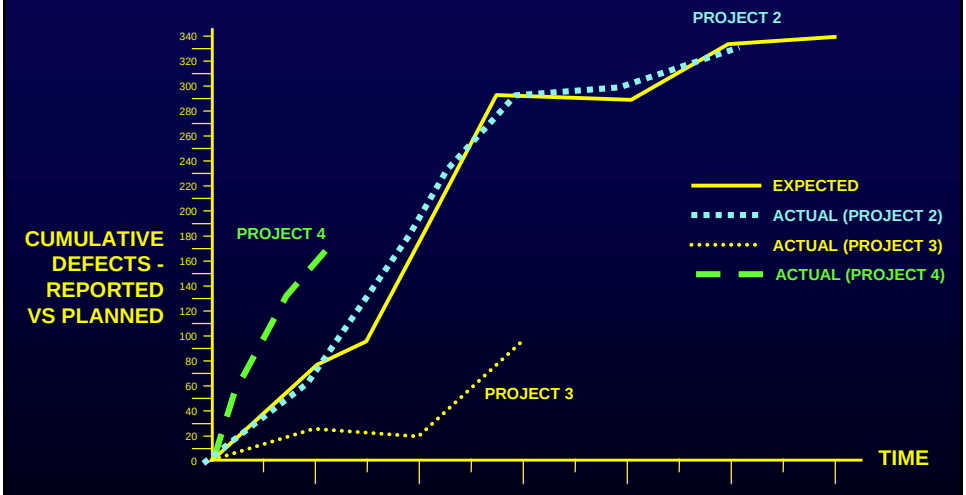
Modeling variation in planning: setting management expectations



Based on S. McConnell, "Software Project Survival Guide", page 7

Modeling performance: defects



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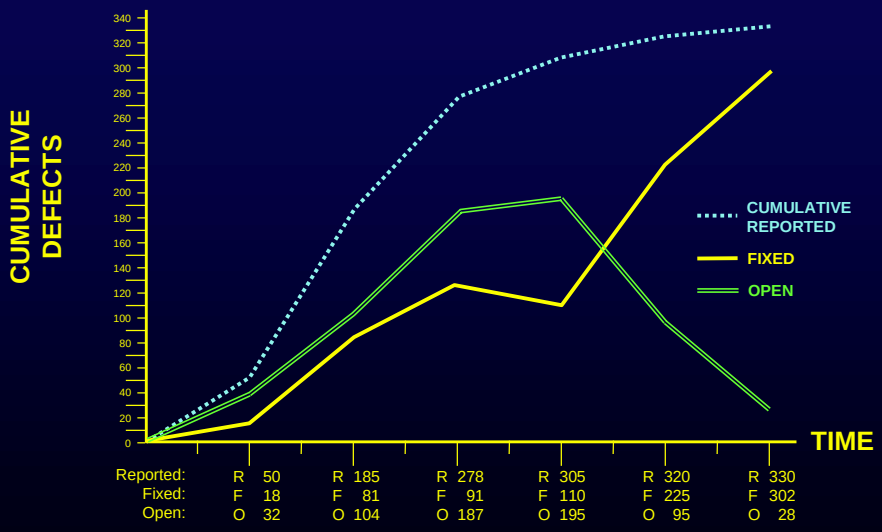
Tracking performance: defects



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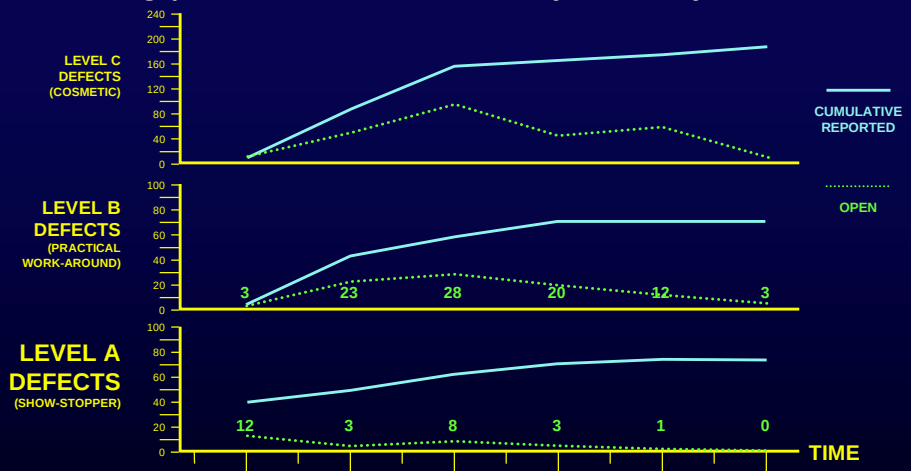
Tracking performance: defects by severity



Total Reported:	R 50	R 185	R 278	R 305	R 320	R 330
CUMULATIVE DEFECTS A:	A 41 +9	A 50 +12	A 62 +8	A 70 +3	A 73 +0	A 73
B:	B 4 +41	B 45 +13	B 58 +12	B 70 +0	B 70 +0	B 70
C:	C 5 +85	C 90 +68	C 158 +7	C 165 +12	C 177 +10	C 187

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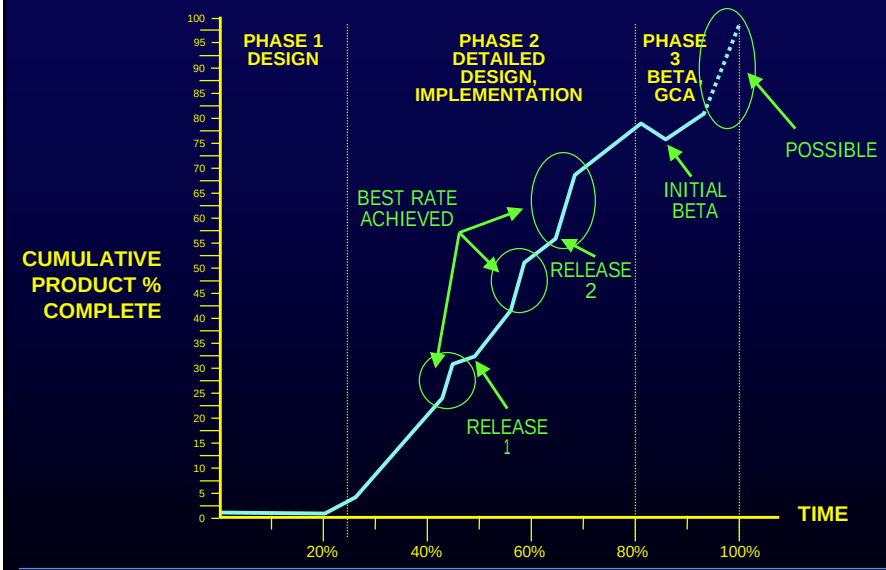
Tracking performance: code



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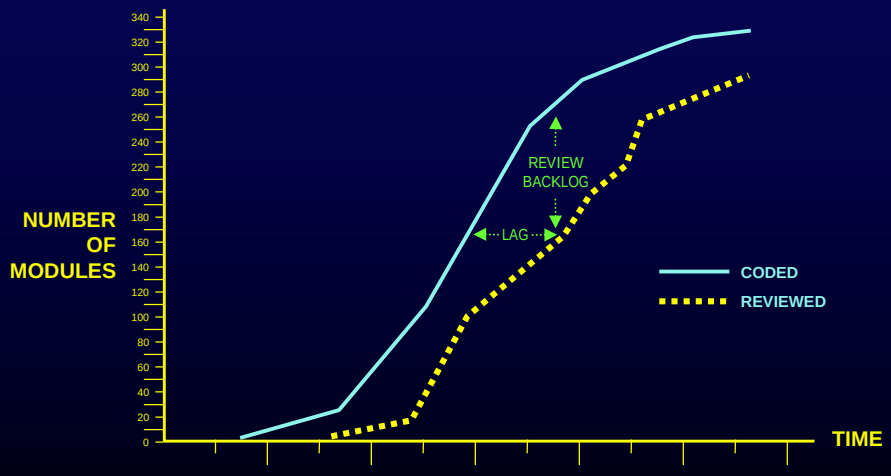
Tracking performance: reviews



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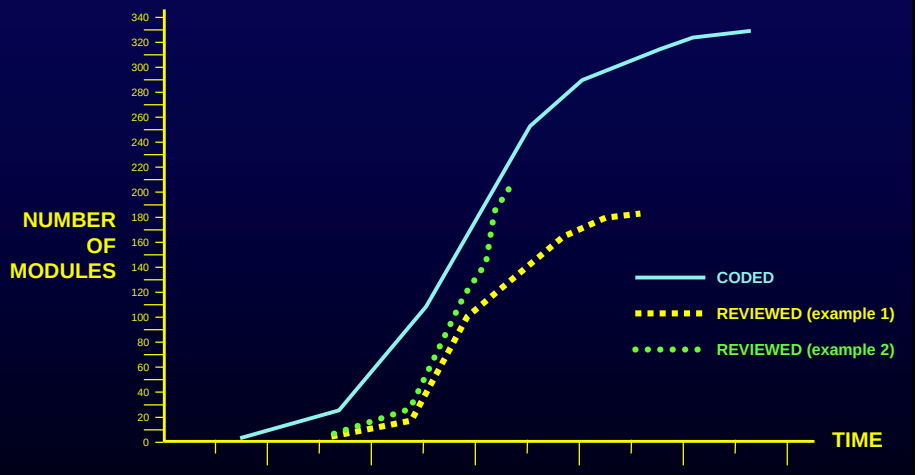
Tracking performance: reviews (cont.)



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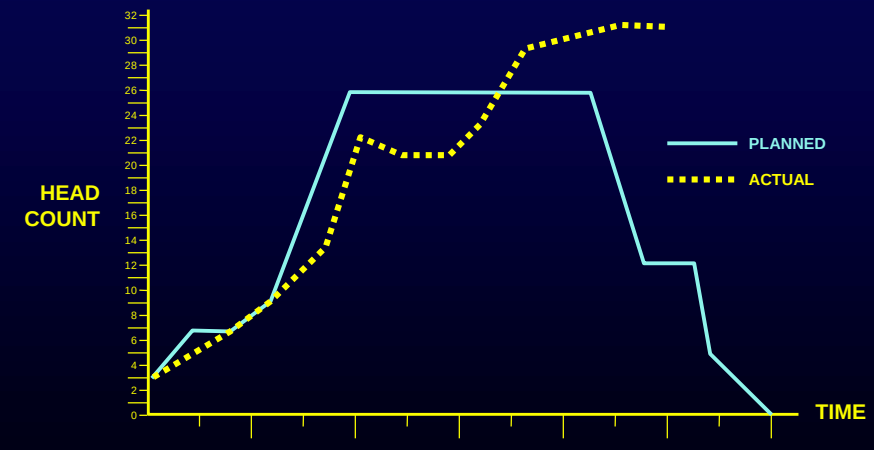
Tracking head count against the plan



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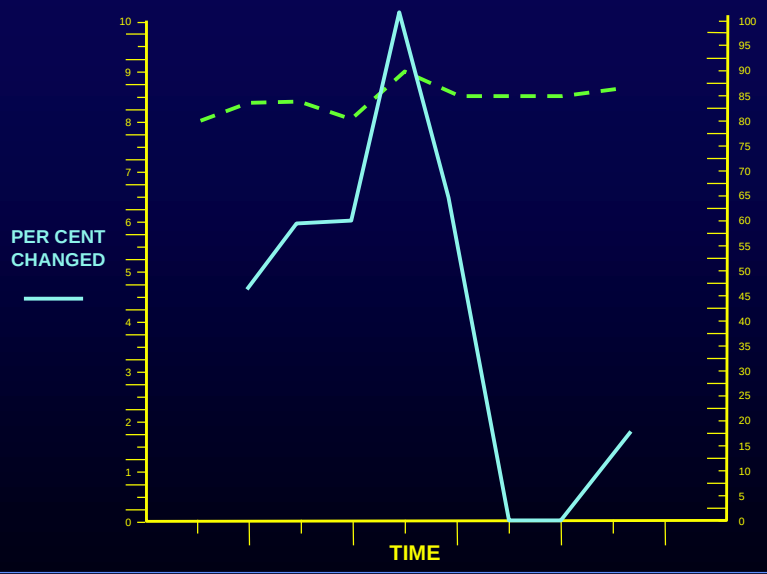
Requirements stability



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IPM: Specific goals and practices (cont.)

SPECIFIC GOALS

SG 1 The project is conducted using a defined process that is tailored from the organization's set of standard processes.

SG 2 Coordination and collaboration of the project with relevant stakeholders is conducted.

SPECIFIC PRACTICES

SP2.1 Manage the involvement of the relevant stakeholders in the project.

SP 2.2 Participate with relevant stakeholders to identify, negotiate, and track critical dependencies.

SP 2.3 Resolve issues with relevant stakeholders.

INTEGRATED PROJECT MANAGEMENT

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A critical specific practice

2.2 Manage [critical] dependencies

WHY: make dependencies continuously visible, mitigate or prevent impact

SIGNIFICANT INDICATOR(S):
SP2.2, SubPractice 5 - document the critical dependencies and commitments

AFFECTED STAKEHOLDERS:
Project team (Mktg … Mfg)

RESISTANCE:
Exposure - versus milestone chicken (*or* R = v / i)

SPECIAL APPRAISAL CONSIDERATIONS AND CHALLENGES: Look carefully at SubPractice 6 - track and take action

RECOMMENDATIONS: Pick a pilot project with a strong manager who under-stands the big picture; ensure team focuses on critical dependencies - avoid blame, focus on solutions

- Identify
- Inform
- Manage - SP 2.2.6
  - Track and take corrective and preventive action
  - Evaluate the effects of late and early completion for impacts on future activities and milestones

I wish someone had told me …

Specific practice 2.2, subpractice 5

5. Document the critical dependencies and commitments.

Documentation of commitments typically includes the following:

- Describing the commitment
- Identifying who made the commitment
- Identifying who is responsible for satisfying the commitment
- Specifying when the commitment will be satisfied
- Specifying the criteria for determining if the commitment has been satisfied

Project Planning (PP)

SPECIFIC GOALS		SPECIFIC PRACTICES	
SG 1	Estimates of project planning parameters are established and maintained.	SP 1.1	Establish … top-level Work Breakdown Structure (WBS)
		SP 1.2	Establish and maintain estimates of attributes *[parameters]* of the work products and tasks
		SP 1.3	Define project life cycle phases …
		SP 1.4	Estimate … effort and cost for work products and tasks ...
SG 2	A project plan is established and maintained as the basis for managing the project.	SP 2.1	Establish and maintain budget and schedule
		SP 2.2	Identify and analyze risks
		SP 2.3	Plan for data management [documentation, all forms]
		SP 2.4	Plan for ... resources
		SP 2.5	Plan for knowledge and skills
		SP 2.6	Plan stakeholder involvement
		SP 2.7	Establish and maintain the overall project plan
SG 3	Commitments to the project plan are established and maintained.	SP 3.1	Review all plans that affect the project ...
		SP 3.2	Reconcile plan to reflect available and estimated resources
		SP 3.3	Obtain commitment from … stakeholders

Life cycles and life cycles

From Project Planning (PP), Specific Practice 1.3

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

The determination of a project's life-cycle phases provides for planned periods of evaluation and decision making. These are normally defined to support logical decision points at which significant commitments are made concerning resources and technical approach. Such points provide planned events at which project course corrections and determinations of future scope and cost can be made.

For Software Engineering

The determination of project phases for software typically includes selection and refinement of a software development model to address interdependencies and appropriate sequencing of software project activities.

For Systems Engineering

Identify the major product phase (e.g., concept exploration, development, etc.) for the current state of the product ...

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Life cycles and life cycles (cont.)

More from Project Planning (PP), Specific Practice 1.3

The project life cycle consists of phases that need to be defined depending on the scope of requirements, the estimates for project resources, and the nature of the project. Larger projects may contain multiple phases, such as concept exploration, development, production, operations, and disposal. Within these phases, subphases may be needed. A development phase may include subphases such as requirements analysis, design, fabrication, integration, and verification. Depending on the strategy for development, there may be intermediate phases for the creation of prototypes, increments of capability, or spiral model cycles.

Understanding the project life cycle is crucial in determining the scope of the planning effort and the timing of the initial planning, as well as the timing and criteria (critical milestones) for re-planning.

Life cycles and life cycles (cont.)

Guidance from IPM Specific Goal 1

The project's defined process must include those processes from the organization's set of standard processes that address all processes necessary to develop and maintain the product. The product-related life-cycle processes, such as the manufacturing and support processes, are developed concurrently with the product.

From Chapter 3

A “product life cycle” is the period of time, consisting of phases, that begins when a product is conceived and ends when the product is no longer available for use. ... A product life cycle could consist of the following phases: (1) concept/vision, (2) feasibility, (3) design/development, (4) production, and (5) phase out.

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Life cycles and life cycles (cont.)

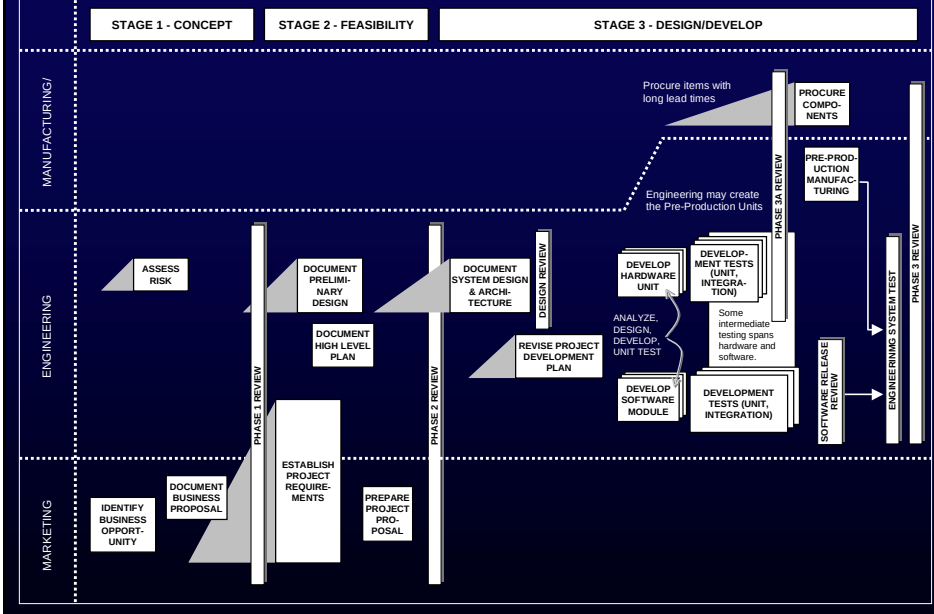
From the Glossary

Integrated Product and Process Development	A systematic approach to product development that achieves a timely collaboration of relevant stakeholders throughout the product life cycle to better satisfy customer needs.

Guidance from RD Specific Practice 1.2

For Integrated Product and Process Development

Relevant stakeholders representing all phases of the product's life cycle should include business as well as technical functions. In this way, concepts for all product-related lifecycle processes are considered concurrently with the concepts for the products.



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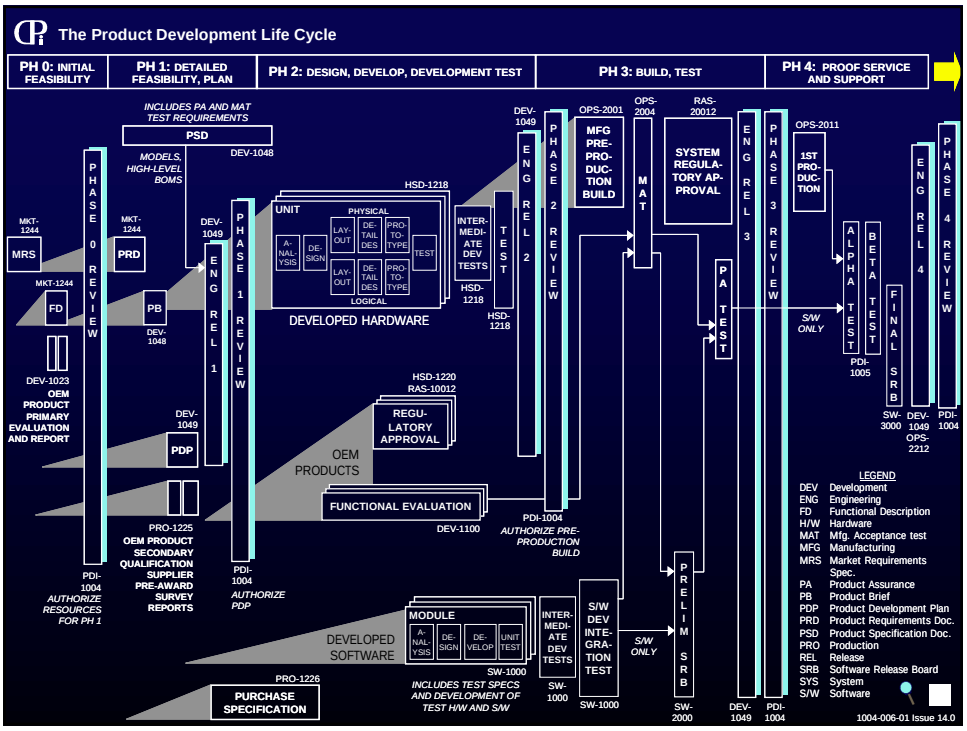
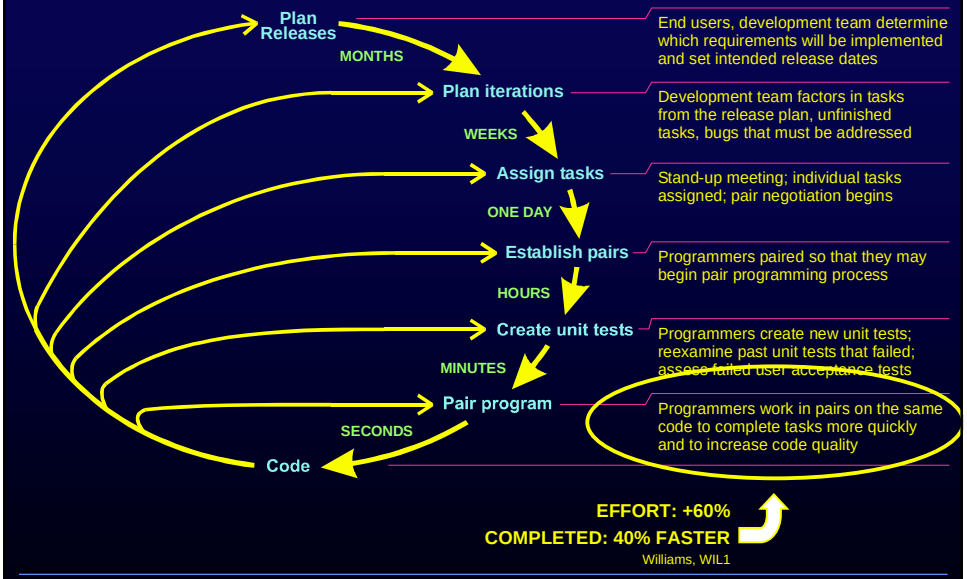


Extreme programming and pair programming

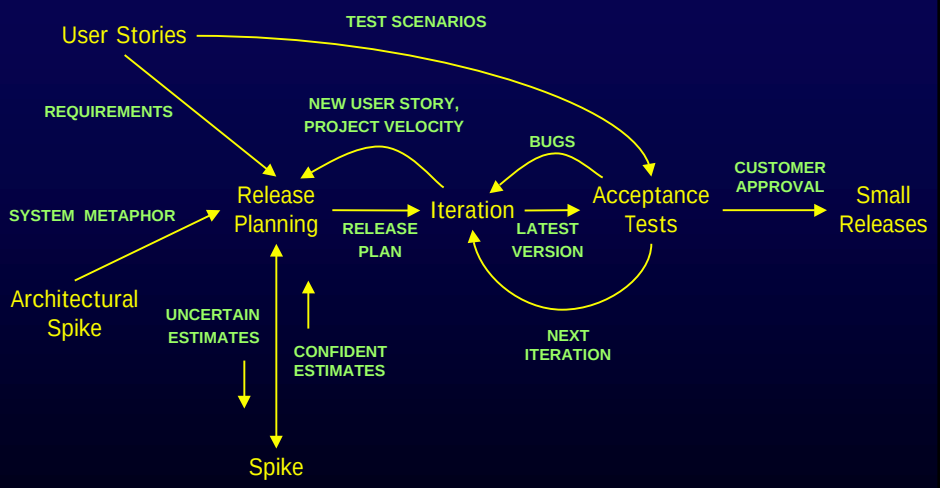


INTEGRATED PROJECT MANAGEMENT

Based on Wells, WEL1

42

Extreme programming - as a process flow



Wells, WEL2

INTEGRATED PROJECT MANAGEMENT

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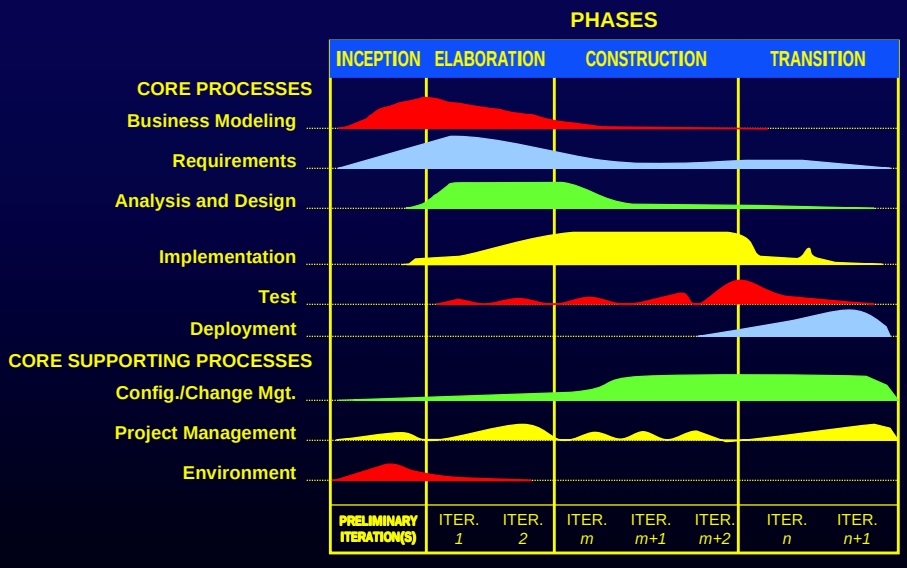
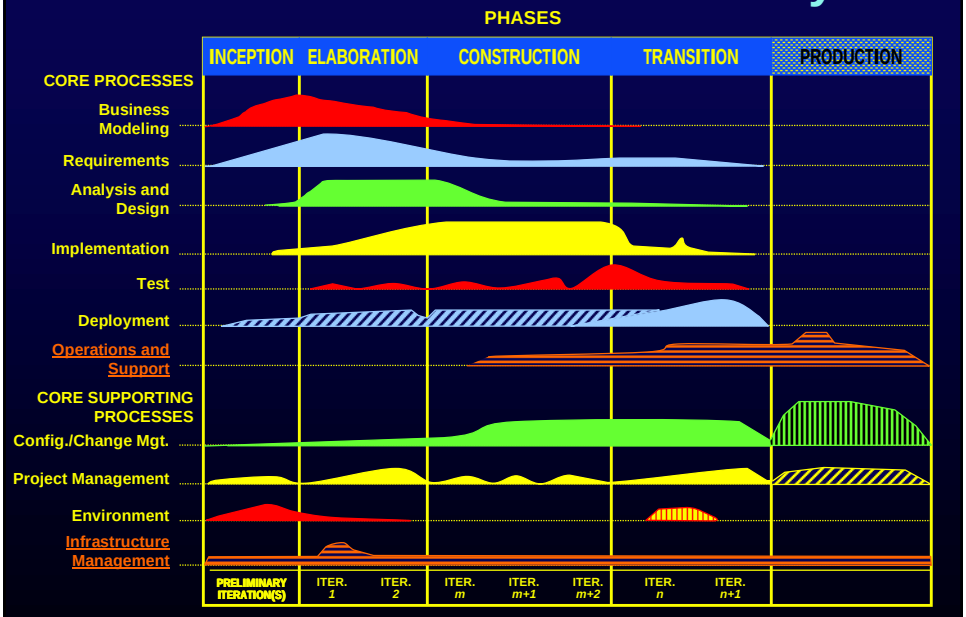
Unified Process Life Cycle



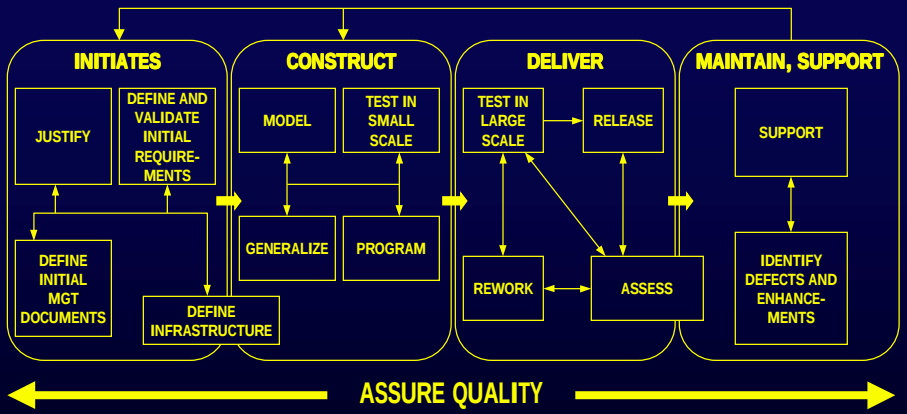
Scott Ambler, *Enhancing the Unified Process*, **Software Development** , Vol. 7, No. 10, Oct. 1999, p.33

Enhanced Unified Process Life Cycle



Scott Ambler, *Enhancing the Unified Process*, **Software Development** , Vol. 7, No. 10, Oct. 1999, p.33

The Object-Oriented Process (OOSP) Life Cycle



ASSURE QUALITY

- Manage the project
- Train and educate
- Manage people
- Manage risk
- Manage reuse
- Manage metrics
- Manage deliverables
- Manage infrastructure

Scott Ambler, *Enhancing the Unified Process*, **Software Development** , Oct. 1999, p.33

Project Monitoring and Control (PMC)

SPECIFIC GOALS	SPECIFIC PRACTICES
SG 1 Actual performance and progress of the project are monitored against the project plan.	Monitor actuals against the plan: SP 1.1 Parameters SP 1.2 Commitments SP 1.3 Risks SP 1.4 Data management SP 1.5 Stakeholder involvement SP 1.6 Periodically review progress, performance, issues SP 1.7 Review accomplishments and results at selected milestones
SG 2 Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.	SP 2.1 Collect and analyze the issues and determine the corrective actions necessary to address the issues. SP 2.2 Take corrective action on identified issues. SP 2.3 Manage corrective actions to closure … *complete … effective*.

NOTE The word *dependency* does not appear in Project Monitoring and Control.

Integrated Product and Process Development (IPPD)

- With IPPD you get:
  - Two new specific goals for Integrated Product Management (IPM)
  - Two new Process Areas (PA)s
  - Amplification in various other Process Areas
  - Only 64 more pages

IPPD: Specific goals for Integrated Project Management (IPM)

SG 1 The project is conducted using a defined process that is tailored from the organization's set of standard processes.

SG 2 Coordination and collaboration of the project with relevant stakeholders is conducted.

SPECIFIC GOALS

SG 3 The project is conducted using the project's shared vision.

SG 4 The integrated teams needed to execute the project are identified, defined, structured, and tasked.

SPECIFIC PRACTICES

SP3.1 Identify expectations, constraints, interfaces, and operational conditions applicable to the project's shared vision.

SP 3.2 Establish and maintain a shared vision for the project.

SP 3.3 Resolve issues with relevant stakeholders.

IPPD: Specific goals for Integrated Project Management (IPM) (cont.)

SG 1 The project is conducted using a defined process that is tailored from the organization's set of standard processes.

SG 2 Coordination and collaboration of the project with relevant stakeholders is conducted.

SPECIFIC GOALS

SG 3 The project is conducted using the project's shared vision.

SG 4 The integrated teams needed to execute the project are identified, defined, structured, and tasked.

SPECIFIC PRACTICES

SP 4.1 Determine the integrated team structure that will best meet the project objectives and constraints.

SP 4.2 Develop a preliminary distribution of requirements, responsibilities, authorities, tasks, and interfaces to teams in the selected integrated team structure.

SP 4.3 Establish and maintain teams in the integrated team structure.

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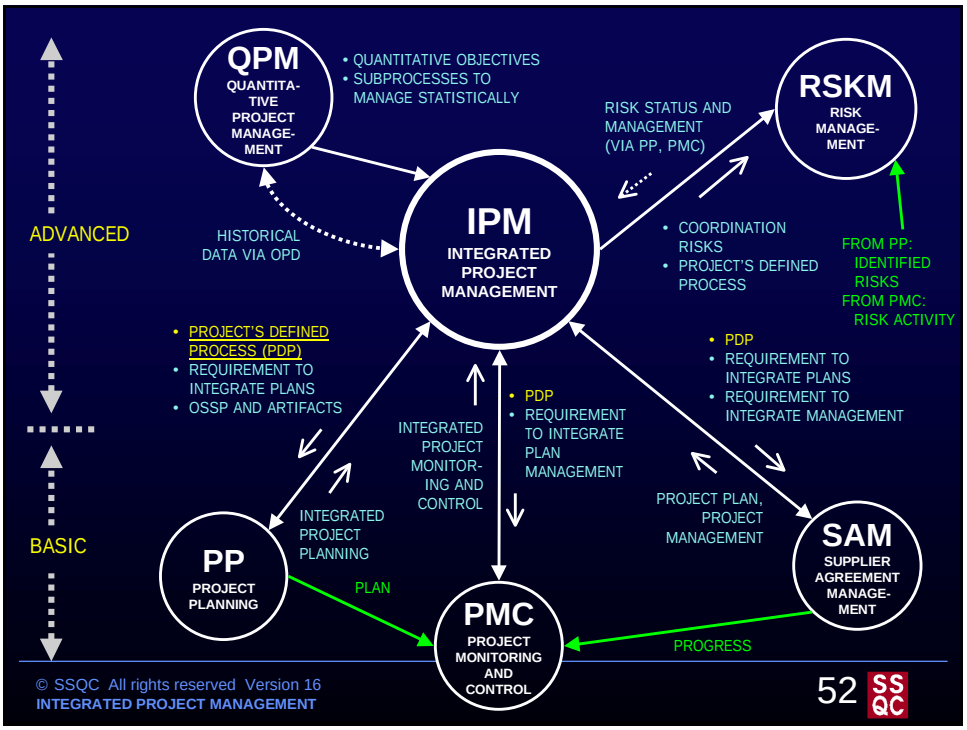
Case Study: AJ OY



Risk Management (RISKM)

SPECIFIC GOALS

SG 1 Preparation for risk management is conducted.

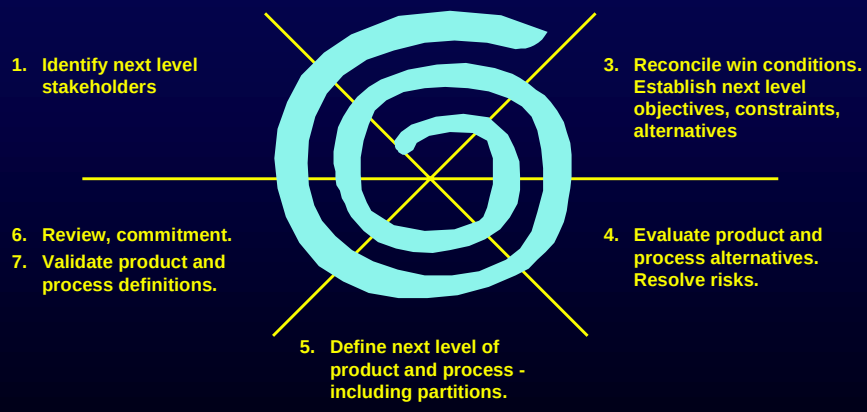
SG 2 Risks are identified and analyzed to determine their relative importance.

SG3 Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.

SPECIFIC PRACTICES

- **SP 1.1** Determine risk sources and categories
- **SP 1.2** Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.
- **SP 1.3** Establish and maintain the strategy to be used for risk management.
- **SP 2.1** Identify and document the risks [in all appropriate product life cycle phases SP2.1.1]
- **SP 2.2** Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.
- **SP 3.1** Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy.
- **SP 3.2** Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate.

Risk and the new spiral model - the win-win elaboration



[BOE1]

INTEGRATED PROJECT MANAGEMENT

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Top 10 Risks

1989	1995
1. Personnel shortfalls	1. Personnel shortfalls
2. Schedules and budgets	2. Schedules, budgets, process
3. Wrong software functions	3. COTS, external components
4. Wrong user interface	4. Requirements mismatch
5. Gold plating	5. User interface mismatch
6. Requirements changes	6. Architecture, performance, quality
7. Externally-furnished components	7. Requirements changes
8. Externally-performed tasks	8. Legacy software
9. Real-time performance	9. Externally-performed tasks
10. Straining computer science	10. Straining computer science

Barry Boehm

How do you already incorporate risk prevention and mitigation into your projects?

A COMMENT

Some activities, which are not perceived as having intrinsic importance, may be parts of a mitigation strategy (cross training, reviews, investigation of alternatives).

If the mitigation strategy is not clearly communicated and managed, there is a significant risk that the mitigation will be OBE*.

* OBE Overcome by Events

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Risks to be managed

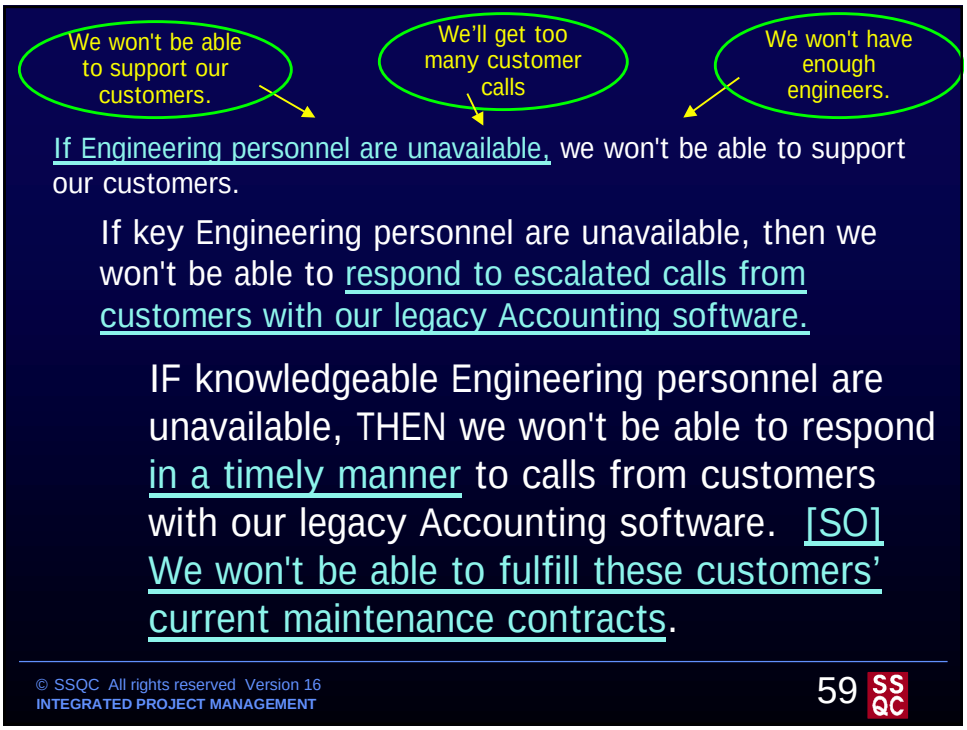
- Future
- Significant probability of future occurrence
- Significant potential impact
- Specific and manageable

IF … THEN … SO …

CONDITION **EFFECT** **CONSEQUENCE**

How a specific planned behavior or outcome is adversely affected

Specific relationship to defined process, plan, assigned responsibility, customer commitment, schedule, cost


We won't be able to support our customers.
We'll get too many customer calls
We won't have enough engineers.
If Engineering personnel are unavailable, we won't be able to support our customers.
If key Engineering personnel are unavailable, then we won't be able to respond to escalated calls from customers with our legacy Accounting software.
IF knowledgeable Engineering personnel are unavailable, THEN we won't be able to respond in a timely manner to calls from customers with our legacy Accounting software. [SO] We won't be able to fulfill these customers' current maintenance contracts.
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INTEGRATED PROJECT MANAGEMENT
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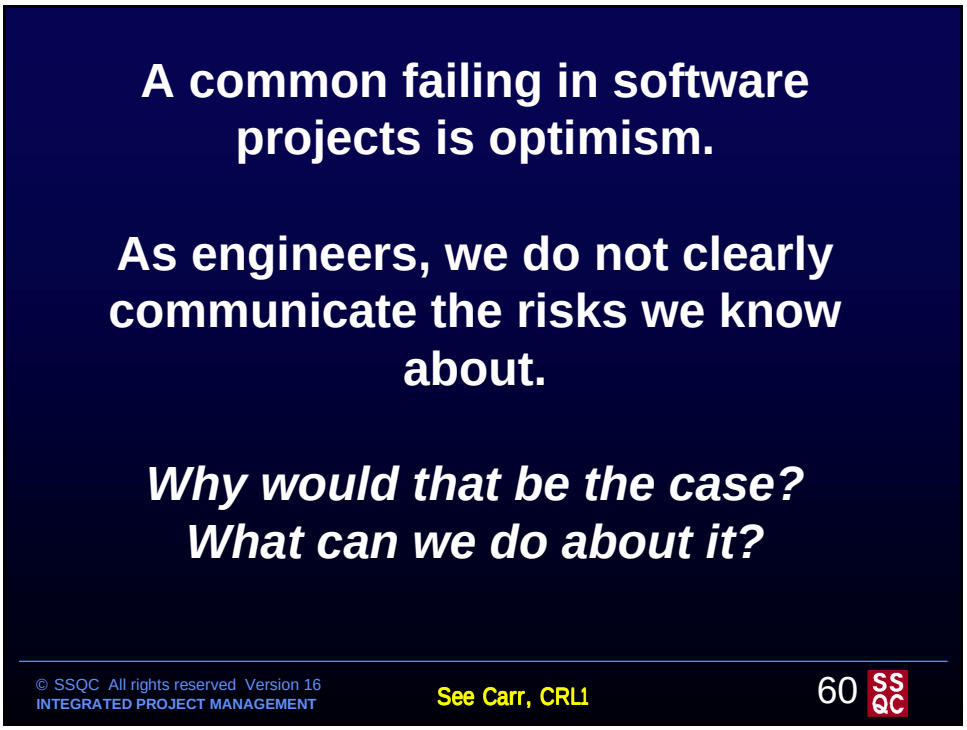
A common failing in software projects is optimism.
As engineers, we do not clearly communicate the risks we know about.
Why would that be the case?
What can we do about it?
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INTEGRATED PROJECT MANAGEMENT
See Carr, CRL1
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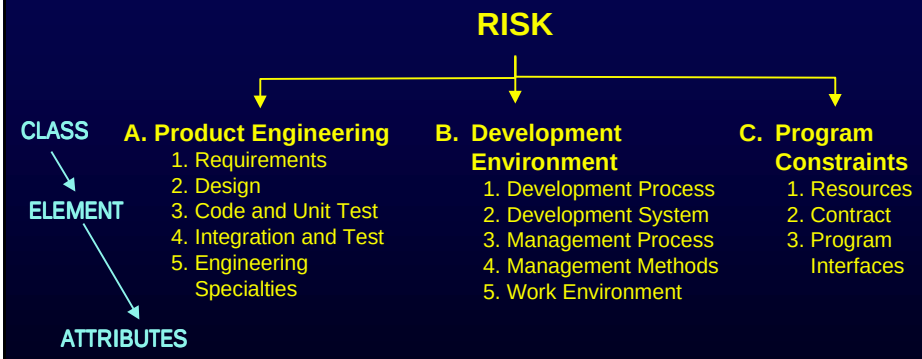
Formal risk identification

- Systematic investigation



Carr, CRL1

INTEGRATED PROJECT MANAGEMENT

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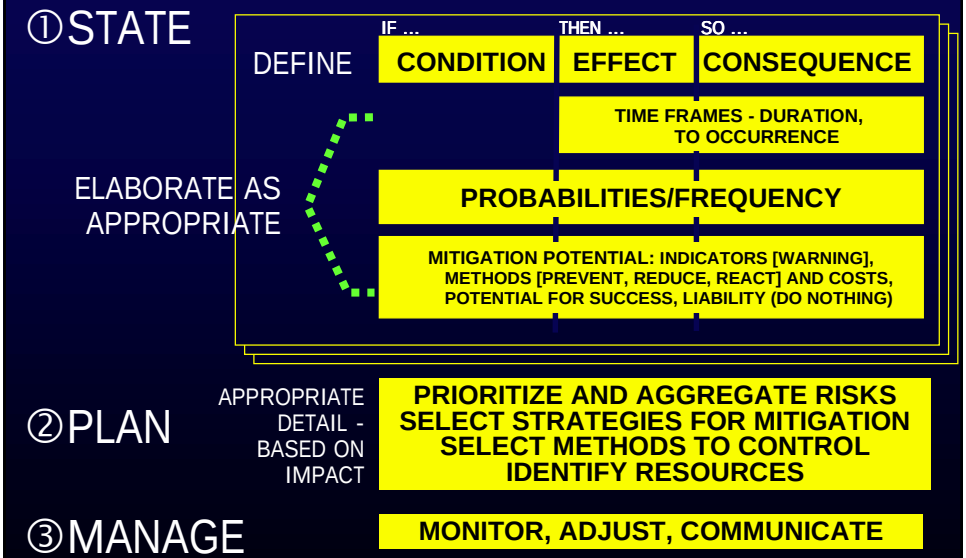
Formal Risk Analysis



Elaborate as appropriate

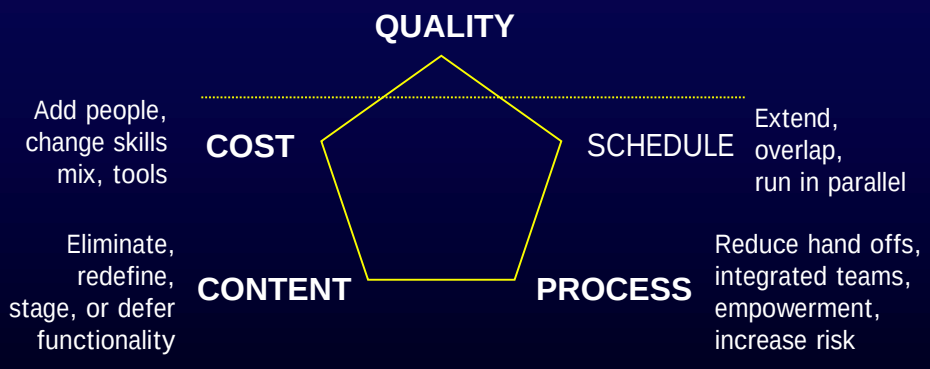
#	Condition	Effect	Consequence	Impact	Prob	REL RISK
1	If knowledgeable engineering personnel are unavailable	We won't be able to respond in a timely manner to escalated calls from customers with our legacy Accounting software	So we won't be able to fulfill these customers' current maintenance contracts.	LO (1) MED (5) HI (7) V HI (9)	LO (1) MED (5) HI (7) V HI (9)	45

When we release the next version of the new accounting package and if we get the WPI outsource contract, we will be really stretched in engineering

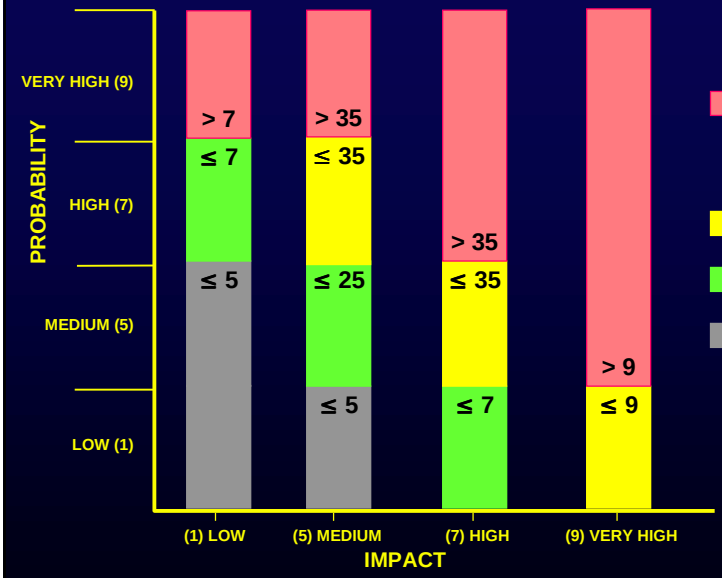
Last year Support received 20 calls about the accounting package, 3 were escalated to Engineering, one required a patch, which took 2 weeks.

We don't quote response times in our maintenance contracts, but these are loyal customers who only call with obscure problems, when they need help. We have 16 customers with our legacy package. None of them are candidates to upgrade and all are happy with what they have.

Plan: Variables and mitigation techniques



Manage risks: levels of response and thresholds



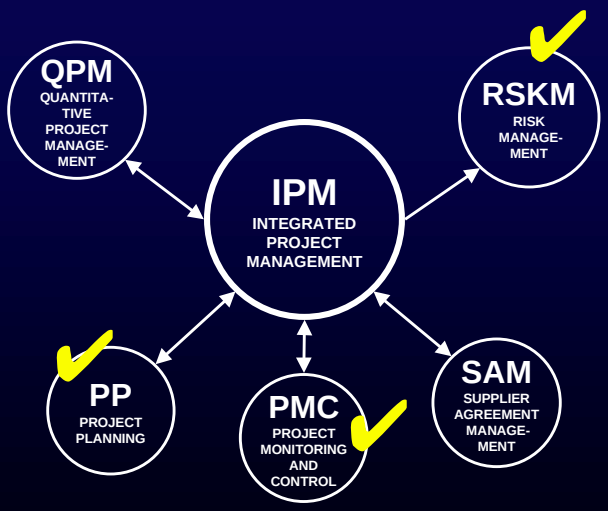
Establish levels of response for different types of projects based on past experience ("should have")

Report to executive management: the risk profile

Impact	REACT	Observe: OBS	Monitor: MON	Mitigation in progress: MIP	Total
LOW	-	-	11	2	-
MED	2	17	8	0	27
HIGH	0	8	4	7	19
V. HIGH			6	1	7

Relationships and dependencies

WITHIN THE PROJECT MANAGEMENT CATEGORY



Relationships and dependencies

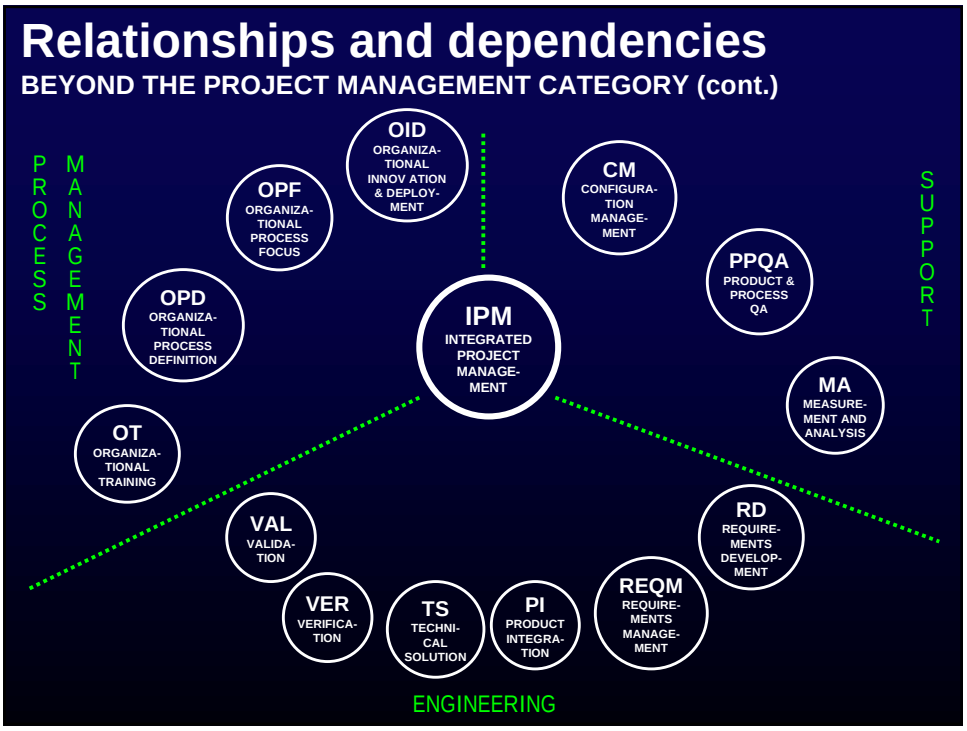
BEYOND THE PROJECT MANAGEMENT CATEGORY

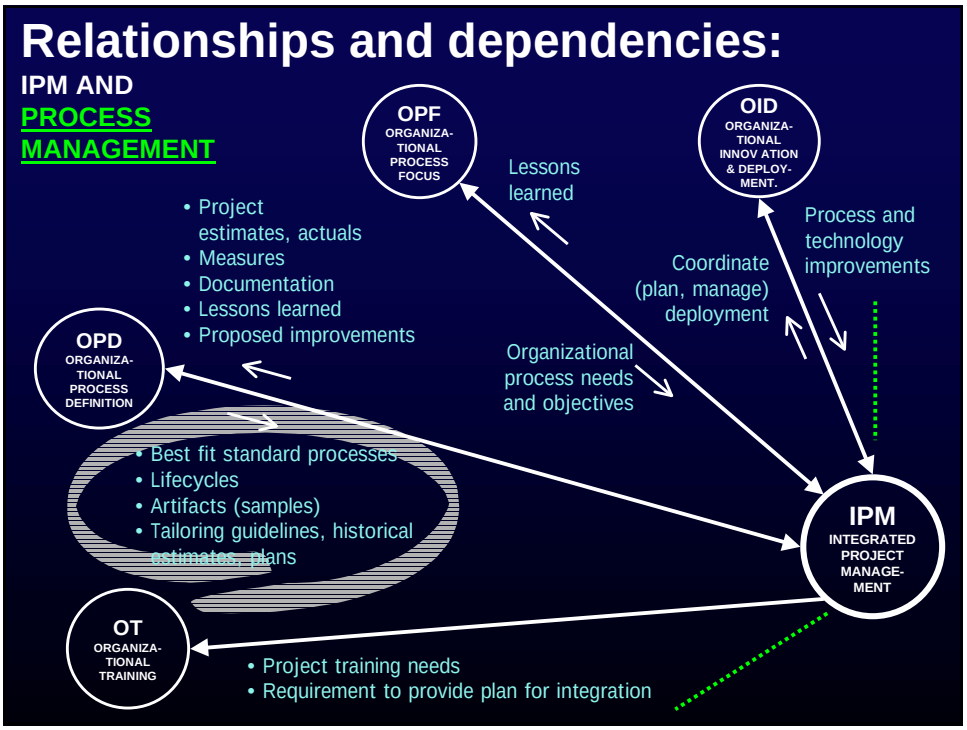
The development of the project plan should account for current and projected needs, objectives, and requirements of the organization, customer, and end users, as appropriate.

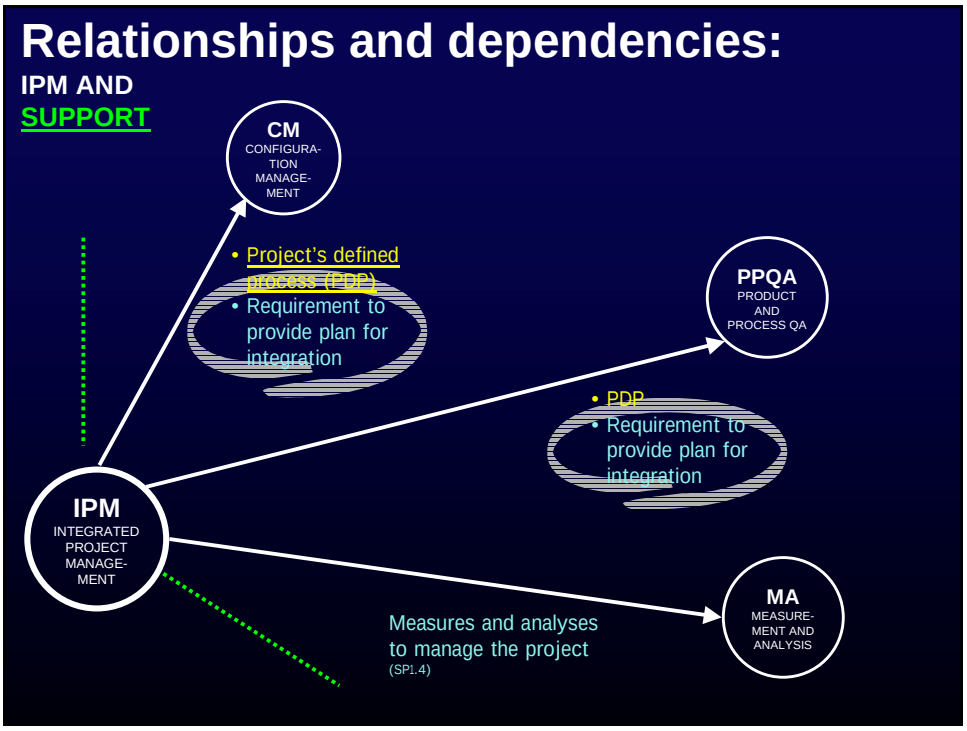
This process area ... addresses the coordination of all activities associated with the project including … technical activities … and support activities.

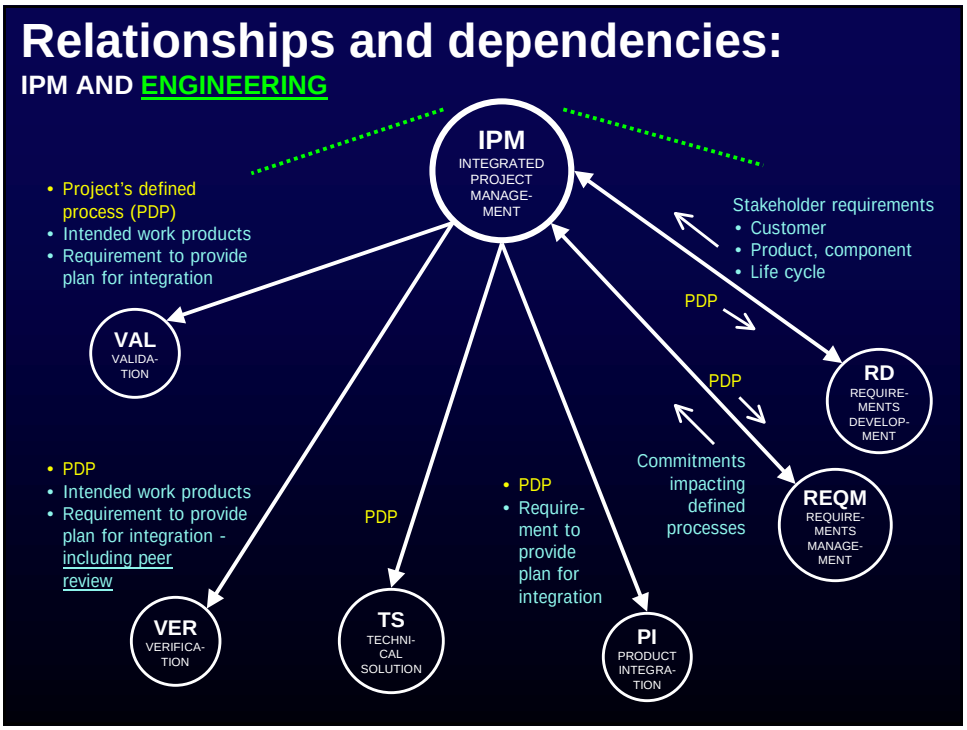
Integrated Project management (IPM) …

- Advances the organization from monitoring and controlling projects to managing projects.
- Requires the coordination of all activities associated with product delivery and lays a foundation for global process improvement and optimization.


Relationships and dependencies
BEYOND THE PROJECT MANAGEMENT CATEGORY (cont.)
PROCESS MANAGEMENT
SUPPORT
ENGINEERING
OID ORGANIZA-TIONAL INNOV ATION & DEPLOY-MENT
OPF ORGANIZA-TIONAL PROCESS FOCUS
CM CONFIGURA-TION MANAGE-MENT
PPQA PRODUCT & PROCESS QA
OPD ORGANIZA-TIONAL PROCESS DEFINITION
IPM INTEGRATED PROJECT MANAGE-MENT
MA MEASURE-MENT AND ANALYSIS
OT ORGANIZA-TIONAL TRAINING
VAL VALIDA-TION
RD REQUIRE-MENTS DEVELOP-MENT
VER VERIFICA-TION
TS TECHNI-CAL SOLUTION
PI PRODUCT INTEGRA-TION
REQM REQUIRE-MENTS MANAGE-MENT


Relationships and dependencies:
IPM AND
PROCESS MANAGEMENT
OPF ORGANIZA-TIONAL PROCESS FOCUS
OID ORGANIZA-TIONAL INNOV ATION & DEPLOY-MENT.
Lessons learned
• Project estimates, actuals
• Measures
• Documentation
• Lessons learned
• Proposed improvements
Process and technology improvements
Coordinate (plan, manage) deployment
Organizational process needs and objectives
OPD ORGANIZA-TIONAL PROCESS DEFINITION
• Best fit standard processes
• Lifecycles
• Artifacts (samples)
• Tailoring guidelines, historical estimates, plans
IPM INTEGRATED PROJECT MANAGE-MENT
OT ORGANIZA-TIONAL TRAINING
• Project training needs
• Requirement to provide plan for integration


Relationships and dependencies:
IPM AND
SUPPORT
CM
CONFIGURA-
TION
MANAGE-
MENT
• Project's defined process (PDP)
• Requirement to provide plan for integration
PPQA
PRODUCT
AND
PROCESS QA
• PDP
• Requirement to provide plan for integration
IPM
INTEGRATED
PROJECT
MANAGE-
MENT
MA
MEASURE-
MENT AND
ANALYSIS
Measures and analyses to manage the project
(SP1.4)


Relationships and dependencies:
IPM AND ENGINEERING
IPM
INTEGRATED
PROJECT
MANAGE-
MENT
• Project's defined process (PDP)
• Intended work products
• Requirement to provide plan for integration
Stakeholder requirements
• Customer
• Product, component
• Life cycle
PDP
PDP
VAL
VALIDA-
TION
RD
REQUIRE-
MENTS
DEVELOP-
MENT
• PDP
• Intended work products
• Requirement to provide plan for integration - including peer review
PDP
• PDP
• Require-ment to provide plan for integration
Commitments impacting defined processes
REQM
REQUIRE-
MENTS
MANAGE-
MENT
VER
VERIFICA-
TION
TS
TECHNI-
CAL
SOLUTION
PI
PRODUCT
INTEGRA-
TION

Integrated Product and Process Development (IPPD) - Beyond IPM

- Two new Process Areas
  - Level
  - Category
  - Goals
- Implementation considerations and recommendations
  - Tools and techniques
  - A road map

Integrated Product and Process Development (IPPD): Process Areas

Maturity Level 2: Managed	Maturity Level 3: Defined
▪ Requirements Management ▪ Project Planning ▪ Project Monitoring and Control ▪ Supplier Agreement Management ▪ Measurement and Analysis ▪ Process and Product Quality Assurance ▪ Configuration Management	▪ Requirements Development ▪ Technical Solution ▪ Product Integration ▪ Verification ▪ Validation ▪ Organizational Process Focus ▪ Organizational Process Definition ▪ Organizational Training ▪ Integrated Project Management for IPPD ▪ ~~Risk Management~~ ▪ **Integrated Teaming** ▪ Decision Analysis and Resolution ▪ **Organizational Environment for Integration**

Maturity Level 4: Quantitatively Managed	Maturity Level 5: Optimizing
▪ Organizational Process Performance ▪ Quantitative Project Management	▪ Organizational Innovation and Deployment ▪ Causal Analysis and Resolution

Integrated Product and Process Development (IPPD): Process categories

Category	Type	Level	Process Area
Process Management	Basic	3	Organizational Process Focus
		3	Organizational Process Definition
		3	Organizational Training
	Advanced	4	Organizational Process Performance
		5	Organizational Innovation and Deployment
Project Management	Basic	2	Project Planning
		2	Project Monitoring and Control
		2	Supplier Agreement Management
	Advanced	3	Integrated Project Management **for IPPD**
		3	Risk Management
		3	**Integrated Teaming**
		4	Quantitative Project Management
Engineering		2	Requirements Management
		3	Requirements Development
		3	Technical Solution
		3	Product Integration
		3	Verification
		3	Validation
Support	Basic	2	Measurement and Analysis
		2	Process and Product Quality Assurance
		2	Configuration Management
	Advanced	3	**Organizational Environment for Integration**
		3	Decision Analysis and Resolution
		5	Causal Analysis and Resolution

IPPD: Process categories and maturity levels

Level	Process Area	Process Management	Project Management	Engi-neering	Support
2	Requirements Management			X	
	Project Planning		B		
	Project Monitoring and Control		B		
	Supplier Agreement Management		B		
	Measurement and Analysis				B
	Process and Product Quality Assurance				B
	Configuration Management				B
3	Requirements Development			X	
	Technical Solution			X	
	Product Integration			X	
	Verification			X	
	Validation			X	
	Organizational Process Focus	B			
	Organizational Process Definition	B			
	Organizational Training	B			
	Integrated Project Management **for IPPD**		A		
	Risk Management		A		
	Integrated Teaming		A		
	Decision Analysis and Resolution				A
	Organizational Environment for Integration				A
4	Organizational Process Performance	A			
	Quantitative Project Management		A		
5	Organizational Innovation and Deployment	A			
	Causal Analysis and Resolution				A

Organizational Environment for Integration (OEI)

SPECIFIC GOALS

SG 1 An infrastructure that maximizes the productivity of people and affects the collaboration necessary for integration is provided.

SG 2 People are managed to nurture the integrative and collaborative behaviors of an IPPD environment.

Integrated Teaming (IT)

SPECIFIC GOALS

SG1 A team composition that provides the knowledge and skills required to deliver the team's product is established and maintained.

SG2 Operation of the integrated team is governed according to established principles.

SW/SE/IPPD/SS

Suggestions and comments: tools and techniques for integrated teams

- Periodic project reviews
  - The Key Deliverables Review (KDR)
- Milestone/Phase reviews
  - Checklists
- Earned Value as an approach
- Planning and replanning
  - Granularity

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KDRs - Avoiding SOS

DEFERRED START REPORT - 01/14

WBS	DESCRIPTION	START ORIGINAL	LAST	CURRENT	ACTUAL	RISK
12.1	Beta Algorithm Detailed Design	01/07		01/21		HI
15.1	Alpha Algorithm Test Specification	01/07		01/14	01/13	
15.1	Fault Tree Test Specification	01/07	01/14	01/21		LO
19.1	High Performance Beta Plan	12/01	01/14	01/21		HI

COMMENTS ON HIGH RISK ITEMS

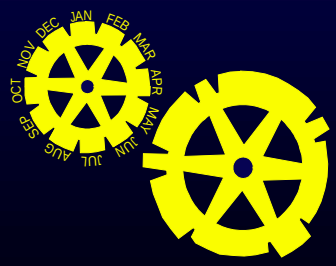
12.1 The assigned engineer has still not been released from the previous assignment. Current release date is 1/15. Another engineer has been assigned as a back up, but is just starting to learn the class library.

19.1 Marketing has still not identified a target customer. This is not a significant issue since the generic high-performance beta plan only needs to be tailored for the specific customer's configuration.

At an appropriate level of detail from the WBS

Tracking performance against the plan: Earned Value

- Assumes regular time or effort reporting
  - Sufficient detail to identify work product and activity
- System(s) to report
  - Cost or effort against plan
  - Completion of work against plan



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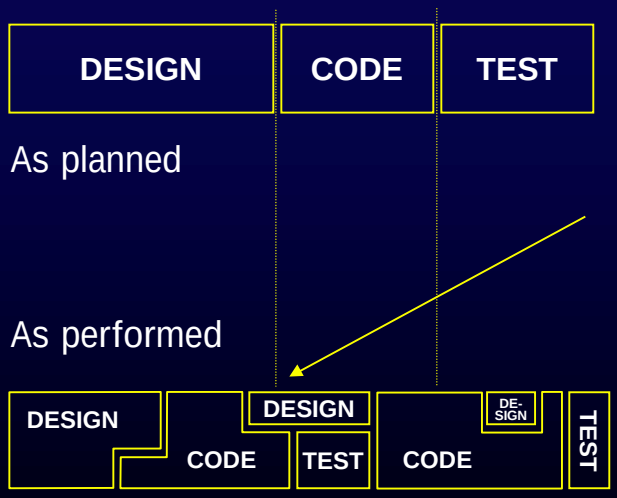
Planning versus reality



Q May I please see the design.

A Well, we just pulled it back to do some more work on it, but we're way ahead of schedule on the code and we're about to start some testing.

INTEGRATED PROJECT MANAGEMENT

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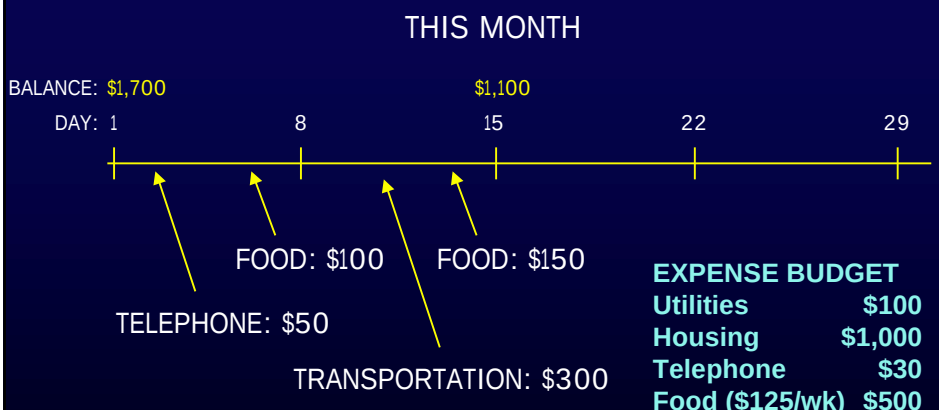
A familiar example: *How am I doing?*



EXPENSE BUDGET

Utilities	$100
Housing	$1,000
Telephone	$30
Food ($125/wk)	$500
Transportation	$70
TOTAL	$1,700

NATURAL FACTORS

- AMOUNT BUDGETED
- ACTUAL AMOUNT SPENT
- SPEND RATE - incremental expenses

INTEGRATED PROJECT MANAGEMENT

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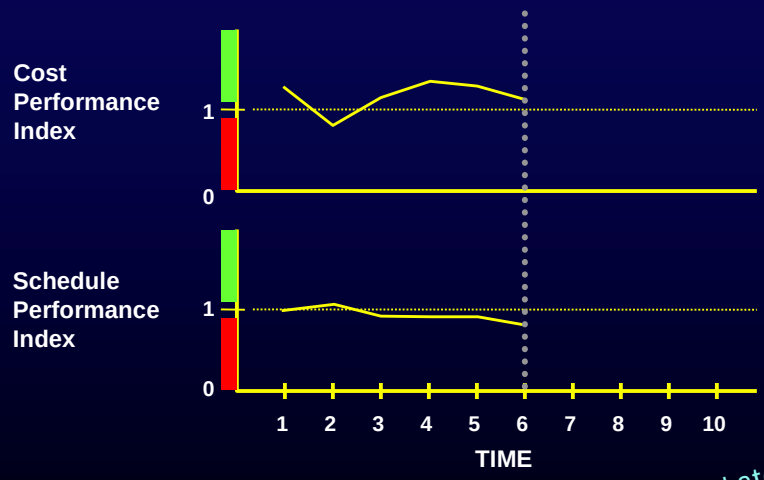
Performance indices



Monitor Late Starts

INTEGRATED PROJECT MANAGEMENT

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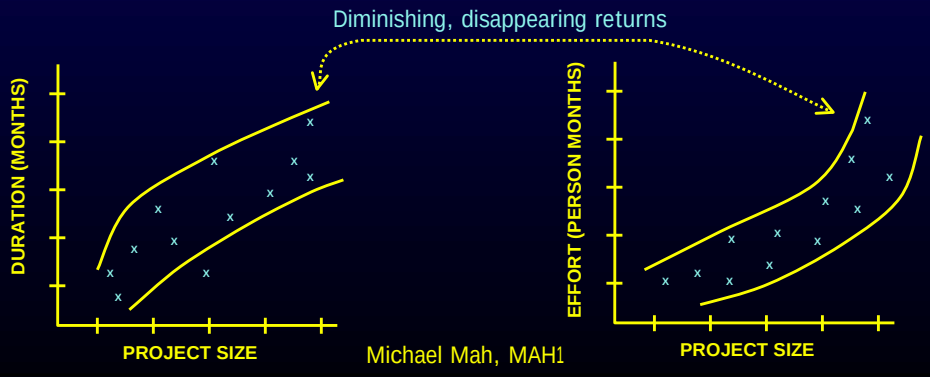
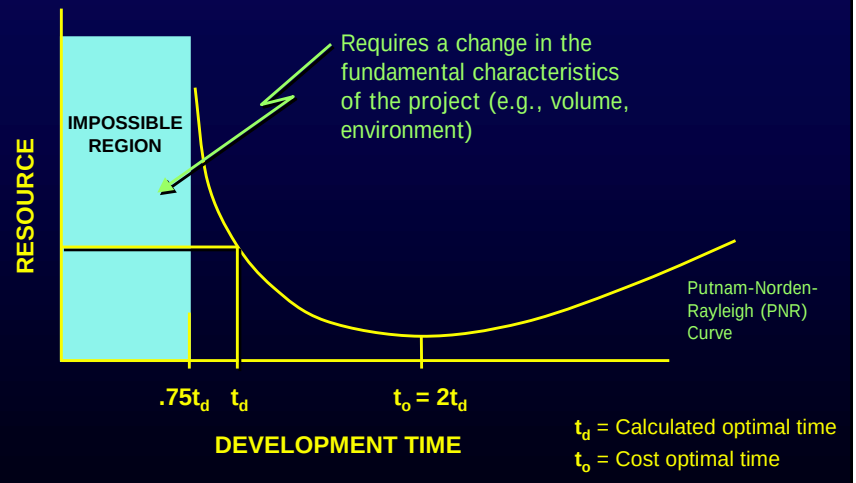
Myth 1: Add staff, compress the schedule

- Brook's Law: manpower and time are not interchangeable
- Based on a nominal schedule, 2x staff:
  - 20% faster
  - 6x defects
- Supported by core metrics: Size, Time, Effort, Defects (Anita Carleton, CAR1)
- GATHER DATA - Identify, learn from experience



Michael Mah, MAH1

Myth 1: Add staff ... (cont.)



Roetzheim, ROE1; DOD1
85

Myth 2: Reuse will save us

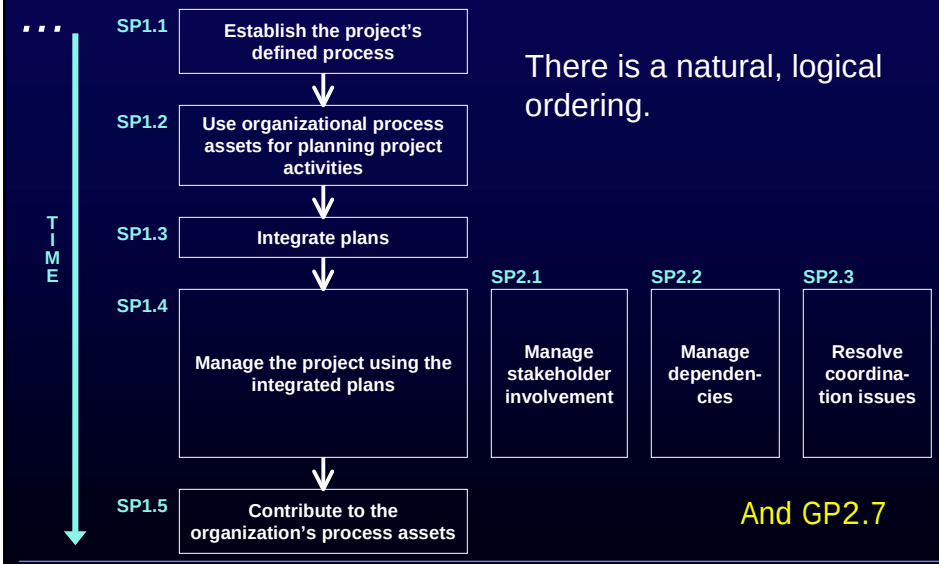
- To build in reusability: 2x effort
  - Per class library - from 20 to 40 days
  - Design, inspection, documentation
- Library maintenance
  - Coordinating obsolescence
- Learning curve (6 to 12 months)
  - Library consultant per 4 projects
  - Maintain, communicate, advise, mentor

PAG1, Meilir Page-Jones
86

Myth 3: We'll make it up later

- Projects over budget when only 15% complete usually complete with overruns
- Actual completion costs will not improve by more than 10% of the current percentage overrun
- For commercial projects
  - 10% late ~ 30% loss in profit
  - 50% cost overrun ~ 3% loss in profit

IPM: Required ordering? *No, but*



There is a natural, logical ordering.

And GP2.7

IPM: The generic practices (GP)

- **Special significance?** - look for elaboration
  - GP2.1 (CO1) Establish an organizational policy
  - ✖GP2.3 (AB3) Provide resources
    - Note the reference to integrated support environments
  - GP2.5 (AB5) Train people
  - ✖GP2.7 (DI2) Identify and involve relevant stakeholders
    - At beginning - start with tailoring
  - GP2.8 (DI3) Monitor and control the process
  - ✖GP2.9 (VE1) Objectively evaluate adherence
    - Significant if PPQA (Quality Assurance) is embedded in the project

The generic practices (cont.)

- Resistance?
  - All the usual suspects
    - Management commitment (CO1, AB3, AB4, AB5, VE2)
    - Politics (DI2, DI3, VE1, VE2)
    - CMMI regurgitation (ALL)
  - To evaluating adherence - if PPQA becomes a “police” function (VE1)
    - Ensure PPQA is value-added - it can be

Tools and tips

- No shortage of tools (free and otherwise)
- BUT ...
  - Process first
  - Tools second

Start-up checklist for project management processes

1. Establish status reporting process
2. Establish risk management process
3. Establish change management process
4. Apply appropriate metrics
5. Align organization with life cycle
6. Align working environment
7. Align development/test environment
8. Ensure training takes place

Typical implementation opportunities - Business acquisition

1. Define interfaces with internal organizations
2. Requirements analysis - capability
3. Requirements definition
4. Requirements change management

Typical implementation opportunities - Development

1. Engineering lifecycle definition
2. Requirements management
3. Planning and project management
   - Development
   - Verification and validation

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2269 Sunny Vista Drive, San Jose CA 95128

Tel 408-985-4476 FAX 408-248-7772
ssqc@concentric.net
www.ssqc.com

4. Configuration management
   - Controls for change
5. Maintenance
   - Lifecycle scaleability
   - External problem resolution

Typical implementation opportunities - Manufacturing

1. Define interface with Engineering/Development
2. Planning to ensure capability to meet commitments
   - New business (resources and training)
   - New types of product (process engineering)
3. Integrate quality functions
4. Automate systems to greatest extent practical

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Typical implementation opportunities - Services and Support

1. Define interfaces with internal organizations
2. Planning to ensure capability to meet commitments
   - New business (resources and training)
   - New types of service (process engineering)
3. Automate systems to greatest extent practical

Contact Information

Bill Deibler
Software Systems Quality Consulting
2269 Sunny Vista Drive
San Jose, CA 95128
Phone +1-408-985-4476 Fax +1-408-248-7772
deibs@ssqc.com

www.ssqc.com

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Software ◆ Systems ◆ Quality ◆ Consulting
2269 Sunny Vista Drive ◆ San Jose CA USA ◆ Tel 408-985-4476
Internet: ssqc@concentric.net ◆ http://www.ssqc.com