



Using CMMI^â for COTS-Based Systems

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CMMI and COTS-Based System Myths

Simply throw COTS products together to form a system

COTS products are “plug and play”

COTS means ready to run “out of the box”

Using COTS is only a technical challenge

Choice of COTS products is simply “make vs buy”

CMMI describes how to do software-intensive system development

CMMI can't be used for COTS-based systems

Need CMMI Level 4 or 5 to build COTS-based systems

Just apply *Supplier Sourcing* for COTS-based systems – NO!



Purpose

Build awareness of what is involved in using CMMI for COTS-based systems

- Fundamentals of CMMI and COTS-Based Systems
- Implications of Using CMMI for COTS-Based Systems
- Summary and What's Next

This presentation represents work in progress



Demands of COTS-Based Systems

COTS-based systems integrate COTS products with other reuse and custom components to support business or mission needs

COTS-based systems are challenging

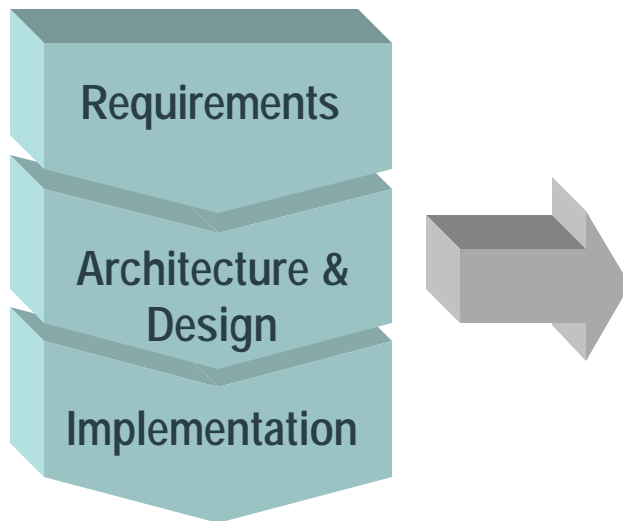
- Marketplace drives COTS product definition and evolution
- COTS products are designed to meet general business processes; not those specific to an organization
- COTS products presume an architecture and often depend on specific product releases
- COTS products are intended to be used as is; vendor maintains product and retains data rights

Projects that simply glue COTS products together or use traditional development often don't meet their objectives

New skills, responsibilities, and processes needed

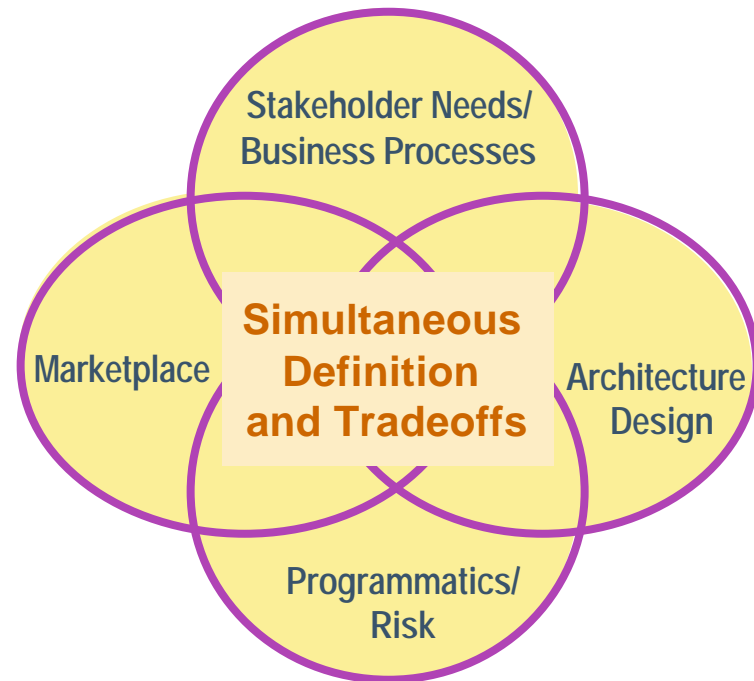
Marketplace Affects COTS Approach

Traditional Engineering
Approach



Requirements-driven

Required COTS Approach



Negotiation-driven



Unique Aspects of COTS Approach

Simultaneous definition and tradeoffs among four spheres
– from project initiation until system retired

- Business process engineering is fully integrated
- Requirements are fluid and formed through discovery
- Flexible system architecture developed early and maintained
- Marketplace monitored continuously
- Cost, schedule, and risk for implementing the system and any required business process changes integral to all trades

Continuous negotiation among stakeholders

Disciplined spiral or iterative practices with frequent executable representations of the evolving system



CMMI: Foundation for Improving Processes

Capability Maturity Models (CMM) provide guidance for processes that manage the development, acquisition, and maintenance of products or services

CMMs offer an approach for integrating

- Total quality management
- Targeted domain best practices
- Organization change practices

CMMI integrates four disciplines

- *System Engineering*
- *Software Engineering*
- *Integrated Product and Process Development*
- *Supplier Sourcing*

CMMI process areas must be interpreted for each targeted domain



Topics

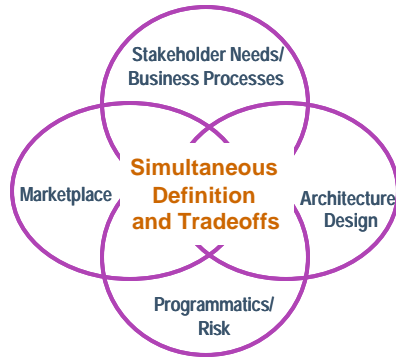
Fundamentals of CMMI and COTS-Based Systems

Implications of Using CMMI for COTS-Based Systems

Summary and What's Next



Presentation Format



- Important process considerations for a COTS-based system approach

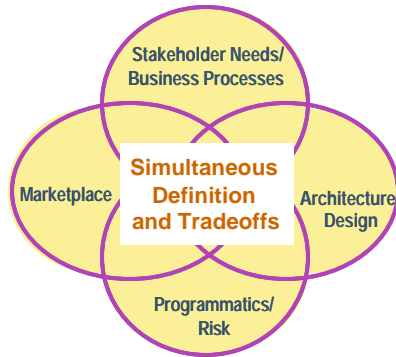
Work Process Implications

- High-level guidance for **selected** CMMI Process Areas or *disciplines*
 - Highlight particular relevance
 - Provide unique interpretation
 - Suggest new process areas
 - Correct misconceptions

Take-away message for each aspect



Simultaneous Definition and Trades



- Balanced consideration of four diverse spheres
 - decisions in one inform and constrain decisions in others
- Information continuously discovered in each sphere
- Identify and analyze tradeoffs among spheres
- Solution evolves as tradeoffs are negotiated among affected stakeholders

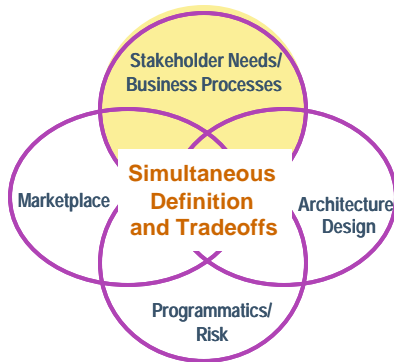
Work Process Implications

- Decision Analysis and Resolution – robust, agreed-upon decision processes are required to manage continuous stakeholder negotiations
- Technical Solution – alternative solutions (including COTS product selection) must be developed and analyzed continuously to accommodate newly discovered information
- Verification and Validation – continuous determination that information in each sphere is sufficient, complete, and meets operational needs is needed
- Risk Management – a key project risk is over-defining one sphere without adequate understanding of implications on other spheres
- Project Planning – project activities must start concurrently with extensive interaction among them from project start until the system is retired

Continuously reconcile what stakeholders want with what is available



Concurrent Business Process Design



- End-user community must be willing/able to change business processes to match those in COTS products
- Business process changes must be explicitly managed and coordinated as part of the project
- Business processes may continue to change with new COTS releases or new COTS products

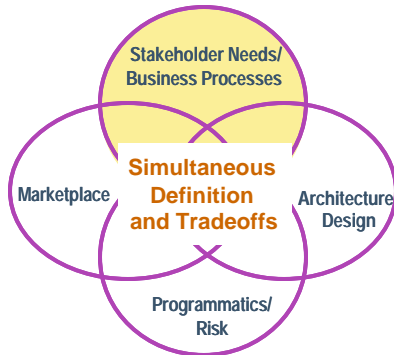
Work Process Implications

- CMMI does not address changes to end-user business processes; concepts in Organizational Process Focus can be expanded in application to explicitly plan and implement end-user business process improvement
- Organizational Environment for Integration – a shared vision of success among stakeholders, with suitable incentives and leadership, is critical to aligning business processes with alternative solutions
- Project Planning/Integrated Project Management for IPPD – implementing agreed upon business processes must be integrated in system planning

Align business process engineering with system engineering



Negotiable Requirements



- Requirements must be flexible enough to leverage available and projected COTS products
- Commit to a requirement premature until behavior of COTS products is understood
- As marketplace continues to change, requirements must be renegotiated

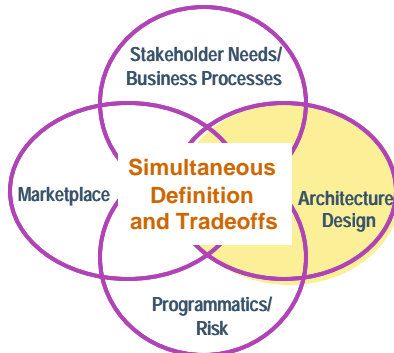
Work Process Implications

- Requirements Management – disciplined and controlled management of requirements must begin at project start; identified and negotiated tradeoffs must be tracked
- Requirements Development – prioritizing requirements to aid tradeoffs is essential
 - stakeholders agree on a minimum set of critical “must-have” requirements
 - evolvability is a high priority, required quality attribute
- Project Planning/Integrated Project Management for IPPD – managing the project to encourage and reinforce the continual discovery of requirements while establishing sufficient stability to deliver a solution is challenging

Requirements formation is a journey of discovery



Flexible Architecture



- Architecture is considered early; evolves and is maintained until the system retired
- Potential drivers of change accommodated in architecture definition

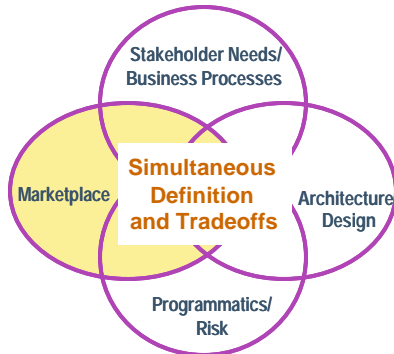
Work Process Implications

- Technical Solution – “make-or-buy” analysis should continue with each new COTS product release
 - project standards or protocols used to link COTS products and other system components must be described for each alternate solution’s architecture
- Product Integration – composing and evaluating executable representations from project start is critical to verify and validate architecture suitability and evolvability
- Project Planning/Integrated Project Management for IPPD – appropriate skills and resources are necessary to form, evaluate, and maintain system flexibility
 - effort to create and maintain “wrappers” or “glue” and re-integrate solution as COTS products change must be included

Architecture is created and maintained as a corporate asset



Current Market Knowledge



- Anticipate and track changes to relevant market segments until system retired
- Anticipate and prototype system changes from updates to COTS products critical to the system
- Influence (not direct) COTS products changes, technology investments, and standards development

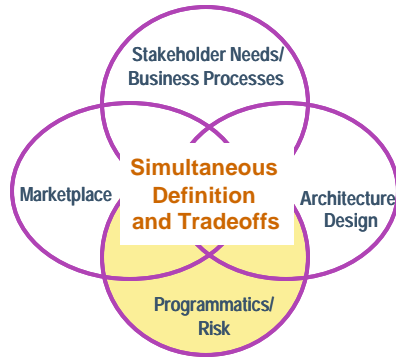
Work Process Implications

- Supplier Agreement Management – license agreements with COTS vendors must be *negotiated* to meet project needs
- Integrated Supplier Management – establishing and maintaining appropriate relationships with key vendors is critical
 - vendors seldom allow monitoring of their processes; use hands-on evaluation
 - relationships with key vendors' other customers is necessary (not explicitly covered in CMMI)
- Technical Solution – modification of COTS products introduces long term maintenance considerations and sizeable risk to project; avoid if possible
- Project Planning – significant resources may be required to monitor the marketplace and conduct COTS product evaluation; including experimentation facilities

Marketplace is proactively monitored



Integral Programmatics and Risks



- Analysis of alternative solutions includes team skills and expertise, cost, schedule, and associated risks for
 - building, fielding, and supporting the system
 - implementing any needed changes to operational processes

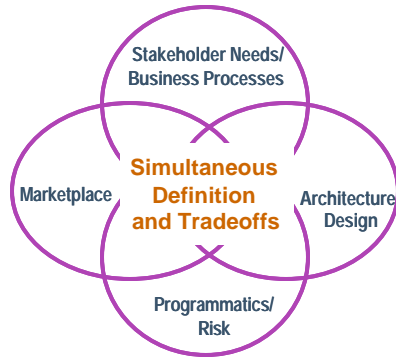
Work Process Implications

- Project Planning – estimates of work product and task attributes should be generated for each alternative
- Technical Solution – engineering trades should include risk, cost, schedule and other programmatic factors associated with each alternative solution

Programmatic factors shape technical alternatives



Continuous Stakeholder Involvement



- Significant commitment from all stakeholders required
 - identify, evaluate, and select alternative solutions
 - resolve mismatches quickly
 - confirm results of any and all negotiations
 - agree evolving system meets their needs
- Stakeholders must reflect full diversity of interests

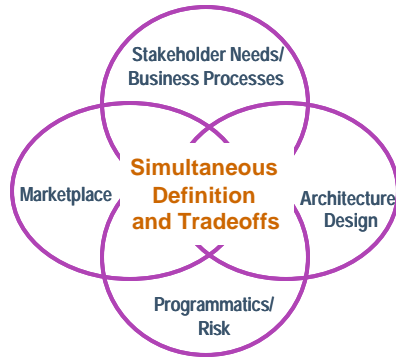
Work Process Implications

- *IPPD discipline* – integrated teaming among disparate stakeholders throughout the development and maintenance is essential
- Validation – end users must *always* be involved in validating solution suitability
- Integrated Project Management for IPPD – accommodates resources for stakeholder involvement
 - necessary changes to end-user operational processes must be explicitly and continuously managed and coordinated with solution development

Required stakeholder commitment may be unprecedented



Disciplined Spiral or Iterative Practices



- Concurrently determinate a compatible and feasible set of: business processes, requirements, plans, design, COTS products, and other components
 - Enterprise business objectives drive solution definition
 - risk considerations drive degree of detail
 - alignment with marketplace dynamics drives development and maintenance processes

Work Process Implications

- Project Planning – if not already implemented, extensive effort may be needed to revamp planning and engineering processes for a spiral development approach
- Risk Management – tracking effectiveness of risk mitigation is key
 - highest priority remaining risks should be used to (re) direct and manage the project

Spiral development facilitates developing a viable solution



Frequent Executables



- Frequent executable representations reduce risk and reduce misunderstandings
 - provide critical insight into the solution's behavior
 - explore critical system attributes
 - validate end user business process
 - verify technical viability

Work Process Implications

- Requirements Development, Technical Solution and Product Integration – an executable representation should be produced in each iteration to reflect the current understanding of requirements, COTS products, and alternative designs explored and negotiated

Executable representations demonstrate stakeholder buy-in



Topics

Fundamentals of CMMI and COTS-Based Systems

Implications of Using CMMI for COTS-Based Systems

Summary and What's Next



Summary

Building COTS-based systems is more than selecting products

CMMI (all disciplines) provides a sound basis for improving processes for building, fielding, and supporting COTS-based systems

Some interpretations are needed for this targeted domain

- Reconcile COTS products and end-user operations
- Business process definition, engineering and project management must be considered concurrently – for the life of the system
- Balancing the spheres of influence and negotiating tradeoffs require extensive communication and strong decision processes
- Risk-based spiral development processes are needed

Additional processes are needed

- Business process design and management of required changes
- Market research and vendor relationships



What's Next

Develop a community of practice

- Identify those with experience in using CMMI for a spiral approach and/or a COTS-based system
- Gather lessons learned (with emphasis on necessary unique interpretations of CMMI) and sample process descriptions
- Provide draft findings for review and feedback

Develop amplified products to share experience in applying CMMI in a COTS-based system environment

- Technical report (s)
- Workshop (s)



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