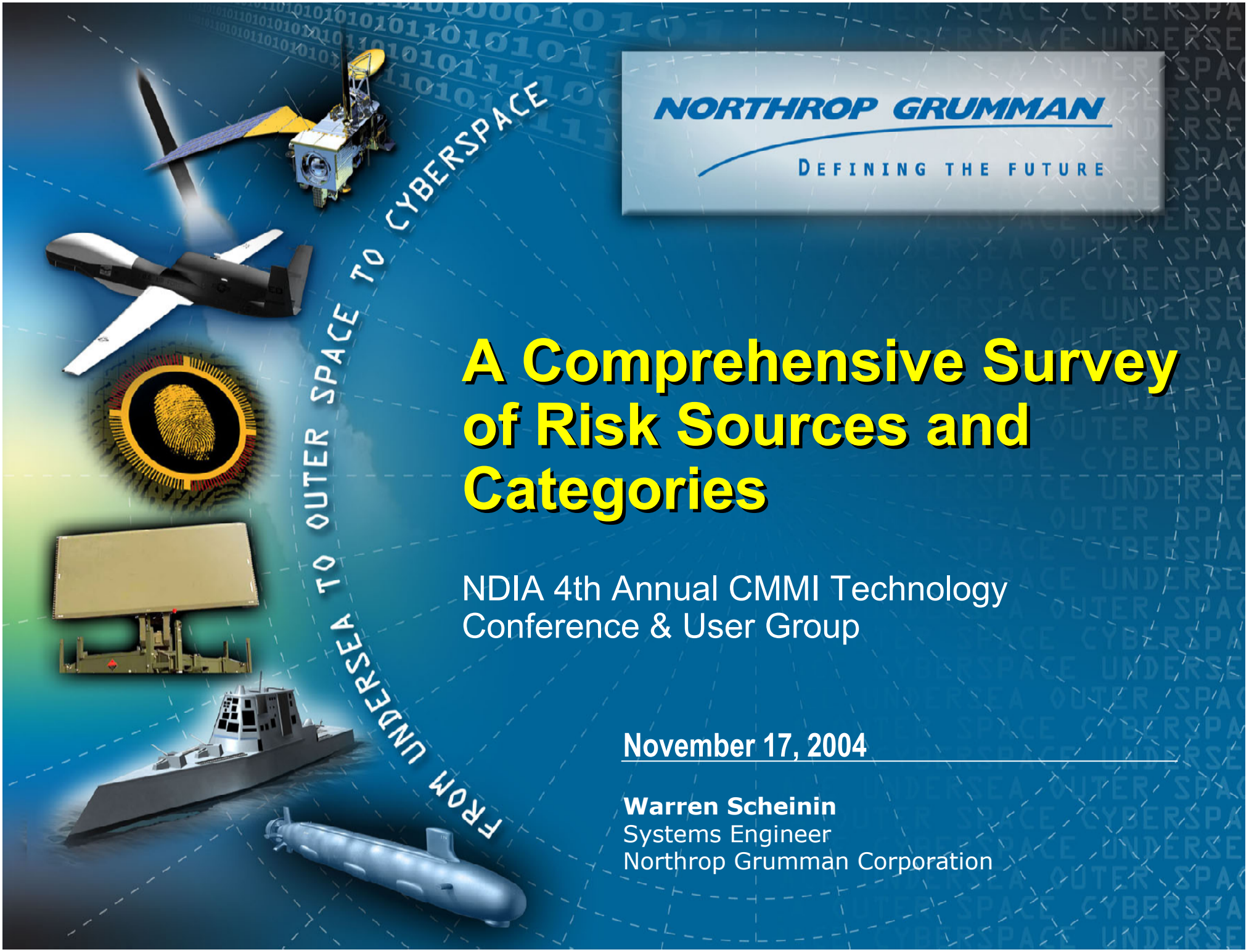


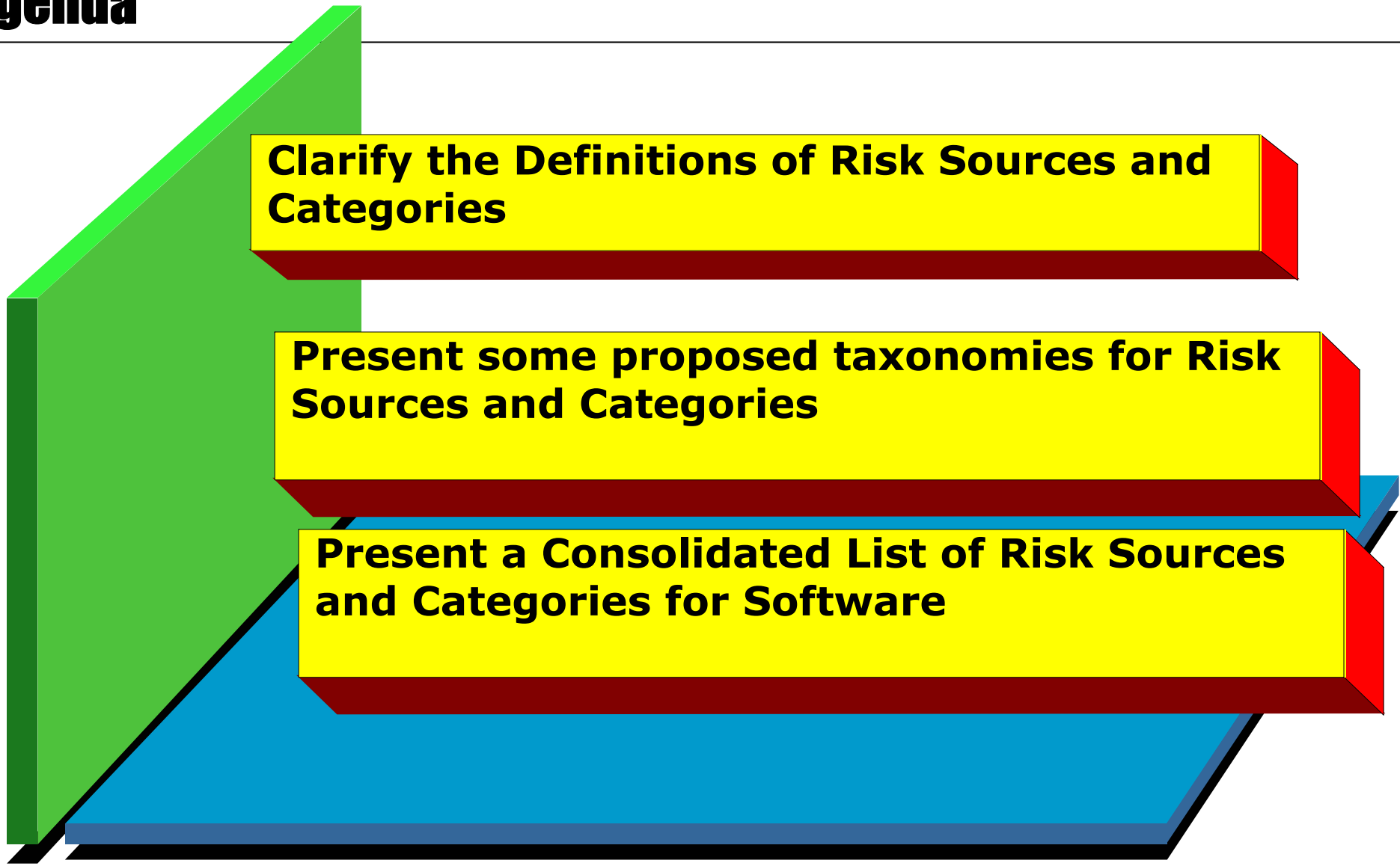
A Comprehensive Survey of Risk Sources and Categories

NDIA 4th Annual CMMI Technology Conference & User Group

November 17, 2004

Warren Scheinin
Systems Engineer
Northrop Grumman Corporation

Agenda



The Source of This Investigation

SP 1.1 Determine Risk Sources and Categories

- Identification of risk sources provides a basis for systematically examining changing situations over time to uncover circumstances that impact the ability of the project to meet its objectives. Risk sources are both internal and external to the project. As the project progresses, additional sources of risk may be identified.
- Establishing categories for risks provides a mechanism for collecting and organizing risks as well as ensuring appropriate scrutiny and management attention for those risks that can have more serious consequences on meeting project objectives.

CMMI[SM] for Systems Engineering/Software Engineering, Version 1.1, Staged Representation (CMMI-SE/SW, V1.1, Staged)
Technical Report **CMU/SEI-2002-TR-002**

A Source by Any Other Name . . .

Lots of ways to slice and dice it

- Risk **Factors**, Drivers, Type, Attributes
  - Cost (C)
  - Schedule (S)
  - Technical [performance] (T)
  - Process Capability
  - Deployability
  - Support

SPM 924 **4.4 Analyze Risks**

020 Determine risk sources and **categories**. {CMMI L3 RM SP 1.1} **{PRM-924-110}**

*Note: Risk **categories** reflect the **bins**/groups for collecting and organizing risks, such as lifecycle phase, product type, responsible organization, internal vs external risks, etc.*

- Risk **Sources** = Risk (common) Areas (fundamental drivers), Elements
  - Requirements
  - Vendors, etc.

Taxonomy: A classification system for assigning elements to specially named categories based on shared characteristics

Characteristics of Risk Sources

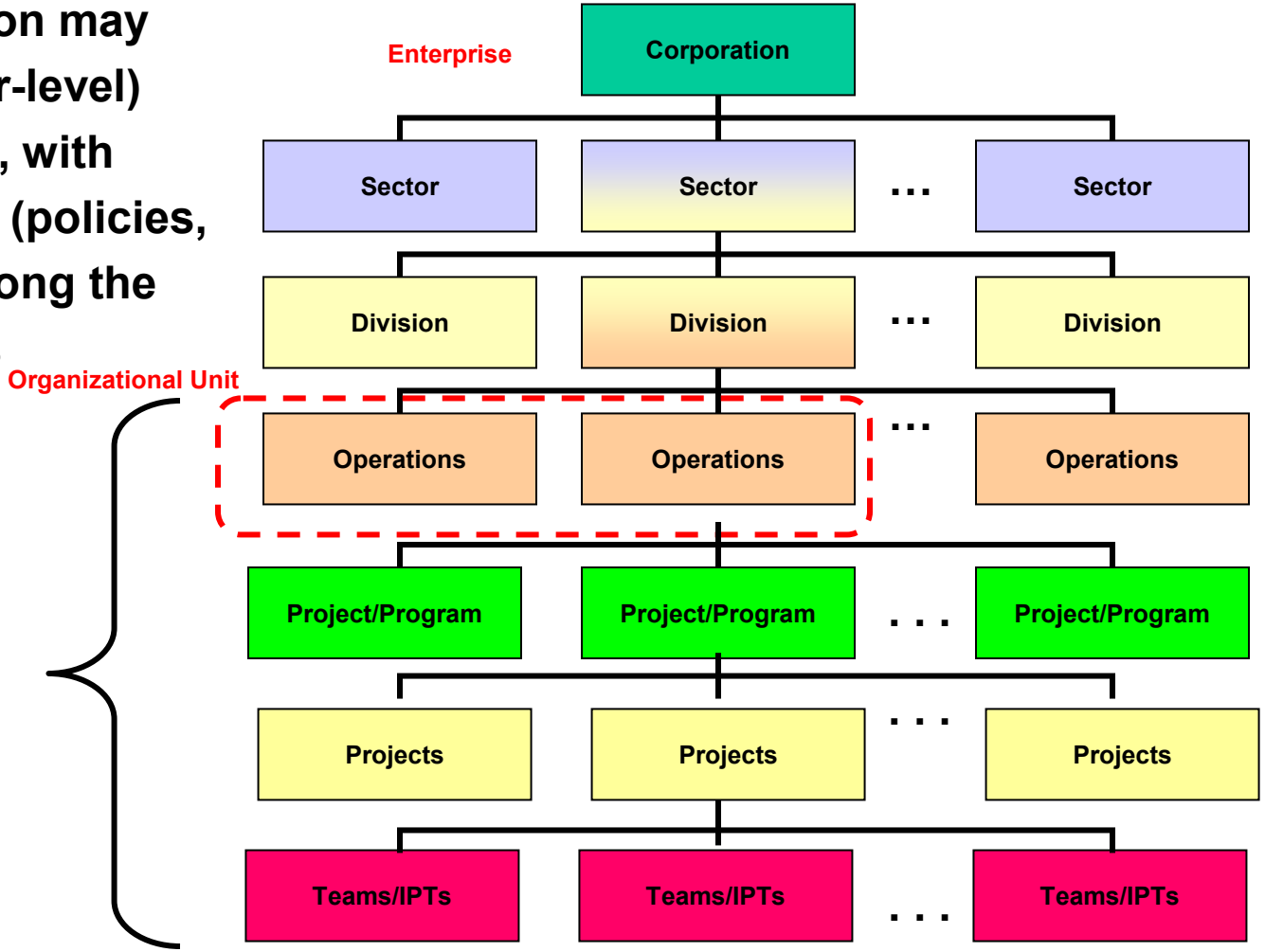
- Contains one or more fundamental drivers that cause risks events to arise within a project or organization
- Provides risk criteria specific to a project
  - Programmatic risks
  - Technology risks
- Guides those doing the risk candidate identification to areas most likely to produce risk events
  - Allows subject matter experts to concentrate on their areas of expertise
- Adds direction to the risk candidate identification activities by maximizing coverage

Characteristics of Risk Categories

- **Designates risks identified by common attributers**
  - Product type
  - Lifecycle phase
  - Responsible organization
    - Often useful to associate risks with the IPT they are assigned to
  - Internal versus external source
- **Provides groupings that are more easily managed**
  - Tools like Risk Status Charts commonly have a set of characteristics they capture for each risk
  - Highlights interactions between associated risks
  - Helps in the consolidation of activities in the risk handling plans.

Scope of This Presentation Within the Organization

- **Organization –** An administrative structure in which people collectively manage one or more projects as a whole, and whose projects share a senior manager and operate under the same policies.
  - **An organization may contain (lower-level) organizations, with infrastructure (policies, etc.) split among the various levels**



Why Not Higher?

Holmes 2002 Organizational Risk Categories

- **Credit**
- **Country and transfer**
- **Interest rate**
- **Strategic and business**
- **Program and project**
- **Liquidity**
- **Foreign exchange**
- **Reputation**
- **Financial (fraud)**
- **Legal**
- **Regulatory**

Revised Boehm Top Ten Sources of Risk 1991

- Personnel Shortfalls
- Unrealistic schedules and budgets
- Developing the wrong software functions
- Developing wrong user interface
- Goldplating
- Continuing stream of requirements changes
- Shortfalls in externally furnished components
- Shortfalls in internally performed tasks
- Real-time performance shortfalls
- Straining computer science capabilities

Risk Identification - *SEI Risk Taxonomy 1993*

- **Risks are categorized by**
  - —**class**
  - —**element**
  - —**attribute**
- **Risk taxonomy is intended for software, but can be adapted for Systems Engineering**
- **Use**
  - —**As a check list**
  - —**To promote deeper thinking**
  - —**Basis of interviews**
  - —**Distribute to SMEs**

A. Product Engineering

1. Requirements
   a. Stability
   b. Completeness
   c. Clarity
   d. Validity
   e. Feasibility
   f. Precedent
   g. Scale
2. Design
   a. Functionality
   b. Difficulty
   c. Interfaces
   d. Performance
   e. Testability
   f. Hardware
   g. Non-Developmental Softw
3. Code and Unit Test
   a. Feasibility
   b. Testing
   c. Coding/Implementation
4. Integration and Test
   a. Environment
   b. Product
   c. System
5. Engineering Specialties
   a. Maintainability
   b. Reliability
   c. Safety
   d. Security
   e. Human Factors
   f. Specifications

B. Development Environment

1. Development Process
   a. Formality
   b. Suitability
   c. Process Control
   d. Familiarity
   e. Product Control
2. Development System
   a. Capacity
   b. Suitability
   c. Usability
   d. Familiarity
   e. Reliability
   f. System Support
   g. Deliverability
3. Management Process
   a. Planning
   b. Project Organization
   c. Management Experience
   d. Program Interfaces
4. Management Methods
   a. Monitoring
   b. Personnel Management
   c. Quality Assurance
   d. Configuration Management
5. Work Environment
   a. Quality Attitude
   b. Cooperation
   c. Communication
   d. Morale

C. Program Constraints

1. Resources
   a. Schedule
   b. Staff
   c. Budget
   d. Facilities
2. Contract
   a. Type of Contract
   b. Restrictions
   c. Dependencies
3. Program Interfaces
   a. Customer
   b. Associate Contractors
   c. Subcontractors
   d. Prime Contractor
   e. Corporate Management
   f. Vendors
   g. Politics

DoD RISK MANAGEMENT GUIDE, 2003

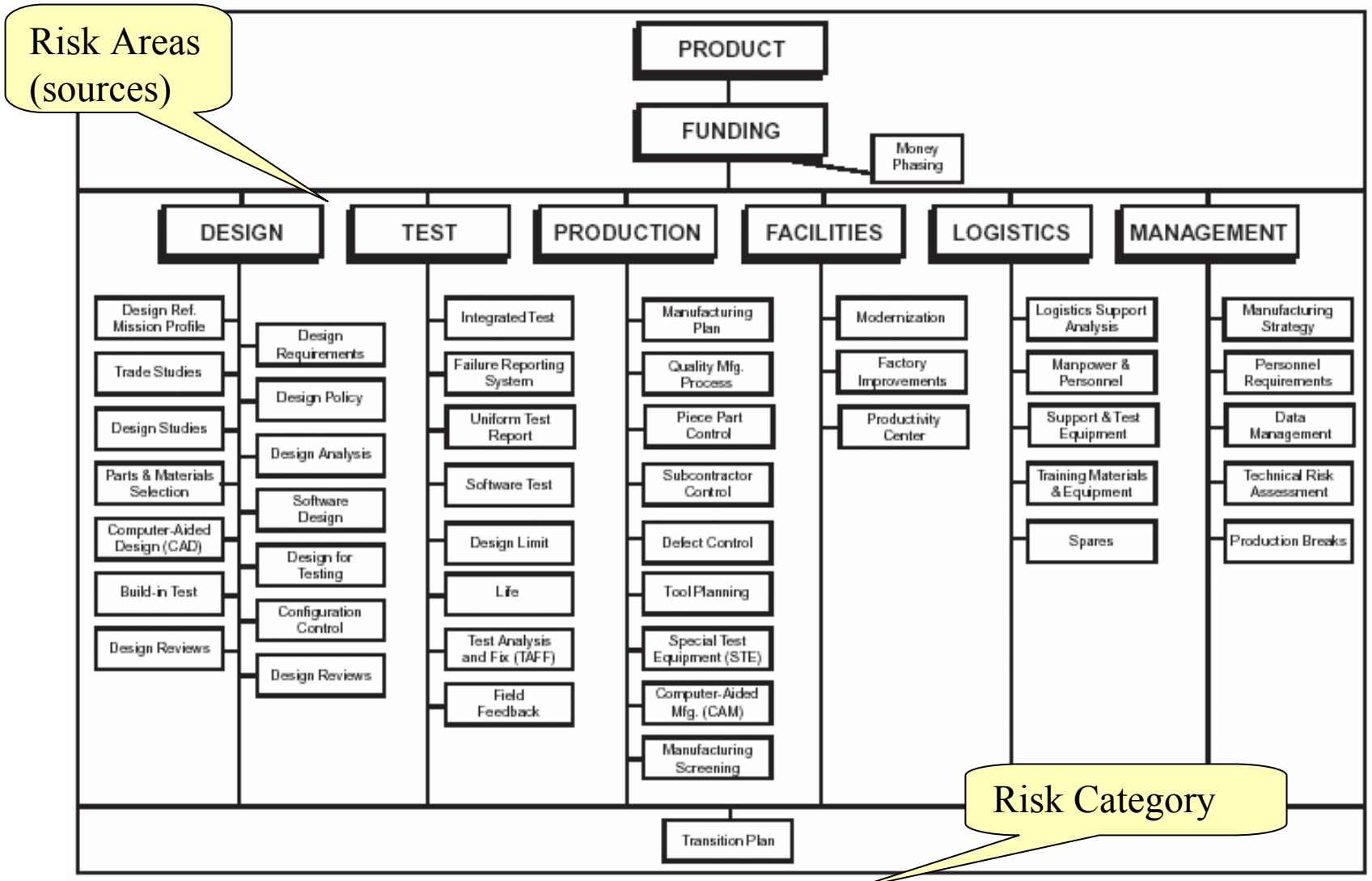


Figure 2-2. Critical Process Areas and Templates

DoD Acquisition Risk Management Guide, 2003

- Threat
- Requirements
- Design
- Test
- Evaluation
- Simulation
- Technology
- Logistics
- Production
- Facilities
- Concurrency
- Capability
- Developer
- Cost/Funding
- Schedule
- Management
- Design and Engineering
- Logistics
- Testing
- Manufacturing
- Concurrency
  - —Program schedule

Sage 1992 annotated by Buttigieg 2004

- **Requirements identification and specification**
  - Ambiguity
  - Completeness
  - Traceability
  - Understandability
  - Volatility
- **Preliminary conceptual design**
  - Ambiguity
  - Completeness
  - Structure/architecture
  - Coupling
- **Logical design and system architecture**
- **Detailed design, production, and test**
  - Highly experienced programmers
  - Standard design formats
  - Metrics
- **Operational Implementation – ready for**
- **Evaluation and Modification**
  - Well defined guidelines
  - Measurability
- **Operational deployment – final acceptance**
  - Change management
  - Training

Chittister, 1993

- **Functional decomposition**
  - Requirements
  - Product
  - Process
  - People
  - Management
  - Environment
  - System development
- **Source-based decomposition**
  - Hardware
  - Software
  - Organization
  - Human
- **Temporal decomposition**
  - Phases of software development

Chittister, 2000

Acquisition
- Proposal
- Changes
- Reviews
- Acceptance

S/W Development
- Requirements
- Specifications
- Architecture
- Process
- Product
- Support systems for integration
- ~~*People*~~
- ~~*Management*~~
- ~~*System development*~~

Environment
- Hardware
- Software
- Organization
- External
- Human

Temporal
- Requirements
- Architectural Design
- Initial Operating Capability
- Final Operating Capability
- Maintenance
- Upgrade and growth

Quality
- Technical perforamce
- Cost overrun
- Schedule delay

Technology
- Type
- Extent of Use

Leadership
- Personal trustworthiness
- Interpersonal trust
- Management empowerment
- Institutional alignment
- Communication ability
- Technical competence

Sherer, 1995

- Technical
  - Tasks
  - Procedures
- Organizational
  - Poor communication
  - Structure
- Environmental
  - Rapid changes
  - External relationships
    - Developers
    - Users

Keil et al, 1998

- Top management commitment
- User commitment
- Requirements misunderstood
- Lack of user involvement
- Managing end user expectations
- Changing scope/objections
- Project personnel knowledge/skills
- Requirements creep
- New technology
- Insufficient/inappropriate staffing
- User department conflicts

Ropponen and Lyytinen, 2000 survey of project managers

- Schedule
- System functionality
- Subcontracting
- Requirements management
- Resource usage and performance
- Personnel management

Revised Standish Group 2001 Success Factors (Chaos Ten)

Application Development Projects

- **Executive support**
- **User involvement**
- **Project manager**
- **Clear business objectives**
- **Scope**
- **Standard software infrastructure**
- **Firm basic requirements**
- **Formal methodologies**
- **Reliable estimates**

Murthi, 2002

External Risks

- **Requirements**
- **Technology**
- **Business**
- **Political**
- **Resources and skills**
- **Deployment and support**
- **Integration**
- **Schedule**
- **Maintenance and enhancement**
- **Design**

Addison and Vallabh, 2002 Project Manager Perceptions

- Misunderstood scope or objectives
- Misunderstood requirements
- User involvement
- Senior management commitment
- Wrong software functions
- Schedules unrealistic
- Budgets unrealistic
- Requirements volatility
- Knowledge/skills
- Project management methodology
- Gold plating

Now to Put Them All Together - Initial List

Category / Source														
Acquisition	Chittister, 2000													
Business								Murthi, 2002						
Clear business objectives													Standish Group's 2	
Proposal	Chittister, 2000													
Contract			SEI Taxonomy, 1993											
Changes	Chittister, 2000													
Reviews	Chittister, 2000													
Acceptance	Chittister, 2000													
Software Development	Chittister, 2000						Ropponen, 2000		Boehm, 1988					
Product Engineering			SEI Taxonomy, 1993											
Requirements	Chittister, 1993		SEI Taxonomy, 1993					Murthi, 2002						
Requirements management							Ropponen, 2000							
Requirements														DoD Guid
Continuing stream of requirements changes									Boehm, 1991					
Requirements creep										Keil et al, 1998				
Goldplating									Boehm, 1991					
Gold plating											Addison and Vallabh, 2002			
Specifications	Chittister, 2000													
Formal methodologies													Standish Group's 2	
Architecture	Chittister, 2000													
Standard software infrastructure													Standish Group's 2	
Developing wrong user interface									Boehm, 1991					
Process	Chittister, 1993													
Development Process			SEI Taxonomy, 1993											
Shortfalls in internally performed tasks									Boehm, 1991					
Design			SEI Taxonomy, 1993					Murthi, 2002						
Design														DoD Guid
Detailed design						Jain, 2004								
Developing the wrong software functions									Boehm, 1991					
Wrong software functions											Addison and Vallabh, 2002			
Production/														DoD Guid
Code and Unit Test			SEI Taxonomy, 1993											
Production and testing						Jain, 2004								
Test														DoD Guid
Integration								Murthi, 2002						
Integration and Test			SEI Taxonomy, 1993											
a. Environment			SEI Taxonomy, 1993											
b. Product			SEI Taxonomy, 1993											
c. System			SEI Taxonomy, 1993											
Evaluation														DoD Guid
Product	Chittister, 1993													
Support systems for integration	Chittister, 2000													
Temporal	Chittister, 1993													
Requirements	Chittister, 2000					Jain, 2004								
Firm basic requirements													Standish Group's 2	
Requirements identification and specification		Buttigieg 2004												
Ambiguity		Buttigieg 2004												
Completeness		Buttigieg 2004												
Understandability		Buttigieg 2004												
Requirements misunderstood										Keil et al, 1998				
Misunderstood requirements											Addison and Vallabh, 2002			
Volatility		Buttigieg 2004												
Requirements volatility											Addison and Vallabh, 2002			
Traceability		Buttigieg 2004												
Architectural Design	Chittister, 2000													
System functionality							Ropponen, 2000							
Preliminary conceptual design		Buttigieg 2004												

Development Environment			SEI Taxonomy, 1993											
Environment	Chittister, 1993			Sherer,	Rashmi, 2004									
Hardware	Chittister, 1993													
Facilities														DoD Guid
Work Environment			SEI Taxonomy, 1993											
Resource usage and performance						Ropponen, 2000								
Software	Chittister, 1993													
Organizational				Sherer,	Rashmi, 2004									
Organization	Chittister, 1993													
Logistics														DoD Guid
Development System			SEI Taxonomy, 1993											
Management Process			SEI Taxonomy, 1993											
Resources and skills							Murthi, 2002							
Personnel Shortfalls								Boehm, 1991						
Poor communication				Sherer, 1995										
Structure				Sherer, 1995										
External	Chittister, 2000													
External relationships				Sherer, 1995										
Developers				Sherer, 1995										
Users				Sherer, 1995										
Political							Murthi, 2002							
Subcontracting						Ropponen, 2000								
Shortfalls in externally furnished components								Boehm, 1991						
Rapid changes				Sherer, 1995										
Human	Chittister, 1993													
Human					Rashmi, 2004									
Leadership	Chittister, 2000													
Personal trustworthiness	Chittister, 2000													
Interpersonal trust	Chittister, 2000													
Managerial empowerment	Chittister, 2000													
Institutional alignment	Chittister, 2000													
Communication ability	Chittister, 2000													
Technical competence	Chittister, 2000													
Management Methods			SEI Taxonomy, 1993											
Personnel management						Ropponen, 2000								
Project management methodology											Addison and Vallabh, 2002			
Project manager												Standish Group's 2		
Top management commitment										Keil et al, 1998				
Senior management commitment											Addison and Vallabh, 2002			
Executive support												Standish Group's 2		
Management														DoD Guid
Lack of user involvement										Keil et al, 1998				
User commitment										Keil et al, 1998				
User involvement											Addison and Vallabh, 2002			
User involvement												Standish Group's 2		
Managing end user expectations										Keil et al, 1998				
Changing scope/objections										Keil et al, 1998				
Minimized scope												Standish Group's 2		
Misunderstood scope or objectives											Addison and Vallabh, 2002			
Project personnel knowledge/skills										Keil et al, 1998				
Knowledge/skills											Addison and Vallabh, 2002			
Insufficient/inappropriate staffing										Keil et al, 1998				
User department conflicts										Keil et al, 1998				
Quality	Chittister, 2000													
Program Constraints			SEI Taxonomy, 1993											
Technical performance	Chittister, 2000													
Resources			SEI Taxonomy, 1993											
a. Schedule			SEI Taxonomy, 1993											
b. Staff			SEI Taxonomy, 1993											

How Best to Collapse Into an Integrated list?

- **Some sections were easy to match up**

Top management commitment	Keil et al, 1998			
Senior management commitment		Addison and Vallabh, 2002		
Executive support			Standish Group's 2001	

Schedule delay	Chittister, 2000				
Schedule		Ropponen, 2000			
Schedules unrealistic				Addison and Vallabh, 2002	
Schedule					DoD Guide, 2003
Unrealistic schedules and budgets			Boehm, 1991		

How Best to Collapse Into an Integrated list?

- **Other sections were more difficult**

	Requirements identification and specification				Buttigieg 2004						
		Understandability			Buttigieg 2004						
	Requirements misunderstood					Keil et al, 1998					
	Misunderstood requirements						Addison and Vallabh, 2002				
Product Engineering								SEI Taxonomy, 1993			
	Requirements							SEI Taxonomy, 1993			
		Clarity						SEI Taxonomy, 1993			

Program Constraints				SEI Taxonomy, 1993							
	Technical performance		Chittister, 2000								
	Resources			SEI Taxonomy, 1993							
		a. Schedule		SEI Taxonomy, 1993							
		b. Staff		SEI Taxonomy, 1993							
		c. Budget		SEI Taxonomy, 1993							
	Cost overrun		Chittister, 2000								
	Budgets unrealistic					Addison and Vallabh, 2002					
	Cost/Funding						DoD Guide, 2003				
	Unrealistic schedules and **budgets**				Boehm, 1991						

Consolidated – Final List

Category	Source	Frequency
Acquisition		
	Clear business objectives	2
	Proposal	
	Contract	
	Changes	
	Reviews	
	Acceptance	
Software Development		2
	Requirements	14
	Architecture	6
	Process	3
	Design	6
	Code and Unit Test	6
	Integration and Test	4
	Systems integration	
	Evaluation	
	Initial Operating Capability	2
	Evaluation and Modification	3
	Final Operating Capability	2
	Deployment and support	2
	Maintenance	2
	Upgrade and growth	2

Category	Source	Frequency	
Development Environment			
	Hardware		
	Software		
	Resource usage and performance		4
Organizational			
	Management		7
	Resources and skills		11
	External relationships		2
	Subcontracting		3
Leadership			
	Senior management commitment		3
	User involvement		4
	Changing scope/objections		3
Quality			
	Technical performance		
	Cost		5
	Schedule		7
	Engineering Specialties		2
Technology			
	New technology		4
	Capability		2

Final Words

- **Top Four Risks Sources**
  - Requirements = 14
  - People and Facilities = 11
  - Management = 7
  - Schedule = 7
- **Some risks sources are fairly new and therefore not yet prevalent in the literature**
  - Agile methods
  - System robustness
  - Metrics
  - System of systems interoperability
  - Accelerated procurement

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