The System Concept: Bringing Order to Chaos

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Welcome to Tutorial

- Welcome
- Logistics
- Class Materials
- Evaluation and Feedback
- Introductions

Course Objectives

- Develop a rigorous understanding of how to identify and analyze stakeholders based on function
- Develop a method to analyze stakeholders to develop a behavioral conceptual model for a system based on stakeholder goals
- Develop a method to develop an initial system structural model based on stakeholder language

Requirements Engineering Overview
(30 minutes)

An Introduction to Requirements Engineering in the Context of Systems Development

Requirements Engineering Overview Topics

- Systems Engineering Context for Requirements Engineering
- Concept of Requirement
- Areas in Requirements Engineering
- Role of Requirements Engineer

Requirements Multiple Choice

1. When do you move into concurrent design?
   A) when you have enough engineers
   B) when you have a good idea
   C) when your boss tells you to
   D) when the requirements are ready
2. Who is responsible for the requirements?
   A) the person who asked me to do the work
   B) the marketing group
   C) me and the systems engineer
   D) all of the above
3. When are the requirements ready?
   A) when the document weighs 10 lbs
   B) when I get them
   C) when the cows come home
   D) when all parties feel they contractually can move ahead

Fred Brooks, No Silver Bullet

"The hardest single part of building a software system is deciding precisely what to build. No other part of the conceptual work is so difficult as establishing the detailed technical requirements.... No other part of the work so cripples the resulting system if done wrong. No other part is more difficult to rectify later."

[IEEE Computer, 1987]

Systems Engineering Context

- Systems Engineering addresses the dual problem of:

  (1) translating stakeholder needs into system requirements

  (2) specifying components that, when integrated, will satisfy those requirements

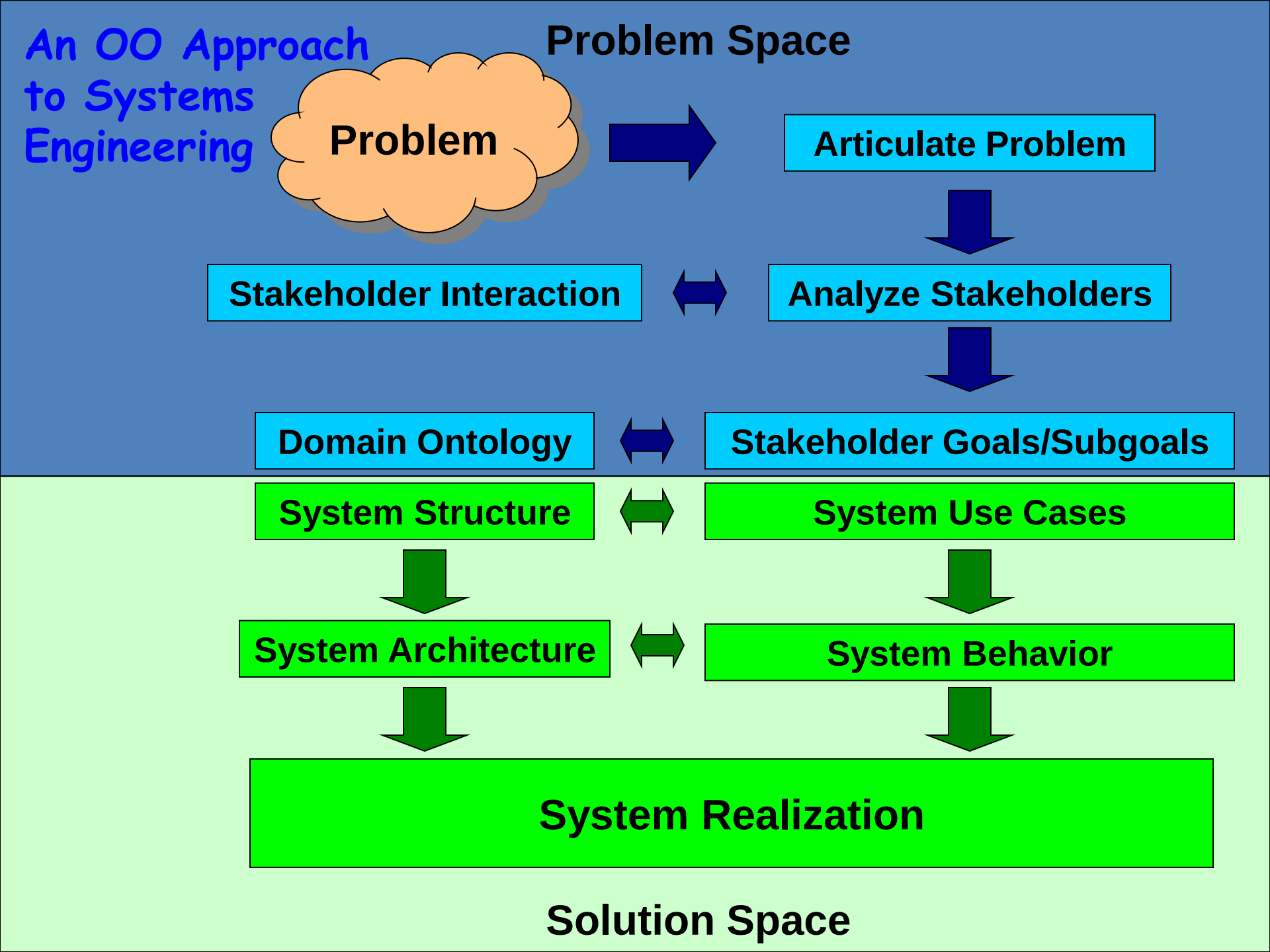
- In other words:

  stating the problem (i.e., defining the problem domain)

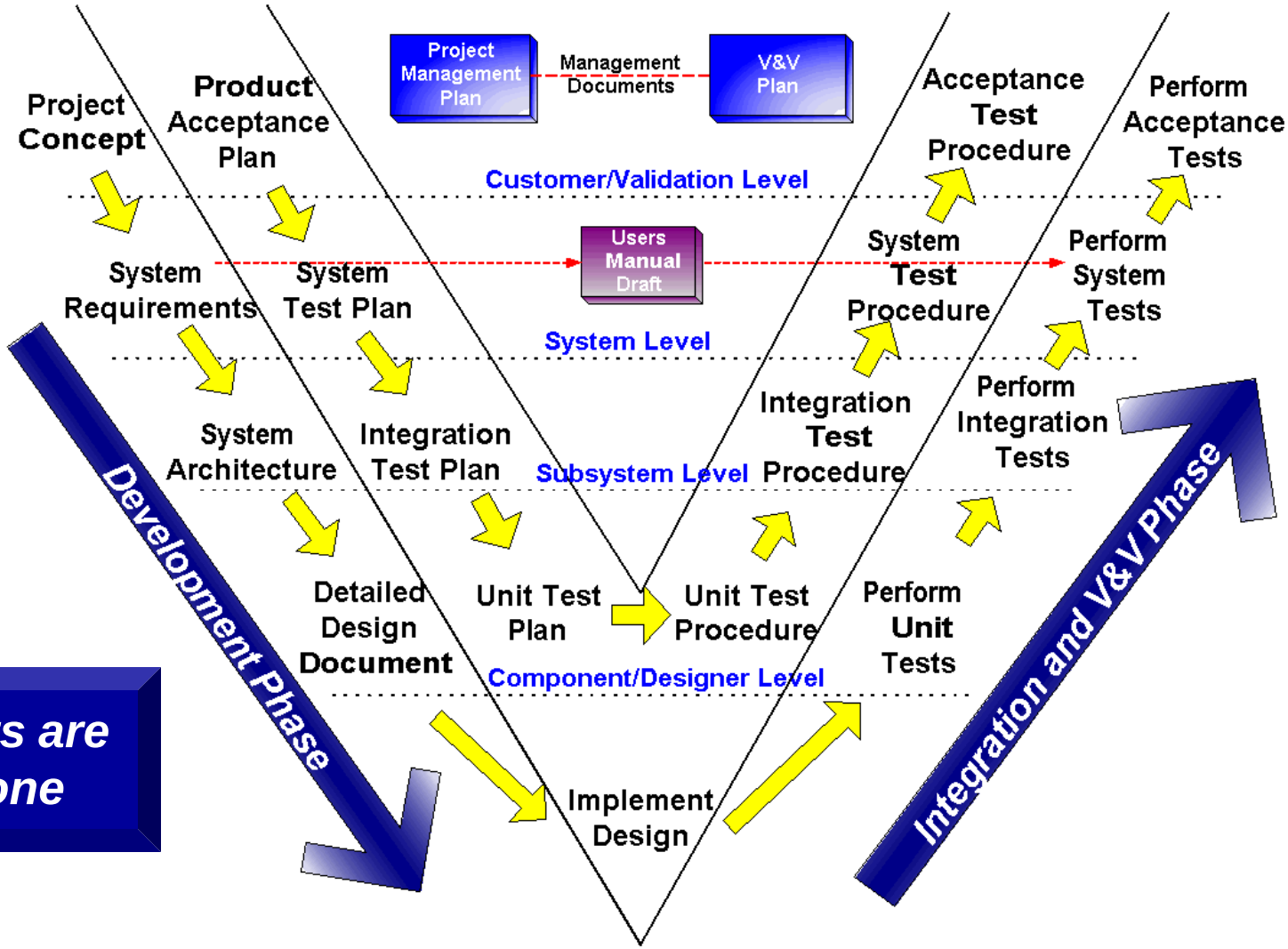
  - and -

  solving it (i.e., defining the solution domain)

Requirements Engineering is a Fundamental Component of the SE


An OO Approach to Systems Engineering
Problem Space
Problem
Articulate Problem
Stakeholder Interaction
Analyze Stakeholders
Domain Ontology
Stakeholder Goals/Subgoals
System Structure
System Use Cases
System Architecture
System Behavior
System Realization
Solution Space

Systems Engineering Process Dependencies



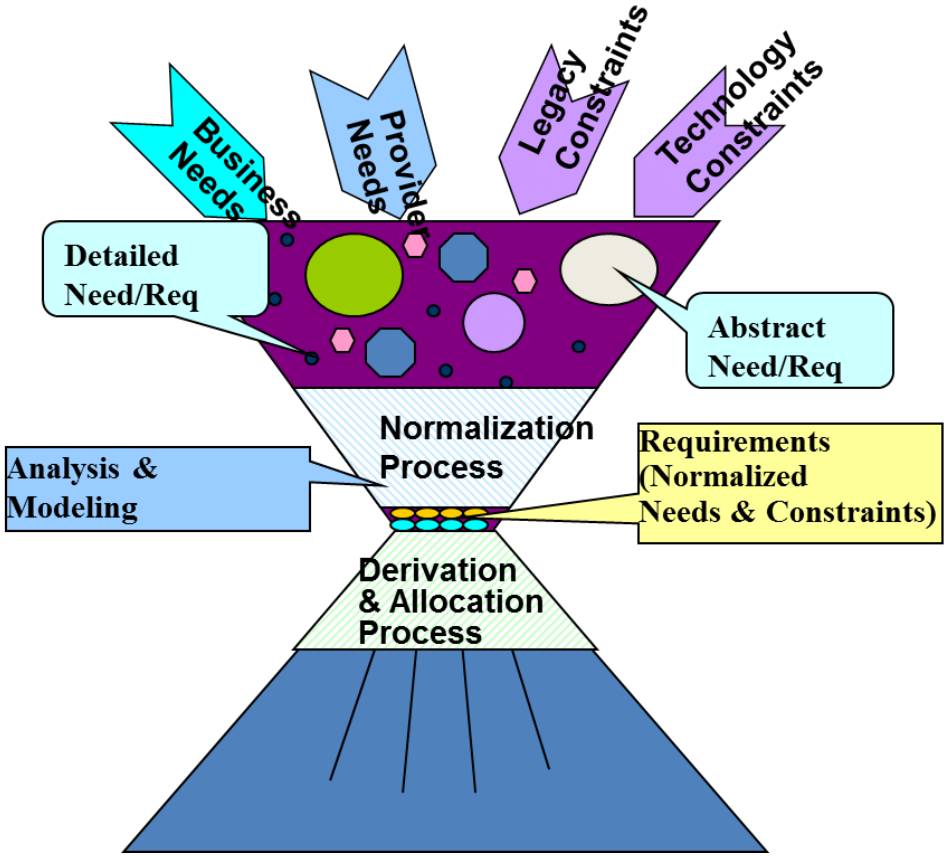
Requirements are the Keystone

Discussion: Brainstorm Requirement Concept

- Break into groups of five
- Brainstorm the Requirement Concept
- Share with the rest of the class
- The word “Requirement” is an overloaded word
  - Some use it when talking about needs
  - Some use it when talking about corporate/policy constraints
  - Some are referring to specified/structured “shall” statements

Requirements Hourglass

- Standard “pyramid” model doesn’t account for Requirements work
- Achieving normalized high-level requirements at the onset of a project is crucial and difficult



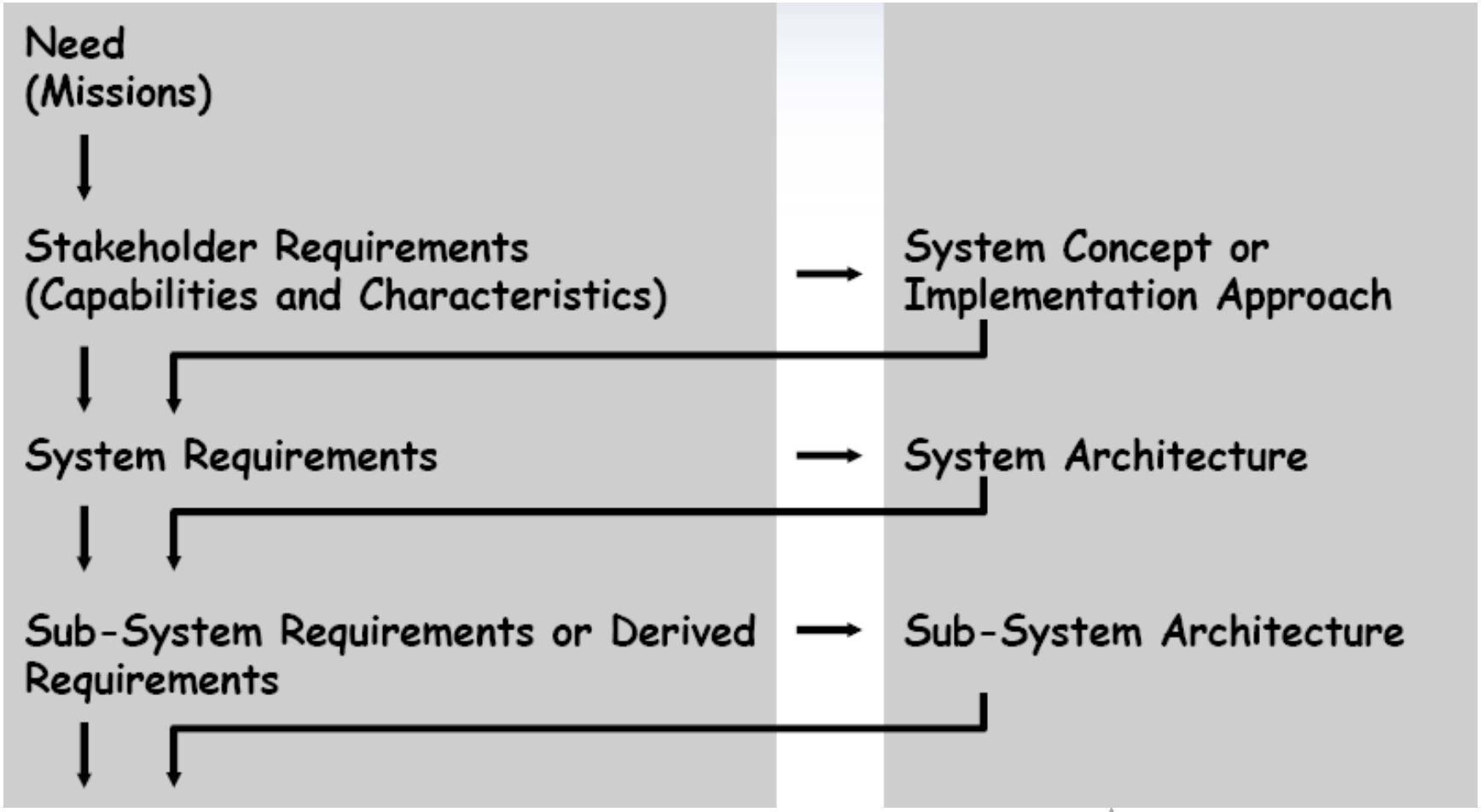
Requirements Definitions

CMMI	Requirement	(1) A condition or capability needed by a user to solve a problem or achieve an objective. (2) A condition or capability that must be met or possessed by a product or product component to satisfy a contract, standard, specification, or other formally imposed documents. (3) A documented representation of a condition or capability as in (1) or (2).
EIA 632	Requirement	(1) Something that governs what, how well, and under what conditions a product will achieve a given purpose. (2) Normative elements that govern implementation of this Standard, including certain documents such as agreements, plans, or specifications.
ISO/ IEC2007	Requirement	Statement that identifies a product* or process operational, functional, or design characteristic or constraint, which is unambiguous, testable or measurable, and necessary for product or process acceptability.
CMMI	Requirements Analysis	The determination of product-specific performance and functional characteristics based on analyses of customer needs, expectations, and constraints; operational concept; projected utilization environments for people, products, and processes; and measures of effectiveness.
ISO/ IEC2010	Requirements Engineering	Subset of systems engineering concerned with discovering, developing, analyzing, validating, communicating and managing requirements.
CMMI	Requirements, Product	A refinement of the customer requirements into the developers' language, making implicit requirements into explicit derived requirements. (See “product-component requirements” and “derived requirements.”) The developer uses the product requirements to guide the design and building of the product.
CMMI	Requirements, Technical	Properties (attributes) of products or services to be acquired or developed.

What Are Requirements?

- Precise statement of what, how well, and under what conditions something must be done
- The three Cs:
  - Capabilities ⟶ Behavioral Requirements
  - Characteristics ⟶ Non-behavioral Requirements
  - Constraints ⟶ Constraints
- Requirements & constraints = problem space
- Design ≡ decisions = solution space

Requirements Layers



Dr. Dinesh Verma

Where Do Requirements Come From?

- Stakeholder/User needs and desires
- Contractual agreements – formal and informal
- Industrial standards, company policies or technical standards
- Government regulations and codes
- A priori constraints
  - cost and schedule
  - limits of available technology
  - use of existing items or standard products
  - laws of nature

Requirements come from many sources, not just marketing or technical specifications

Types of Requirements

Types of System Requirement	Description
Functional Requirements	Describe qualitatively the system functions or tasks to be performed in operation.
Performance Requirements	Define quantitatively the extent, or how well, and under what conditions a function or task is to be performed (e.g. rates, velocities). These are quantitative requirements of system performance and are verifiable individually. Note that there may be more than one performance requirement associated with a single function, functional requirement, or task.
Usability requirements	Define quality in use such as measurable effectiveness, efficiency, and satisfaction criteria.
Interface Requirements	Define how the system is required to interact or to exchange material, energy or information with external systems (external interface), or how system elements within the system, including human elements, interact with each other (internal interface). Interface Requirements include physical connections (Physical Interfaces) with external systems or internal system elements supporting interactions or exchanges.
Operational requirements	Define operational conditions or properties under which the system is required to operate or exist. This type of requirements includes human factors and ergonomics, availability, maintainability, reliability, security.
Modes and/or states requirements	Define the various Operational Modes of the system in use, and events conducting to Transitions of Modes.
Adaptability requirements	Define potential extension, growth or scalability during the life of the system.
Physical constraints	Define constraints on weight, volume and dimension applicable on System Elements that compose the system.
Design Constraints	Define the limits on the options open to a designer of a solution by imposing immovable boundaries and limits (e.g., the system shall incorporate a legacy or provided system element, or certain data shall be maintained in an on-line repository).
Environmental conditions	Define the environmental conditions to be encountered by the system in its different Operational Modes. Should be addressed the natural environment (e.g. wind, rain, temperature, fauna, salt, dust, radiation, etc.), induced and/or self induced environment (e.g. motion, shock, noise, electromagnetism, thermal, etc.), threats, societal environment (e.g. legal, political, economic, social, business, etc.)
Logistical requirements	Define the logistical conditions needed by the continuous utilization of the system. These requirements include sustainment (provision of facilities, level support, support personnel, spare parts, training, technical documentation, etc.), packaging, handling, shipping, transportation.
Policies and regulations constraints	Define relevant and applicable organizational policies or regulatory requirements that could affect the operation or performance of the system (e.g. labor policies, reports to regulatory agency, health or safety criteria, etc.).
Cost and schedule constraints	Define, for example, the cost of a single exemplar of the system, the expected delivery date of the first exemplar, etc.

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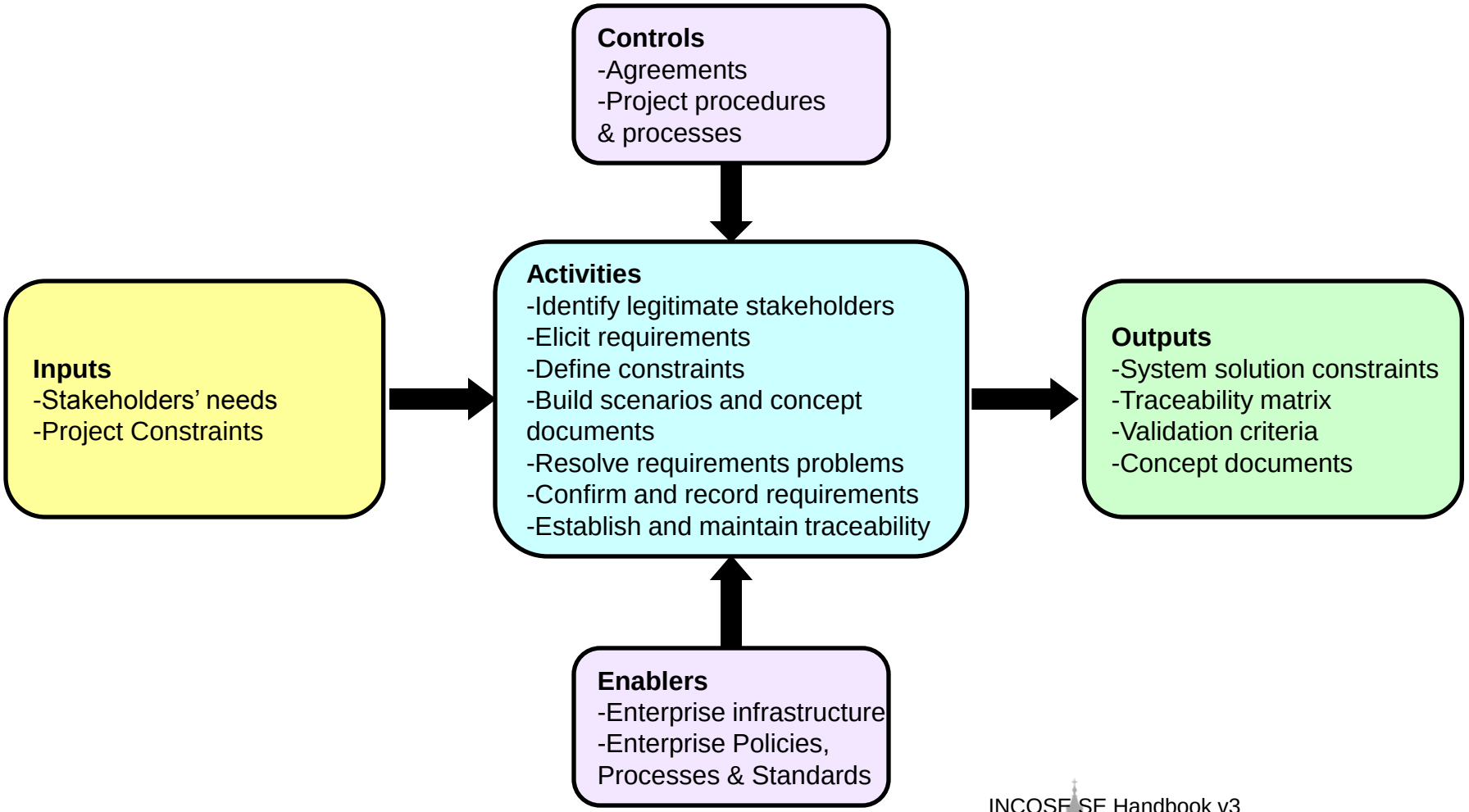
Stakeholder Requirements Definition Process Context (ISO 15288)



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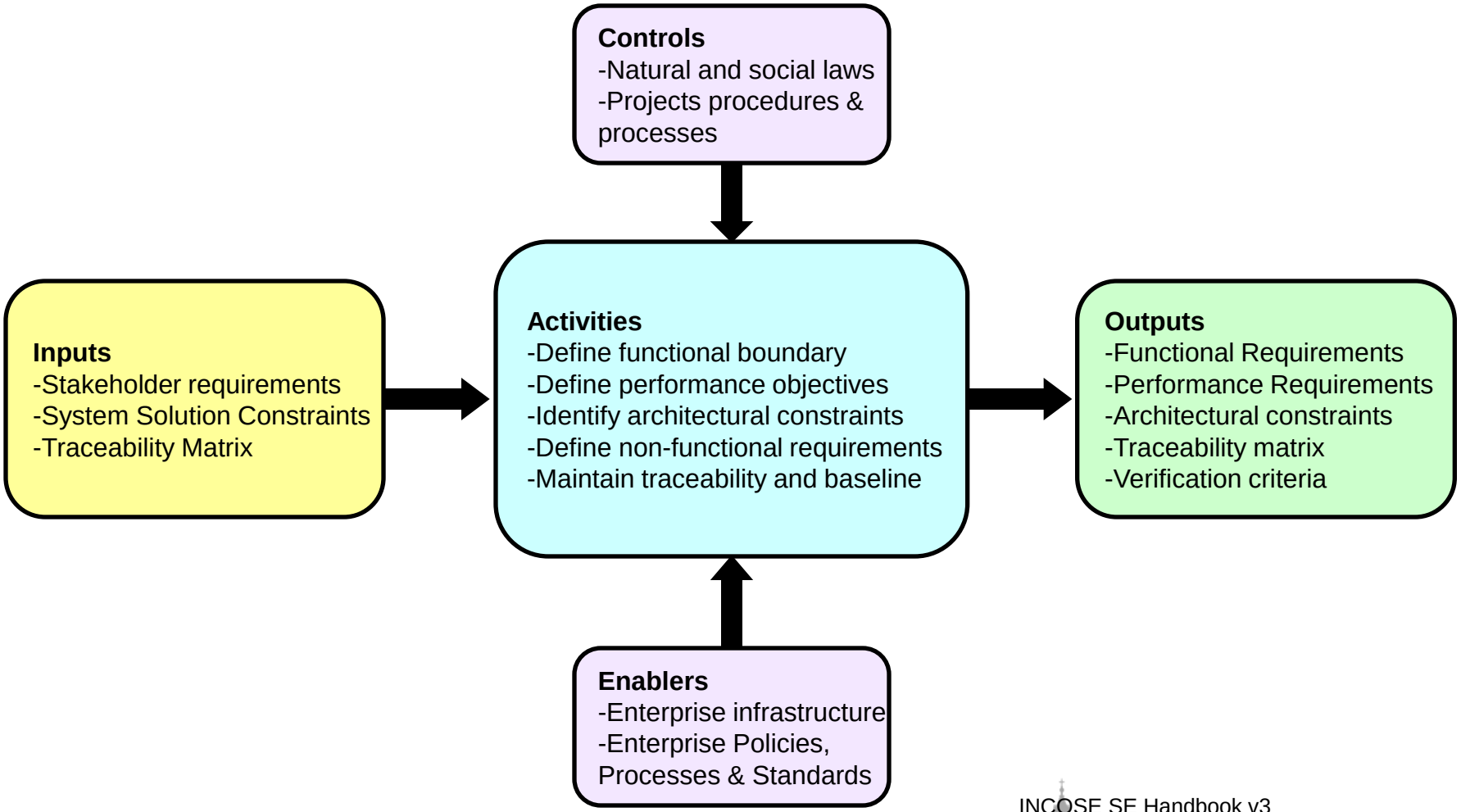
Defining Stakeholder Requirements is crucial to developing the right product

Requirements Analysis Process Context (ISO 15288)



INCOSE SE Handbook v3

Analyzing Requirements using Systems Analysis yields a set of complete and consistent System Requirements

Requirements Engineering

- Identify (Elicit) – obtaining the raw material from which to analyze and formulate the actual requirements; understanding the problem
- Analysis – model, partition, organize, decompose information captured in order to understand fundamental elements of scope, ontology, behavior, and allocation level
- Develop – generating and allocating derived requirements in a form that is unambiguous, verifiable, and manageable
- Manage – update, use, and trace requirements during the life of a requirement
- Verify and validate – ensuring that the requirements are complete and correct as specified and that the requirements as specified will yield a product that meets the stakeholders needs in the environment of its intended use

Role of the Requirements Engineer

- Incumbent on engineers to close the semantic gap
  - Take responsibility for the acquisition and formalization of requirements
  - Responsible for representing stakeholder information in terms of “what” needs to be done
  - Stay in an ‘ask and listen only’ mode during the beginning steps of the process
- Must convey the importance of the stakeholder’s unique viewpoint and must train the stakeholder to actively participate
- Systems integrator at the conceptual level
- Builds the system conceptual model
- Develops complete and consistent requirements that all stakeholders will buy into
- Honest Broker – challenge requirements

Requirements Engineering Overview Summary

- Requirements Engineering is the keystone to good Systems Engineering
- Requirements affect many people and are not simply a process of collection
- The term “Requirement” has multiple meanings and is not simple
- There are many sources for requirements and there are types and levels of requirements
- Requirements Engineering is an established discipline with methods and techniques
- The role of a Requirements Engineer is critical to the success of a project

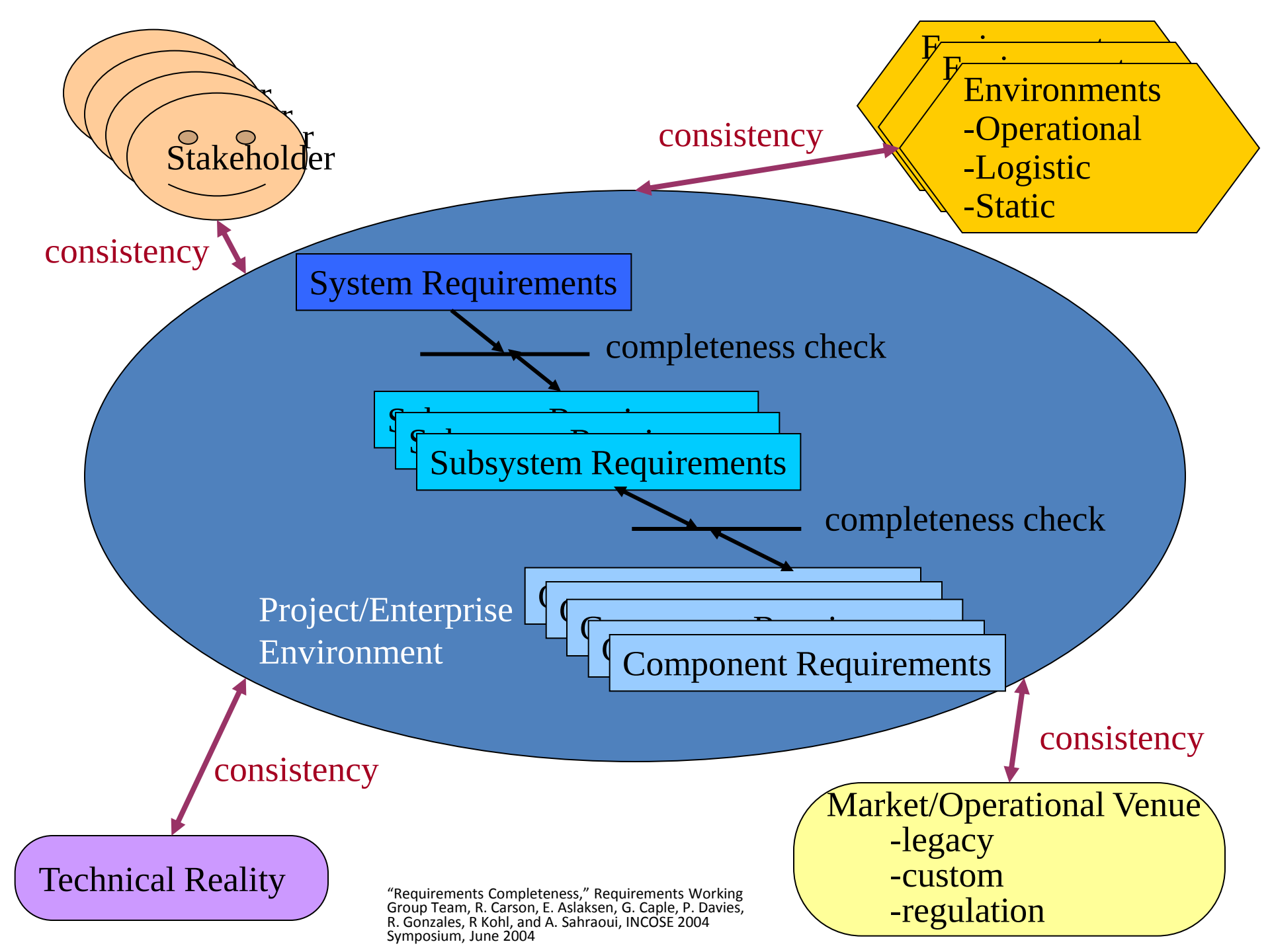
Stakeholder Requirements Definition

Stakeholder Requirements Definition Goals

- Leads to accurate and complete understanding of the problem
- The steps lead to a Concept Document with the following
  - Clear articulation of the Problem
  - Clear understanding of stakeholders
  - Clear understanding of the stakeholder operational needs
  - Clear understanding of the solution mission, capabilities and characteristics
  - Clear understanding of the impacts of the new system

Stakeholder Requirements Definition Topics

- State the problem – a tool is provided
- Identify and profile stakeholders – a tool is provided
- Analyse stakeholder functional viewpoint
- Model stakeholder interaction (N^2 approach) – the structural view of stakeholders
- Determine goals of the stakeholders
- Crossing to solution space – analyse stakeholder goals and create a behavioural architecture
- Determining the mission of the system – going back to the problem
- Develop the as-is and to-be use cases – a step away from writing requirements
- Model structures from nouns identified in behavioural model
- Deriving metrics for success



"Requirements Completeness," Requirements Working Group Team, R. Carson, E. Aslaksen, G. Caple, P. Davies, R. Gonzales, R Kohl, and A. Sahraoui, INCOSE 2004 Symposium, June 2004

Semantic Gap

- Systems and software development models do not address requirements or pre-requirements consistently
  - Waterfall, Spiral, etc.
- Diverse stakeholders
  - Clients or customers
  - Developers from many domain areas
  - Multiple users with diverse needs
  - Production, manufacturing, distribution, and support staff
  - Standards, regulatory agencies, & existing infrastructure

Diversity is at the Core of Requirements: MRI Example

Customers	Development Staff
Hospital administrators Cost and availability **High-profile doctors** Image quality and speed **Nurse medical technicians** ease of use and image quality **Patient Needs** Patient comfort **FDA** Safety Established development process **Application scientists** Accessibility to HW and hpwr **Service staff** Ease of access and repair	**Marketing** Moderate domain understanding Greatest amount of customer interface Limited technical understanding **Application scientist** Very domain knowledgeable Limited engineering skill Key to image quality **Engineers (HW, SW, and mechanical)** Engineering skill Limited domain knowledge **Production engineers** Key w/ engineers to cost of product Limited domain knowledge **Service technicians** Key w/ engineers to availability of product Moderate domain knowledge

Needs Elicitation

- The goal of elicitation techniques is to attack ambiguity in the early development stages to avoid the expensive cost of removing it later –

  "Oh, is that what you meant?"

- Levels of User Consciousness:
  - **Conscious Needs:** uppermost in the user's mind – symptomatic of something the user wants to improve.
  - **Unconscious Needs:** not mentioned since the user assumes everyone else has the same knowledge.
  - **Undreamed of Needs:** things the user will ask for once they realize what is possible.

Identify as many of the user's needs, at all three levels, as efficiently and unambiguously as possible.

Problem Template

The problem of…	*describe the problem*
affects…	*the stakeholders affected by the problem*
the impact of which is…	*what is the impact of the problem*
a successful solution would be…	*list some key benefits of a successful solution*

Problem Statement Example: Fast Food Franchise

The problem of…	*Fast food service relies on an unreliable/untrained workforce.*
affects…	*Fast food franchise owners, consumers of fast food*
the impact of which is…	*Cost and efficiency of providing fast food service.*
a successful solution would be…	*Greater revenue to franchise owner, more options for the consumer*

Problem Statement Example: Logistics

The problem of…	**Long turnaround time (30 days or more) to process supportability analysis and trade studies.**
affects…	**All F-35 stakeholders**
the impact of which is…	**Unacceptable delays, turnaround times and projections that are less than optimal**
a successful solution would be…	**Improved turn-around time to conduct supportability analyses with a goal of twenty-four hours, or less. Analysis/trade-study solution that requires minimum human intervention for data handling, translation, or redefinition. A solution that contributes to greater confidence and accuracy in the data employed.**

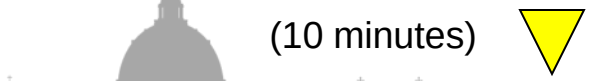
Problem Statement Example: Special Tooling Program

The problem of	Pantex's Special Tooling Program
affects	Primarily, PT's performing weapons work Secondarily, all production activities at Pantex Tertiary, all support activities in the NWC
the impact of which is	Constrained weapons delivery rates to DOD
a successful solution would be	Minimal downtime to production due to tooling Minimized number of repairs, time to repair, time to design, time to fabricate additional copies Maximized utilization of shared design features and reliance on information in the data warehouse Rapid disposal of obsolete and broken tools Result in less reviews of higher quality, traced directly to regulatory requirements hierarchy

Activity 1: Writing a Problem Statement

- Divide into groups of three or four
- Using the Problem Statement template provided, write a problem statement for the case study scenario described to you
- The completed problem statement will be used in Activity 2
- Debrief

(10 minutes)

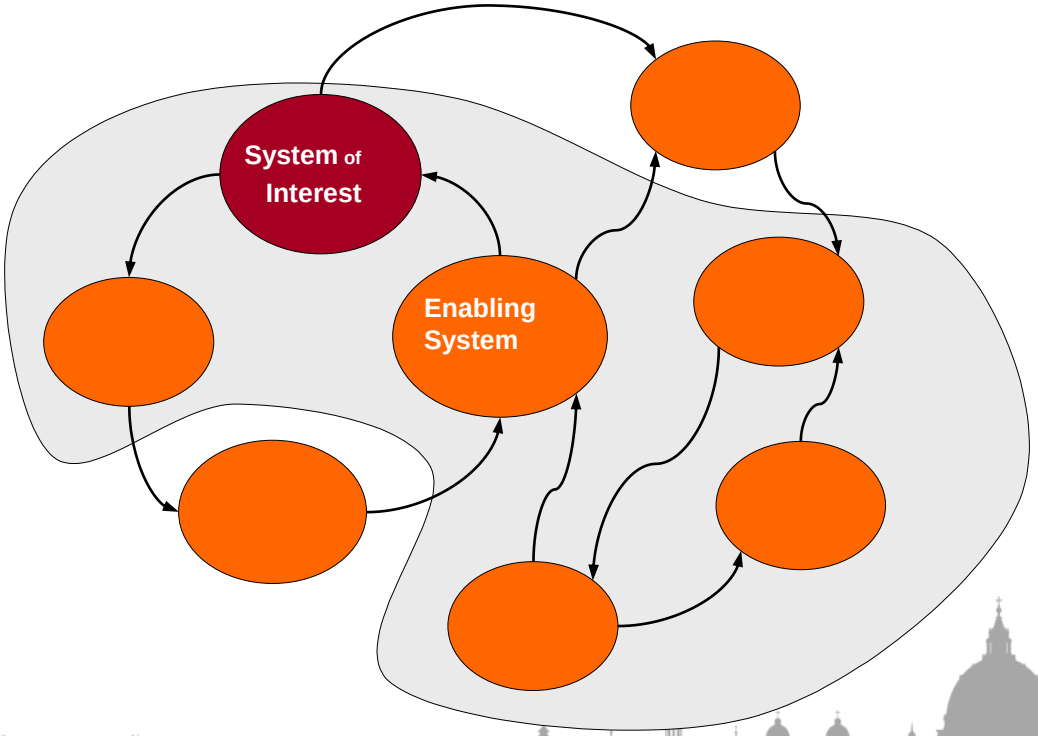


Stakeholder Identification

- A stakeholder is anyone or any system that has a stake in the solution
- Identify Stakeholders
  - Active – People or systems that are likely to interface directly with the system in its operational environment
  - Passive – All other stakeholders
- Stakeholder Identification
  - System context
  - Project and product lifecycle
  - Operational scenarios
  - Who pays the bills?
  - Regulations or policies

System Context

- What are all the systems that this system interfaces with
- What are the enabling systems that are dependant on this system or that this system depends on
  - Who owns or represents them?



Project and Product Lifecycles

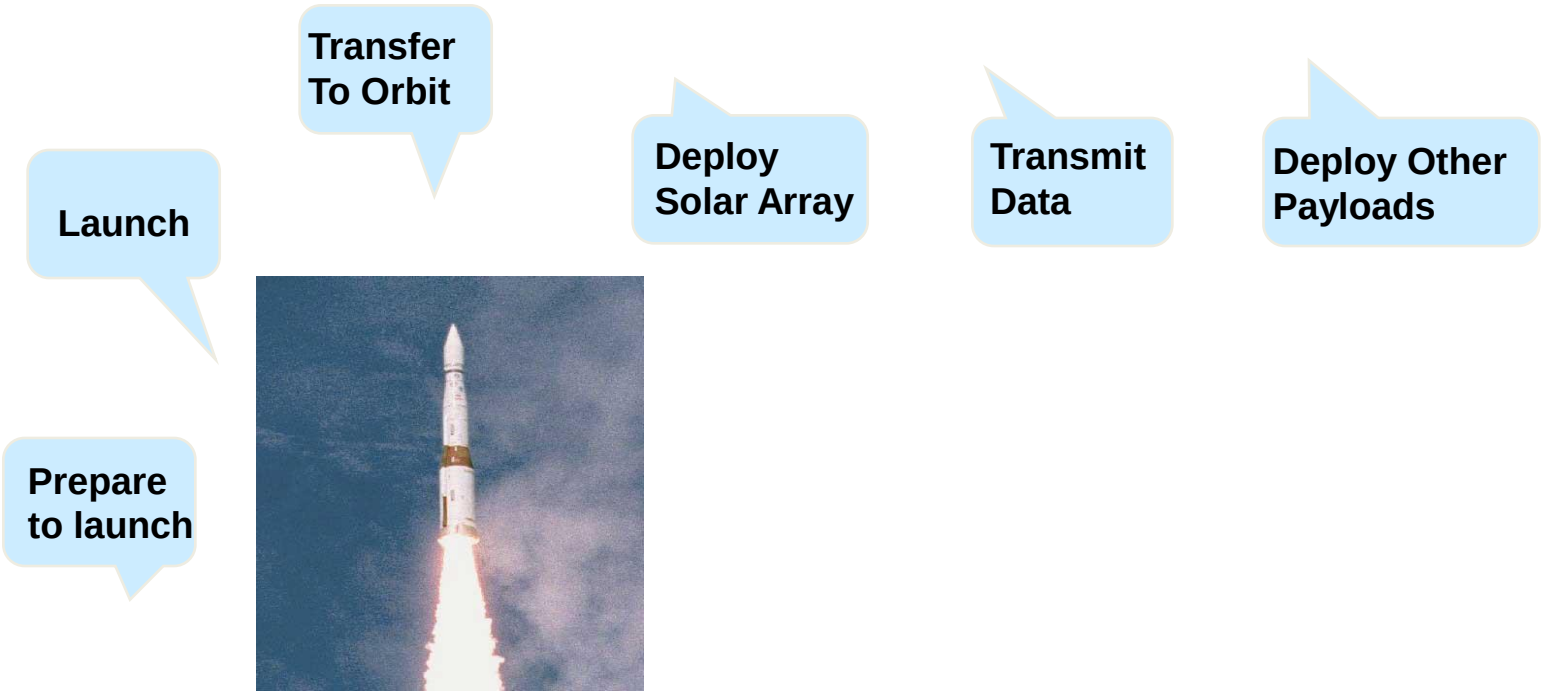
- More than just waterfall, be specific
- What about the surrounding system?
- How many people are involved in development?
- What happens during test?
- Who transitions it to its home environment?
- Who interacts with it while it is in its home environment?
- Who is responsible for maintaining it?
- How does it get disposed?

Operational Scenarios

- Critical to ‘mission’ oriented systems
- Detail the steps the system will take
  - Before the mission as it is being prepared
  - During the mission - all phases
  - After the mission as it is being recovered and disposed
  - What happens in the exception?
- For other “continuous operation” systems
  - A week/month in the life of

System Operational Concept Example

Diagram of Spacecraft Operational Scenario



Who Pays the Bills?

- Customers are not always users
- Who represents the customer?
- What visibility does the customer require?
- Carefully define the win-conditions of the customer(s)

Regulatory Stakeholders

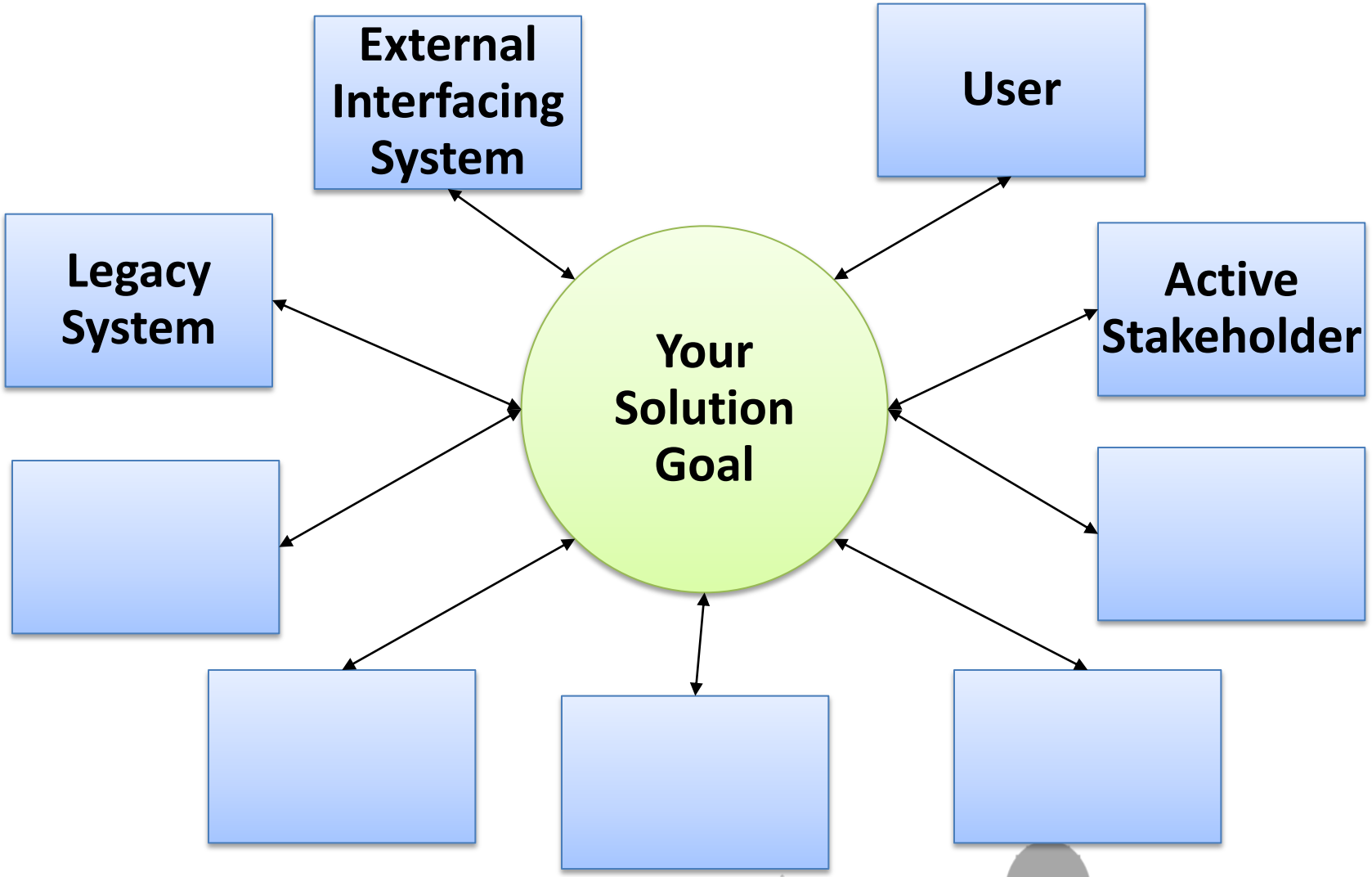
- What agencies or governments have constraints that affect deploying the solution being proposed?
- What contractual obligations does your organization maintain with customers and with governments?
- Who can stop your product from shipping based on evidence of compliance to laws, policies, rules, processes, authorization, or regulations?

Stakeholders in the Context of the Problem

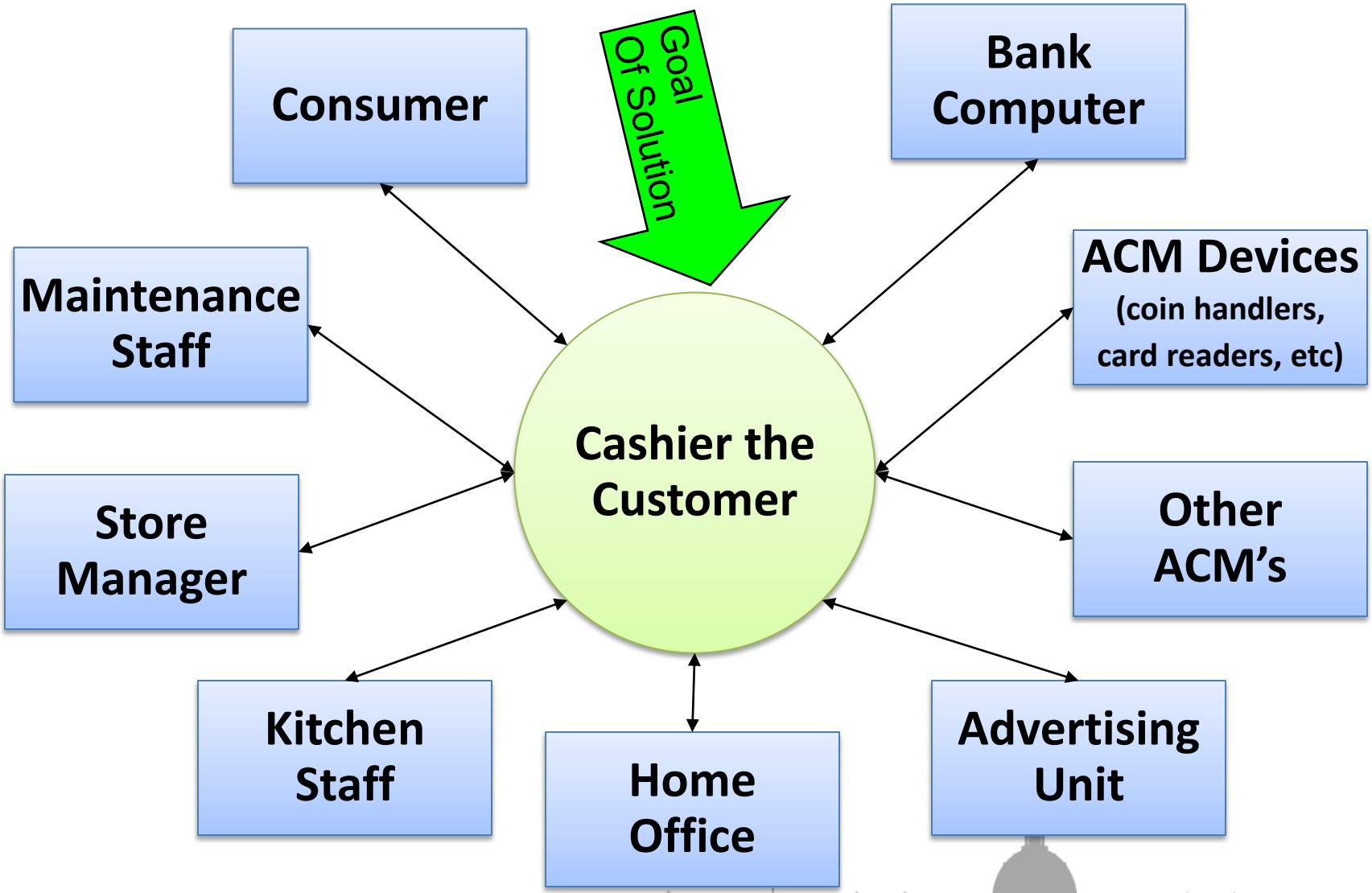
- Active stakeholders interface to the system
- Context diagrams are used to define external boundary of the system
- Clarifies external interfaces to both users and systems

A Context Diagram is a simple tool that allows to you understand solution boundary & external interfaces

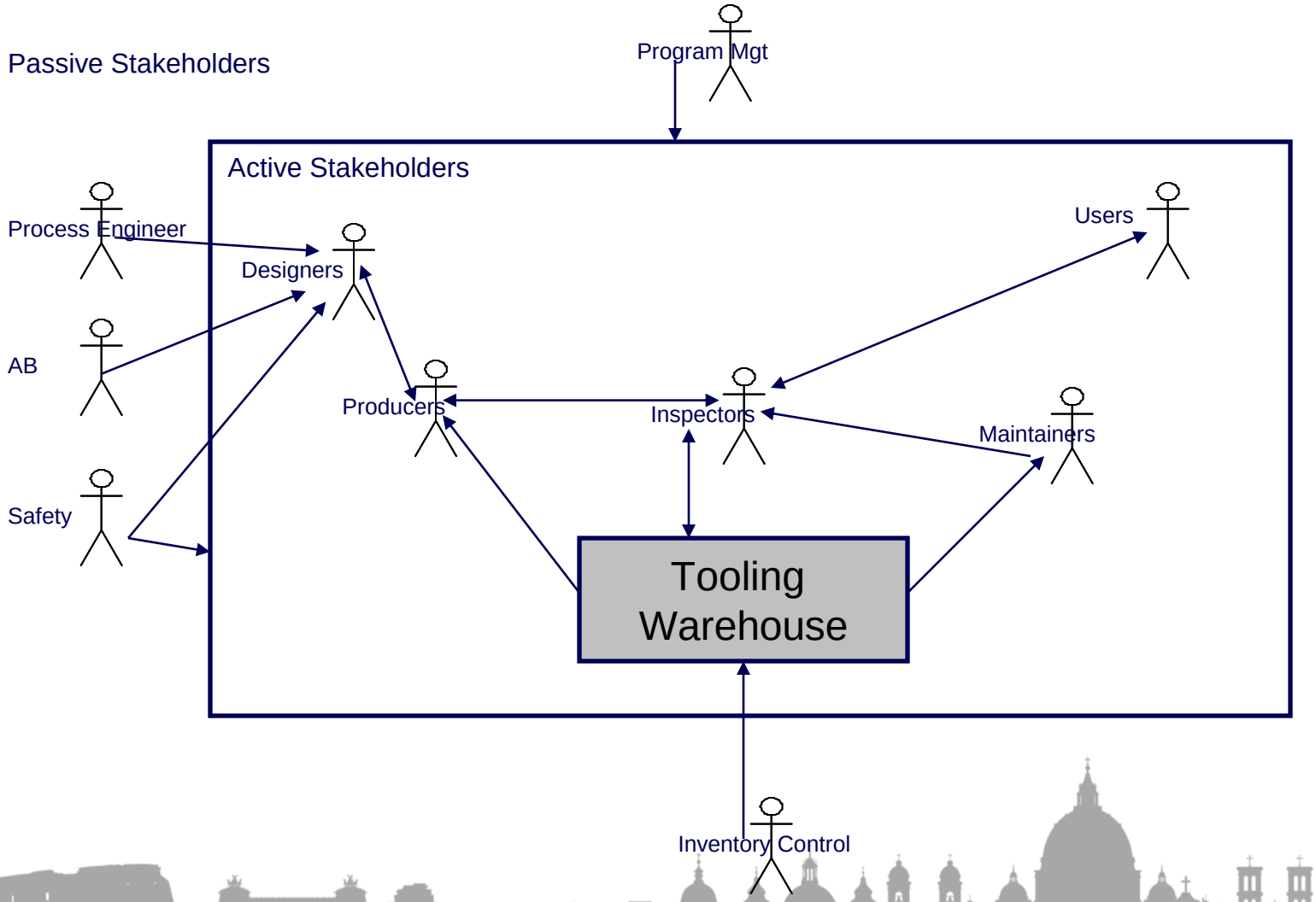
Context Diagram



Context Diagram Example: ACM



Context Diagram Example: Special Tooling Enterprise



Activity 2: Identifying Stakeholders

- Divide into your earlier groups
- Identify the 3-5 stakeholders from the Case Study
- Draw the Context Diagram
  - Identify the active stakeholders
  - Identify the boundaries
- Revise your Problem Statement developed in Activity One to reflect your new understanding of the problem
- The revised Problem Statement and Context Diagram will be used in Activity 3
- Debrief

(10 minutes)

Eliciting Stakeholder Information

- Decide on elicitation method
- Prioritize stakeholders
  - Primary – critical stakeholders that would substantially impact the completeness of a solution
  - Secondary – important stakeholders that some understanding is required
- Arrange for stakeholder interviews or information gathering

Elicitation Techniques

- Examples of elicitation techniques are:
  - Win-Win Theory W (Boehm)
  - Soft Systems and Participatory Design (Checkland)
  - Goal/subgoal analysis
  - Mission Analysis - Scenario development
  - Scenario and Use Case Based Methods (Filippidou, Larmen)
  - Knowledge Elicitation Techniques (Cooke)
    - Interviewing is an example
    - Use the stakeholder models and transcripts created during interviews
  - Facilitator-based Methods (Mcauley, Wood & Silver)
  - Viewpoint Analysis [Darke & Shanks]
  - Apprenticing
  - Ethnography

Identifying the Win Conditions of Stakeholders

- What scenario involving the product would make them deliriously happy?
- What motivates them?
- How will they be evaluated?
  - What will make them look good?
  - What will make them look bad?
- What is their investment?
- What do they have to lose?
  - BATNA (Best Alternative to Negotiated Agreement)
- Ask them.

Win Conditions Example: ACM

- ACM Technologies
  - The ACM should automate virtually all cashier functions.
  - Placement of ACM and components in ACM is consistent with ADA.
  - Maximize ROI by selling many ACM's.
  - Minimize customer cost (cost of purchase, cost of maintenance)
  - Maximize functionality
  - The ACM must be aesthetically pleasing and non-intimidating to users.
  - The ACM must accept all bill and coin denominations specified by ACM business customer.
  - The ACM must be sensitive enough to detect counterfeit currency.
  - The ACM must be capable of storing between 25k and 30k currency bills.
  - The ACM must be reliable with an absolute minimum of down time.
  - The computer controlling the advertising system should provide automatic backup to the ACM computer system.
  - The ACM cash storage must be absolutely tamper proof.
  - The ACM must be able to communicate with business host computers as well as appropriate banking credit card entities.
  - Advertising system composed of high resolution video and audio components.
  - Advertising system must have communication capability.
- ACM Users
  - Intuitive interface that guides customer through the ordering and payment process.
  - A complete range of payment options should be available.
  - The ACM should handle currency in less than mint condition to minimize rejects.
  - ATM capability for cash withdrawal.
  - Acceptance of coupons, food stamps, gift certificates and personal checks.
- ACM Purchasers
  - Rapid ROI.
  - Maximize cashier station productivity.
  - Improve cash and inventory management capability.
  - Eliminate pilferage and cashier errors.
  - Reduce labor force requirements.
  - Realize additional revenue source.
  - Reduce exposure to criminal acts.
- ACM Maintenance Staff
  - Comprehensive self diagnosis capability to pinpoint problem area.
  - Modular components with quick connect/disconnect capability to allow simple replacement of faulty component.
  - Easy to clean.

Activity 3:
Identifying Stakeholder Win Conditions

- Divide into your former groups
- Identify stakeholder win conditions for 3 key stakeholders (1 prime, 2 secondary)
- Share with class
- Debrief

(10 minutes)

Stakeholder Profile

Representative	*Who is the stakeholder representative to the project, what is their name(s)?*
Description	*A brief description of the stakeholder type. In essence the functional responsibility.*
Type	*Qualify the stakeholder's expertise, technical background, and degree of sophistication—that is, guru, business, expert, casual user, and so on.*
Responsibilities	*List the stakeholder's key responsibilities with regard to the system being developed—that is, their interest as a stakeholder.*
Success Criteria	*How does the stakeholder define success? How is the stakeholder rewarded?*
Involvement	*How the stakeholder is involved in the project? Relate where possible to roles—that is, Requirements Reviewer and so forth.*
Deliverables	*Are there any additional deliverables required by the stakeholder? These could be project deliverables or outputs from the system under development.*
Comments / Issues	*Problems that interfere with success and any other relevant information go here, including project or technical risks identified by the stakeholder.*

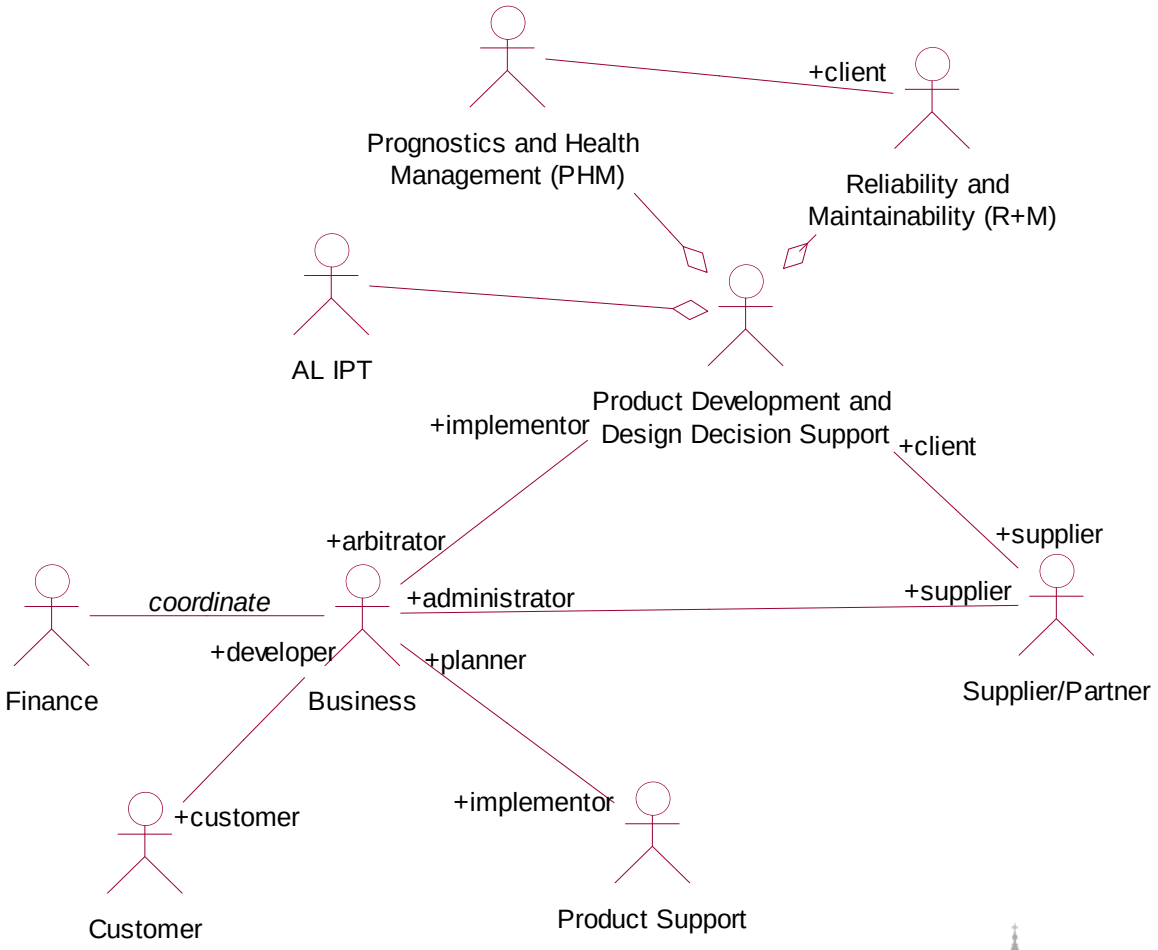
Profile formalizes understanding of the stakeholders and puts that understanding in the context of the project

Stakeholder Classes

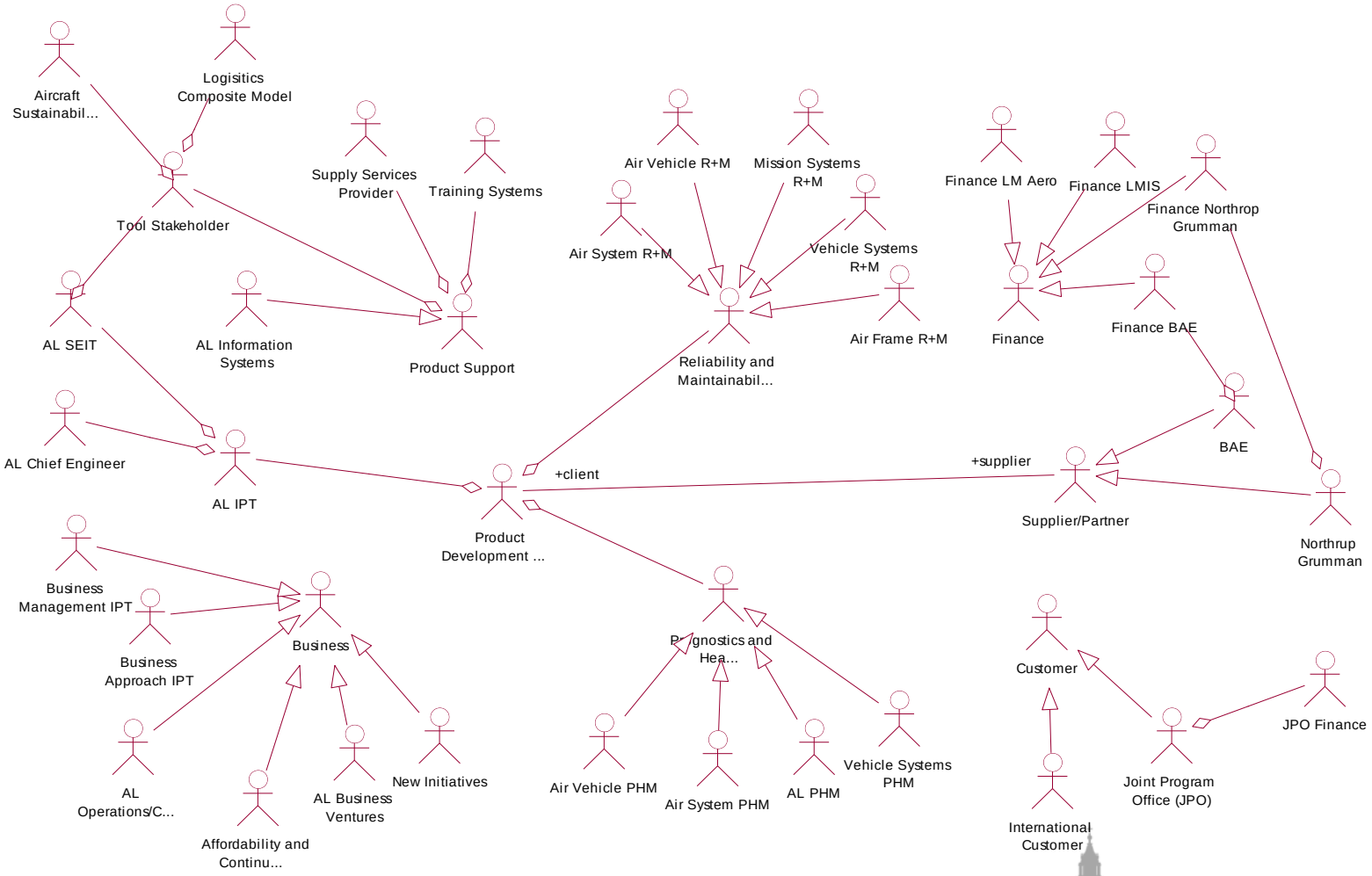
- Grouping Stakeholder by viewpoints
  - How does the stakeholder functionally perform in the domain?
  - What operationally do they contribute to the goals or mission of the solution?
- Look at common win-conditions/success criteria of stakeholders to determine classes of stakeholders

In order to deal with the number of stakeholders we need to understand the relationships and viewpoints of stakeholders and group into classes

Stakeholder Relationships Example: Logistics



Stakeholder Relationships Extended Example: Logistics



Functional Analysis of Stakeholders Example: Special Tooling

		Super Actor Classes									
ID #	Stakeholder Name	**Acquistion Agent**	**Assessor**	**Coordination**	**Customer**	**Designer**	**Integrator**	**Planner**	**Producer/ Maintainer**	**Router**	**User**
1	PCP&I						x				
2	Production Tooling Support Mgr						x				
3	Applied Tech Engineer				x						
4	Tool Design Engineer					x					
5	Tool Design Manager					x					
6	Drafter					x					
9	STI Inspector		x								
10	TRT Inspector		x								
11	TQA Inspector		x								
12	Supplier Quality Representative		x								
13	Quality Engineer – Special Tooling		x								
14	Procurement	x									
15	AB		x								
16	Process Engineer				x						
17	Program Manager	x									
18	Project Manager				x						
19	Production Manager				x						
20	Production Section Manager (PSM)			x							
21	PTs										x
22	Defense Board		x								
23	NNSA				x						
24	Material Handler									x	
25	Expediter									x	
26	Crafts								x		
27	QA Tech (Metrology)		x								
30	Receiving Clerk									x	
31	Scheduler							x			

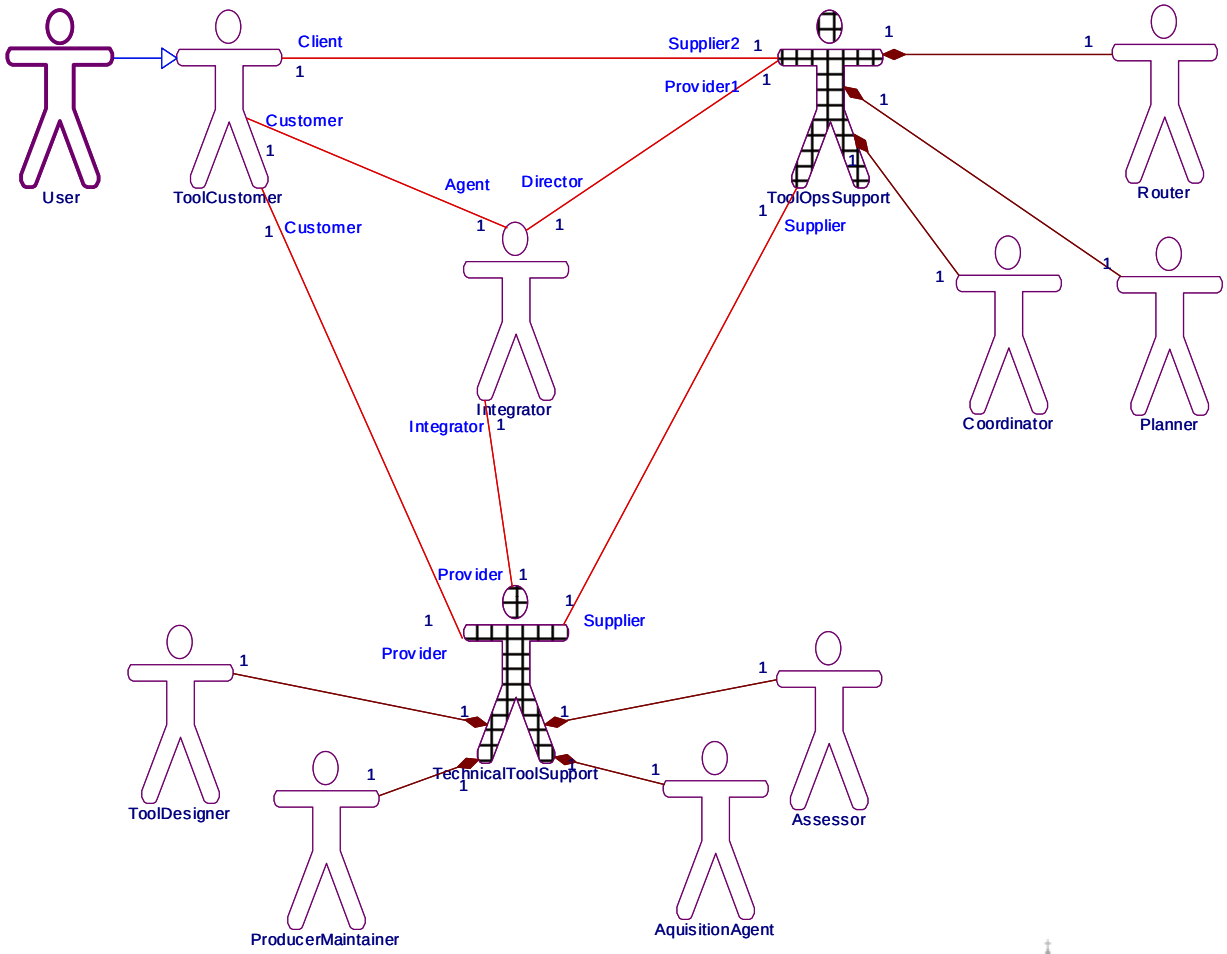
Functional Analysis of Stakeholders Example: Special Tooling (continued)

32	Tooling Coordinator							x			
34	Tooling Warehouse Clerk									x	
35	Planner							x			
36	Shop Coordinator			x							
38	Material Specialist	x									
39	Lead Planner/Scheduler							x			
40	Schedule Controller						x				
41	Tooling Tryout		x								
42	Preventive Maint. Tooling Mechanic								x		
43	Programmer						x				
44	Material Handler Dispatcher									x	
45	Labs										x
46	T&MD Clerk									x	
47	Training										x
48	Vendor								x		
49	HE Safety		x								
51	T&MD Estimator							x			
52	Quality Clerk									x	
53	Field Engineer					x					
54	Product Quality		x								
55	Applied Tech Engineering Tech										x
58	P&L Material Handler									x	
59	Qual Ass Specialist		x								
60	Nuclear Safety		x								
61	Nuclear Explosive Safety		x								
62	Radiation Safety		x								
63	Industrial Safety		x								
64	Industrial Hygiene		x								
65	Ergonomics		x								
66	Waste Operations		x								

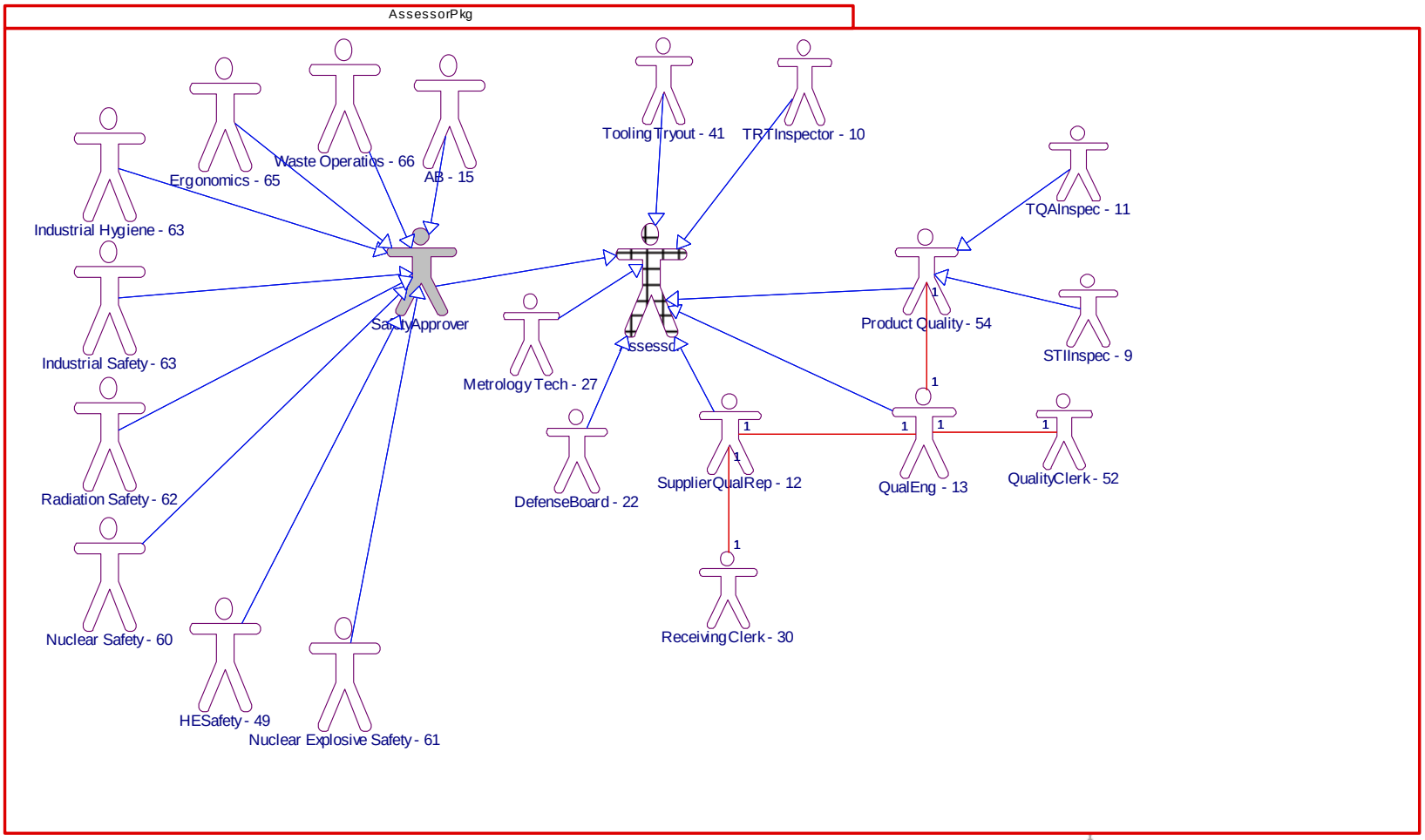
Stakeholder N^2 Example: Special Tooling

	Designer	Assessor	Integrator	Acquisition Agent	Producer Maintainer	Coordinator	Planner	Router	Customer	User
Designer		Conformance Agent	integrates	Broker	Supplier				Customer	
Assessor	DesignAuth			Agent	Supplier		TaskPlanner			
Integrator	Provider			Agent			Provider		Customer	
Acquisition Agent	Customer	ConformanceRep	Director		Supplier		Customer			
Producer Maintainer	Customer	ConformanceRep		Customer		Coordinator	TaskPlanner	Expeditor		
Coordinator					Customer		Client	Supplier		
Planner		TaskExecutor	Director	Broker	TaskExecutor	TaskExecutor				
Router					Supplier	Client			Client	
Customer	Supplier		Agent					Supplier		Isa
User									Isa	

Stakeholder Relationships Example: Special Tooling



Stakeholder Types Example: Special Tooling Assessor



Stakeholder Profile Example: Special Tooling

Name	Assessor
Representative(s)	Safety Approver (HE Safety, Nuclear Safety, Nuclear Explosive Safety, Waste Operations, Ergonomics, Industrial Hygiene, Industrial Safety, Radiation Safety, AB,) QA Tech (Metrology), Defense Board, Quality Engineer, Supplier Quality Representative, Tooling Quality Assurance, Tooling Review Team, Special Tooling Inspection, Tooling Tryout, Product Quality
Description	Assessors are people who ensure that all pieces of tooling are in compliance with all requirements (both functional and non-functional).
Type	Degreed engineers and scientists and other highly-trained technical specialists.
Responsibilities	Responsible for (1) developing and documenting characteristics (quality, safety, etc.), acceptance criteria, and test methodologies for special tooling, (2)assuring tool conformance to required requirements and leaving record-copy documentation, and (3) taking appropriate action to report nonconformances and ensuring tool is not put into use.
Success Criteria	Documentation trail that proves that tool meets all requirements and that traces back to all identified capabilities and characteristics.
Involvement	See stakeholder class diagrams.
Deliverables	Feedback and assurance
Comments/Issues	Efforts are spent on post-production review rather than in pre-production definition that identifies V&V criteria

Stakeholder Profile Example: Logistics

Representative	Business Approach IPT, AL Business Ventures, New Initiatives
Description	Business stakeholders are responsible for defining the sustaining support proposal for presentation to customers and defining processes and procedures required to deliver the solution.
Type	Business stakeholders are very knowledgeable of the logistics support business and their expertise with logistics information systems varies from novice to expert
Responsibilities	1. Design and Propose a Business Support Solution a. Define customer contract terms b. Define supplier contract terms i. Partners ii. Non-partner TSPIR iii. Others c. Forecast financials for LM and its partners including propulsion partners d. Forecast financials for customer e. Define baseline cost f. Forecast financials for suppliers g. Define risks for LM and its partners including propulsion partners h. Define risks for customer i. Define risks for supplier 2. Define AL business operation plans and processes a. Forecasting, planning, budgeting b. Performance management plan c. Reporting requirements 3. Deploy and Manage Business Support Solution 4. Address new customer requirements 5. Address new customers – SCP, etc.
Success Criteria	1. Processes (business performance management system) deliver “best value” 2. JPO accepts business case at CDR 3. Business case successfully supports the F-35 with acceptable risk/return for LM and its partners
Involvement	Business Stakeholders are responsible for reviewing and approving system requirements relating to design and operation of the support business
Deliverables	Business stakeholders and not responsible for project deliverables.
Comments/ Issues	No specific problems or issues were identified by the business stakeholders

Activity 4:
Developing Stakeholder Profiles

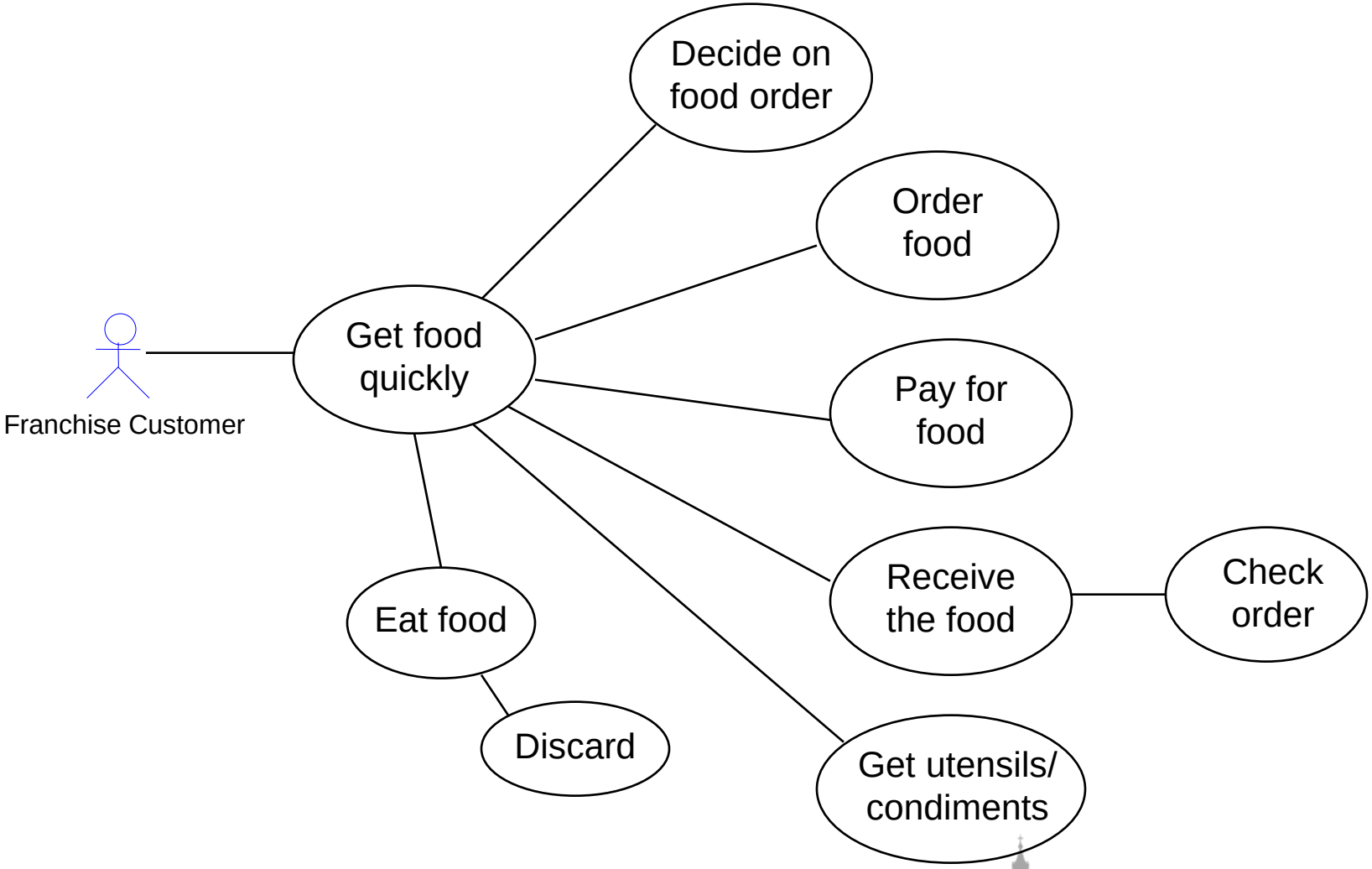
- Divide into your former groups
- Each group will be assigned a different stakeholder
- Using the Stakeholder Profile Template, develop a stakeholder profile for your primary stakeholder
- Debrief

(10 minutes)

Goal/Subgoal Analysis

- Form of cognitive analysis used to make a solution useful to stakeholders
- For each stakeholder ask yourself “Why in the world would they even want to approach the solution you are hypothesizing?”
  - What goal are they trying to accomplish? People don’t use systems if they are not going to get something out of it.
  - As you are trying to come up with this one to three goals, write down the chatter of thinking that might be in their head or if they are present encourage them to talk aloud. (“Talk Aloud” method)
  - Once the primary goal(s) are identified ask in each case what are the subgoals they would define in order to achieve the primary goal.
  - Again encourage and write down the thoughts that emerge in trying to identify this 1-5 subgoals.
  - Continue to the next level to achieve validation of the subgoals and the way the tree of goals/subgoals are defined.

Goal/Subgoal Example: ACM



Workshop Through Case Study Stakeholder Goal/Subgoal

Activity 5: Goal/Subgoal Analysis

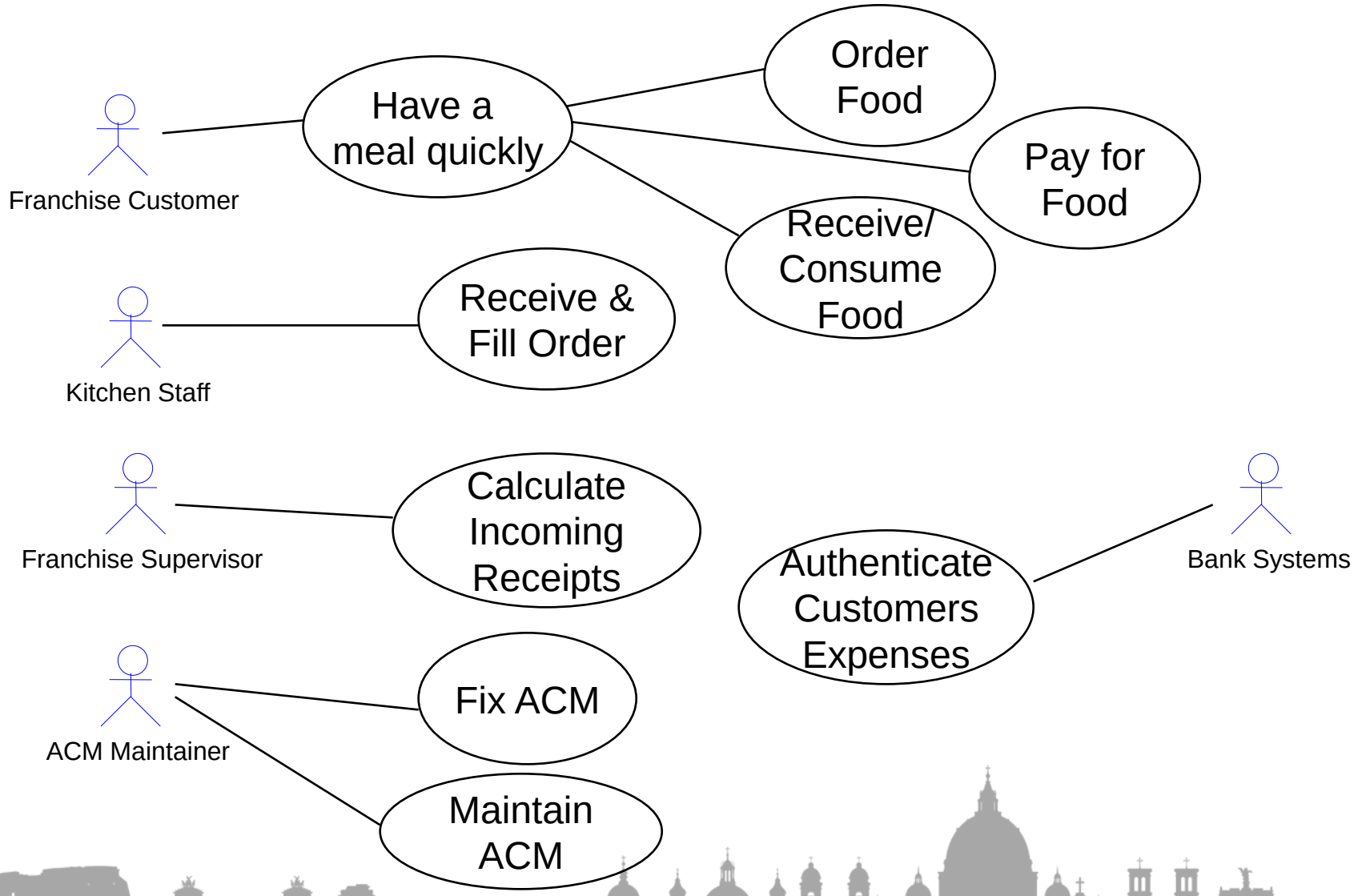
- Divide into your former groups
- Perform goal/subgoal analysis for your stakeholder from the last activity
- Debrief

(10 minutes)

Combining Goals/Subgoals

- Include all top level goals in diagram or spreadsheet
- Analyze the subgoals for repetition, include subgoals that repeat (>50%) on top level
  - May require analyzing logical correspondence
- Fill in subgoals for the goals, but refine and abstract if possible
- For multiple goals/subgoal diagrams for people in the same stakeholder class, combine by class first

Combined Goals Example: Fast Food Franchise



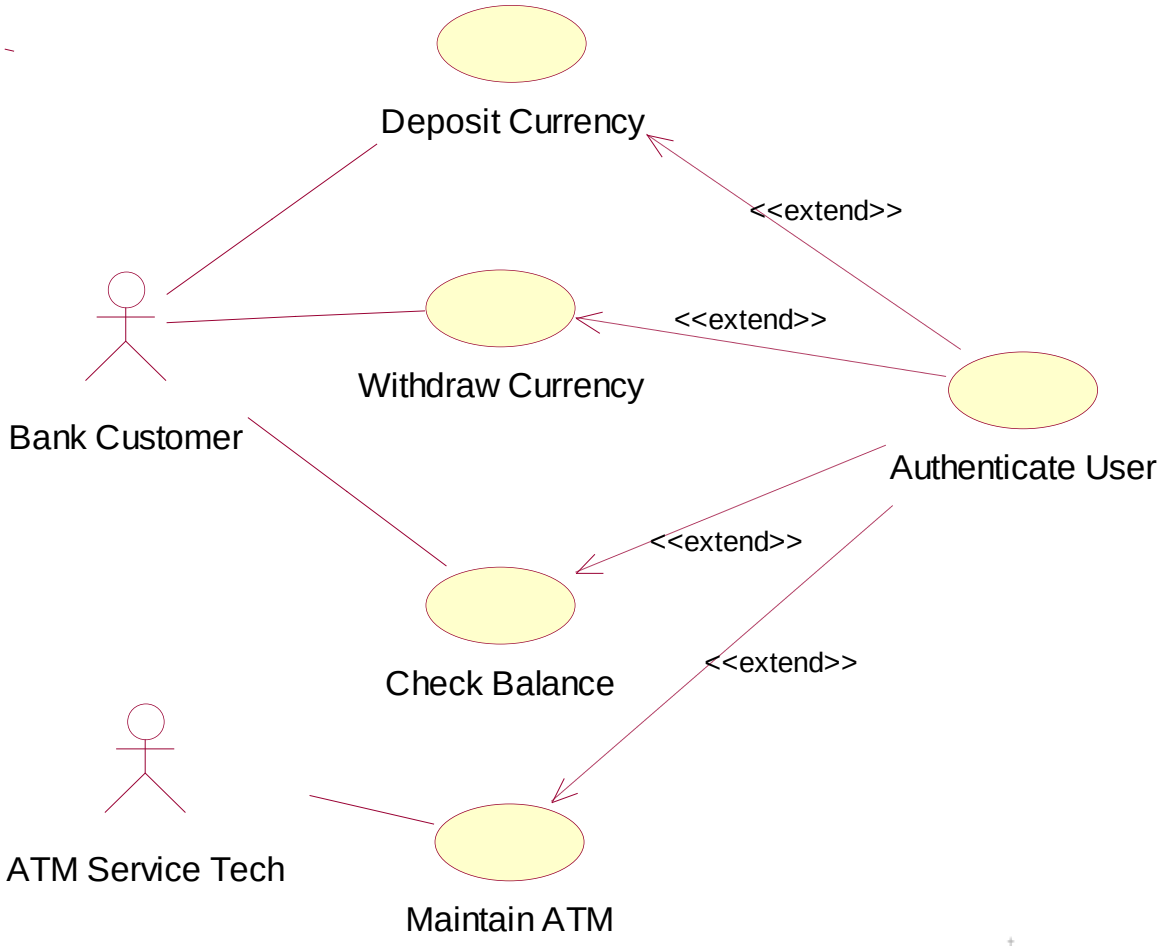
Goals to Use Cases

- A “Use Case” oval represented in a Use Case Diagram is a non-sequential domain process
  - Domain is the world the user lives in
  - Non-sequential process – no ordering implied
- Use Cases can be used to articulate multiple Operational Scenarios
- Use Cases if done right are true for the “As-is” and the “To-be” System
  - They reflect the goals or mission the users have for the system
  - If there are stakeholders with goals and they are able to accomplish those goals there is an “As-Is”

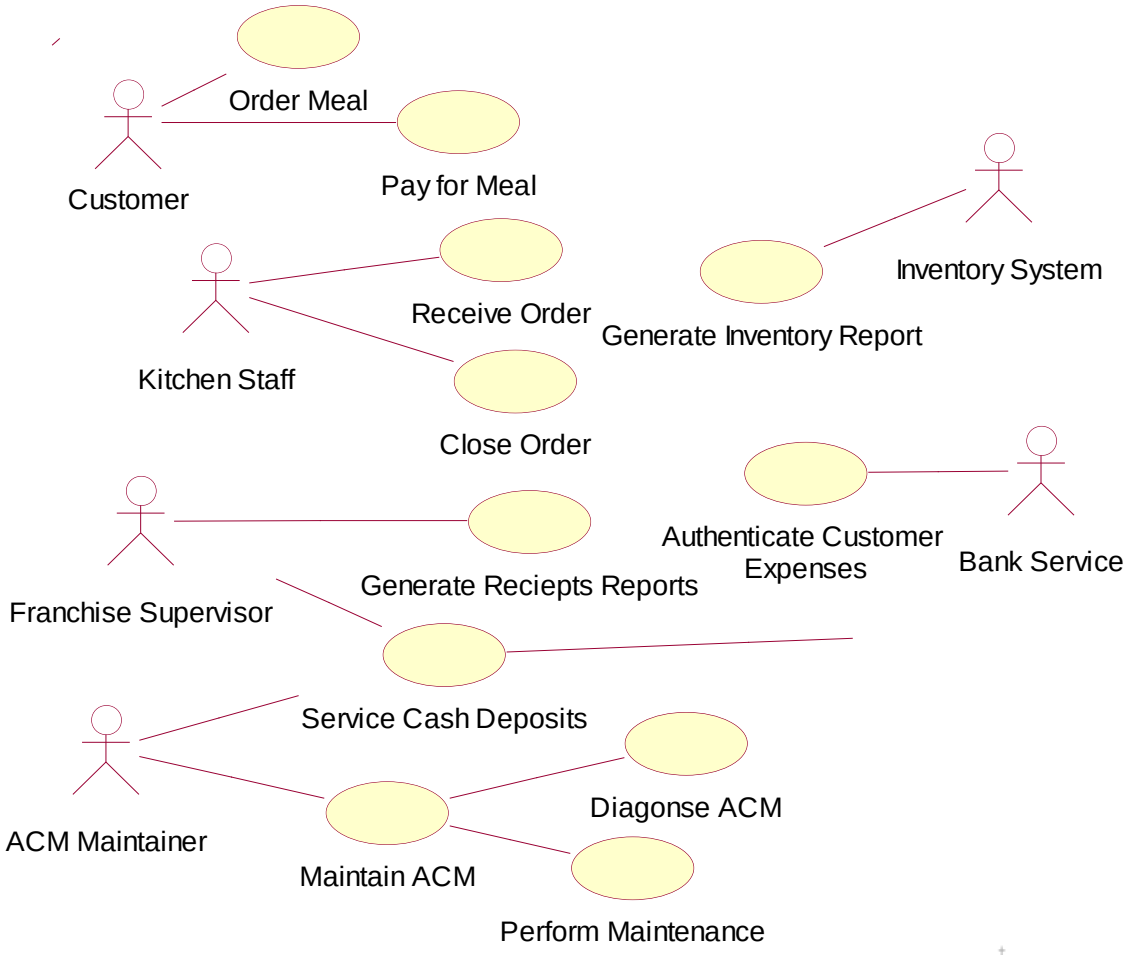
Analyzing Goals for Use Cases

- Analyze the goal/subgoal tree and ask the question “Can we lend improvement to these goals?”
- For those goals that you can lend improvement you keep the subgoals underneath, but they may require refinement
  - May want to keep more of the goals to show context
- Show the goals as Use Case ovals and attach the relevant stakeholder to the Use Case
- Once you have the architecture of Use Cases portrayed then go after the activity flow for the As-Is case for each Use Case that will be part of the solution provided

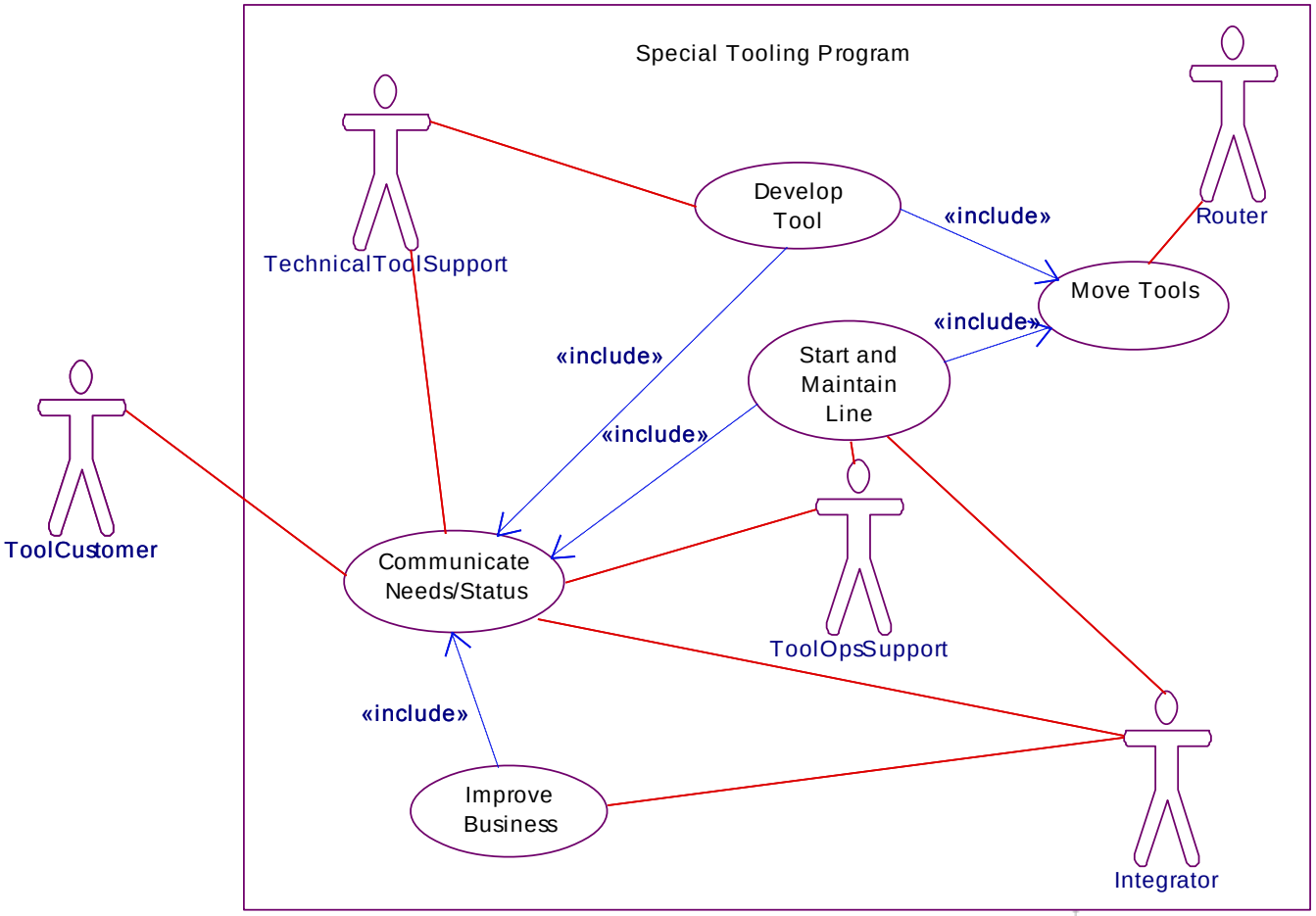
Use Cases: ATM Example



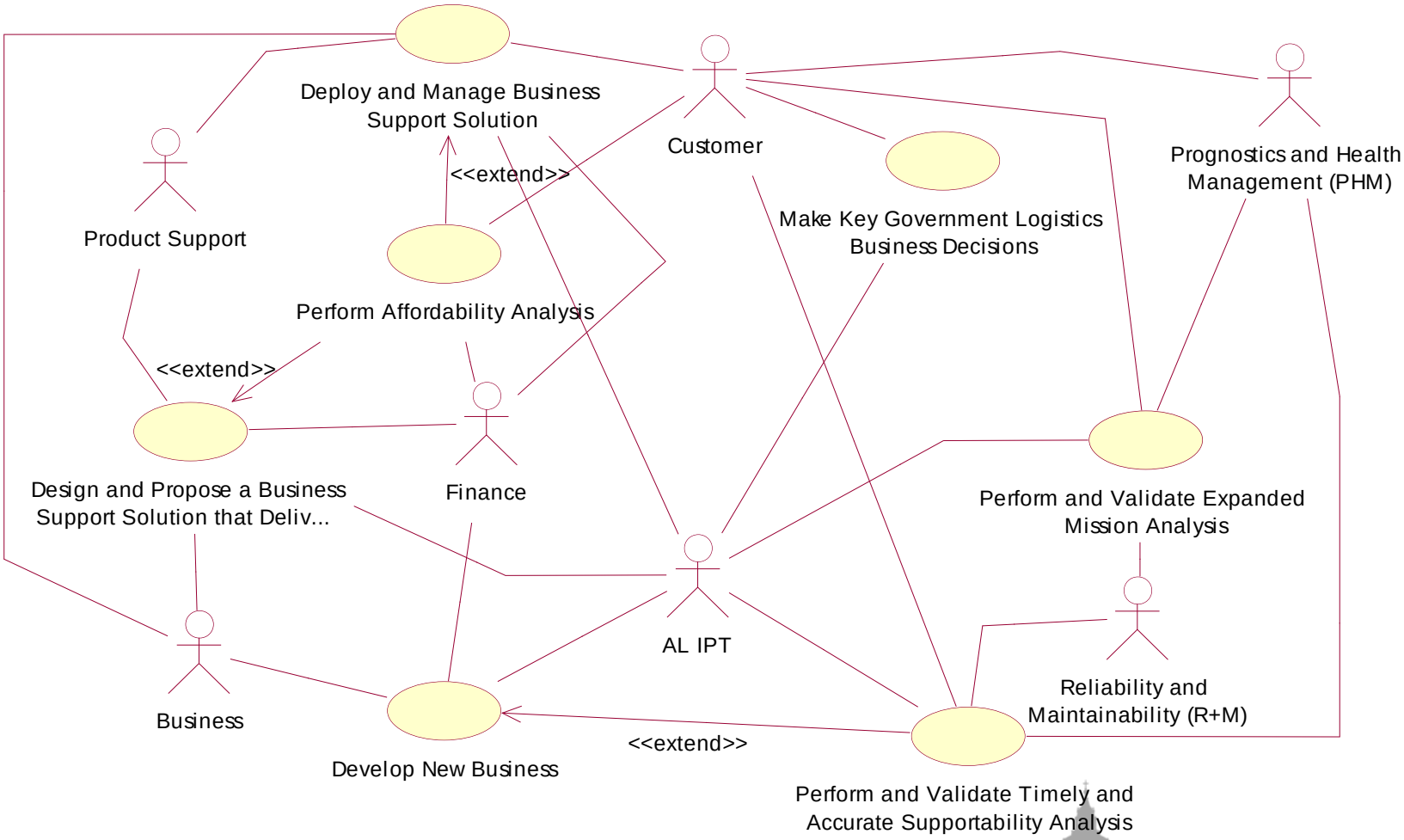
Use Cases: ACM Example



High Level Use Cases Example: Special Tooling



High Level Use Cases Example: Logistics

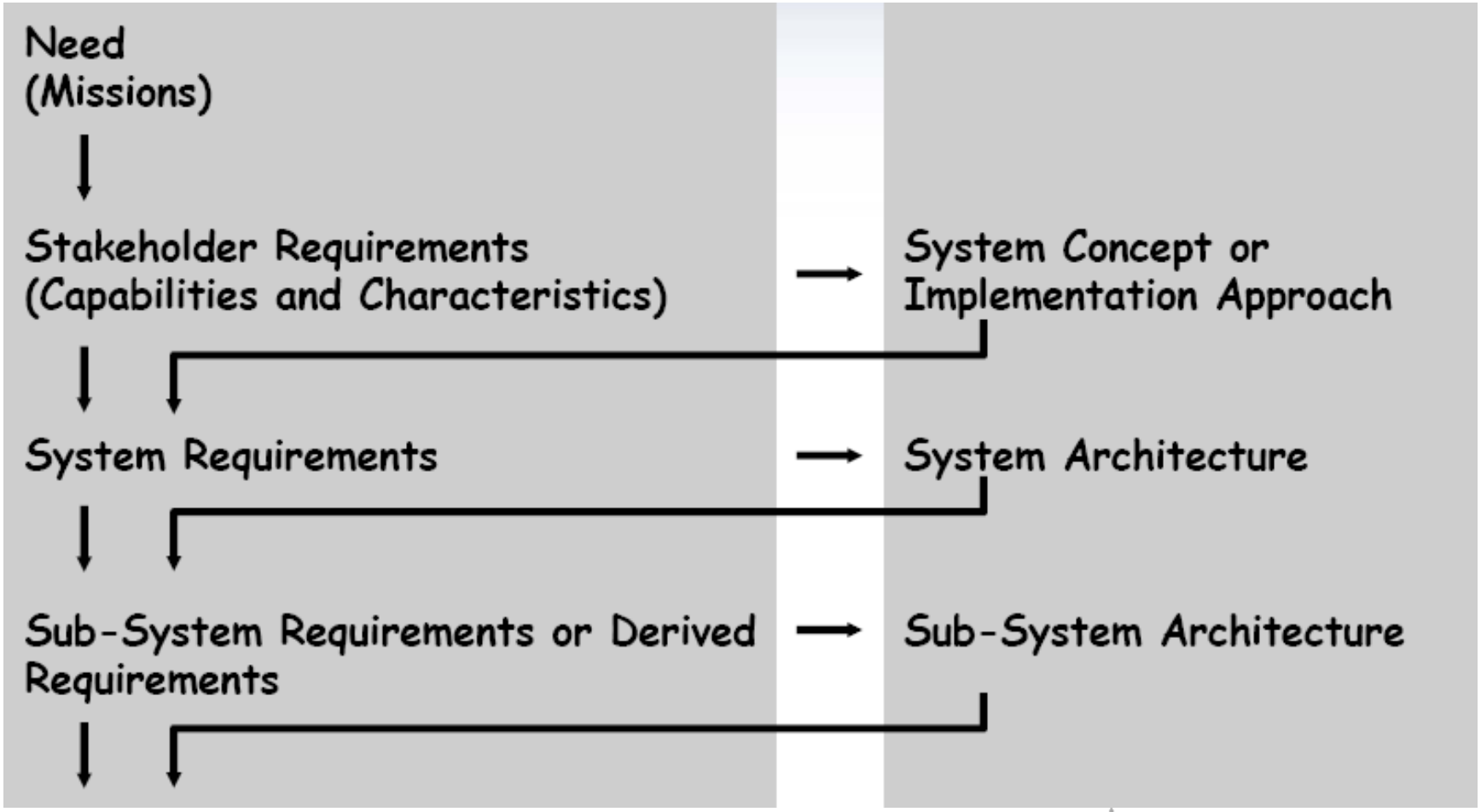


Activity 6: Developing Use Cases

- Divide into former groups and review copies of the:
  - Stakeholder Profiles
  - Stakeholder Goals/Subgoals
- Select 3 or 4 stakeholder and combine their goals
- Using a blank sheet of paper, develop Use Cases from goals
- Debrief

(15 minutes)

Requirements Layers



Dr. Dinesh Verma

Mission Analysis Defined

- Definition
  - Mission analysis is the process of defining mission level requirements, measures of effectiveness, and operational concepts which drive the system development
- Supports the baseline system development by:
  - Defining and analyzing mission/operations scenarios
  - Defining operations and interfaces within larger system
  - Defining system loading
  - Establishing mission trade-offs
  - Examining design sensitivity to mission (threats) and environment
  - Establishing Measures of Effectiveness (MOEs) & Key Performance Parameters (KPPs)

Measures of Effectiveness

- MOEs
  - Measures used by the customer to determine the level of satisfaction with the product(s)
- KPPs
  - A critical subset of the performance parameters, usually from the system specification
  - KPPs have a threshold requirement and an objective
  - If the threshold requirement cannot be met, the concept or system must be re-assessed

Mission Statement Example: Food Franchise

Mission	**The mission of this system is to service the fast food consumer in a effective way and provide revenue for the franchise owner.**
MOEs	**A minimum of 25% of the consumers choose to use the solution over current ordering methods.**

Activity 7: Define Mission

- Divide into your former groups
- Using the Mission Statement/MOE template
  - State the mission of the solution
    - Based on the problem your group identified, state the mission of the system
  - State criteria (MOE) for accepting the solution
    - 5 +/- 2 criteria that the solution must have
    - These are not in the trade space
    - “If you don’t deliver with these, don’t bother”

(10 minutes)

Developing Mission Requirements

- Define basic stakeholder needs and expectations related to mission objectives, environment, constraints, interoperability, and measures of effectiveness.
- Answers these questions:
  - Operational deployment: What is the operating tempo?
  - Mission profile/scenario: How will the system accomplish the mission objective?
  - Performance: What are critical system parameters to accomplish mission?
  - Effectiveness: How effective/efficient must system be in performing mission?
  - Operational life cycle: How long will user use system?
  - Environment: What are environments where system is expected to operate effectively?
- EXAMPLES:
  - The aircraft shall be capable of conducting close and deep air support missions when based aboard Nimitz Class U.S. aircraft carriers.
  - The ACM shall be capable of conducting ordering and payment operations for the top five fast food franchise including international locations.

Measures of Effectiveness Examples

SR-71 Blackbird	Global Hawk	DD-X
80,000 ft	High altitude	Manning
Mach 3	Long range and endurance	Weight
Half the radar cross-section of the U-2	Affordable	Cost

- Stevens Institute of Technology

Activity 8: Write Mission Requirements

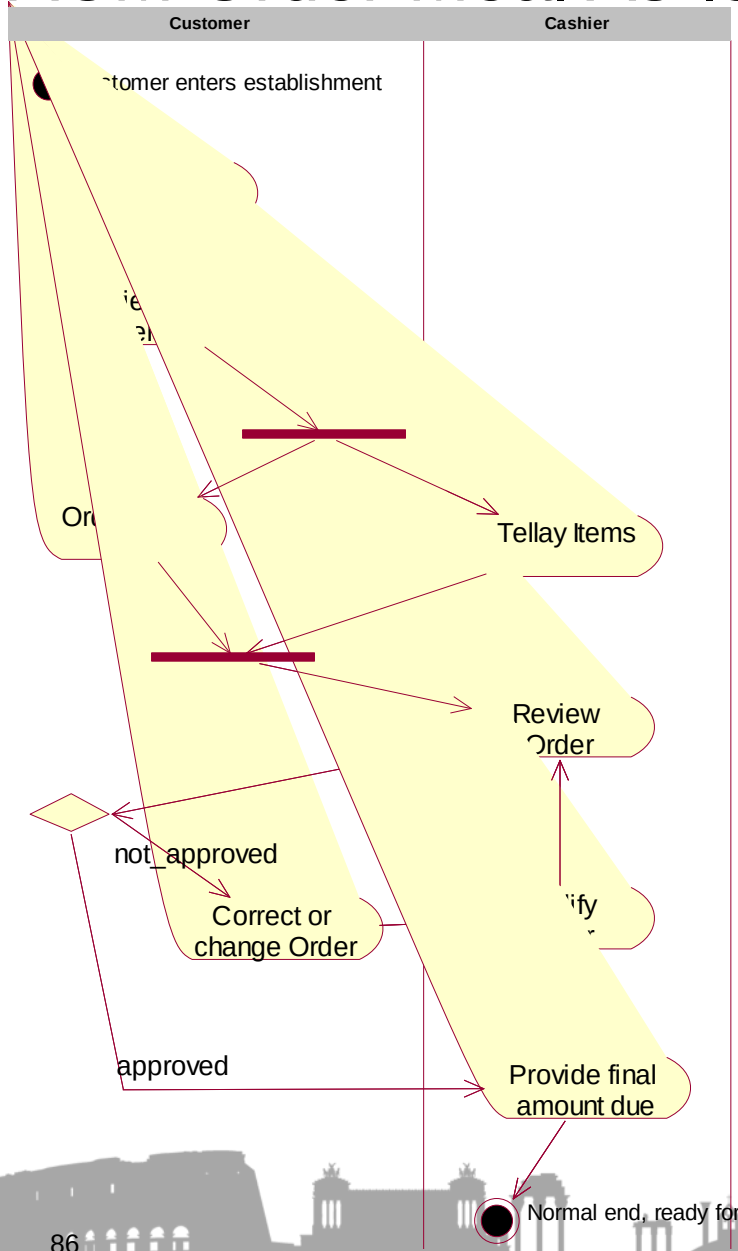
- Divide into your former groups
- Go back to your Use Cases
- State 3-4 as Mission requirements
  - Capabilities
  - Characteristics
  - Constraints
- Debrief

(10 minutes)

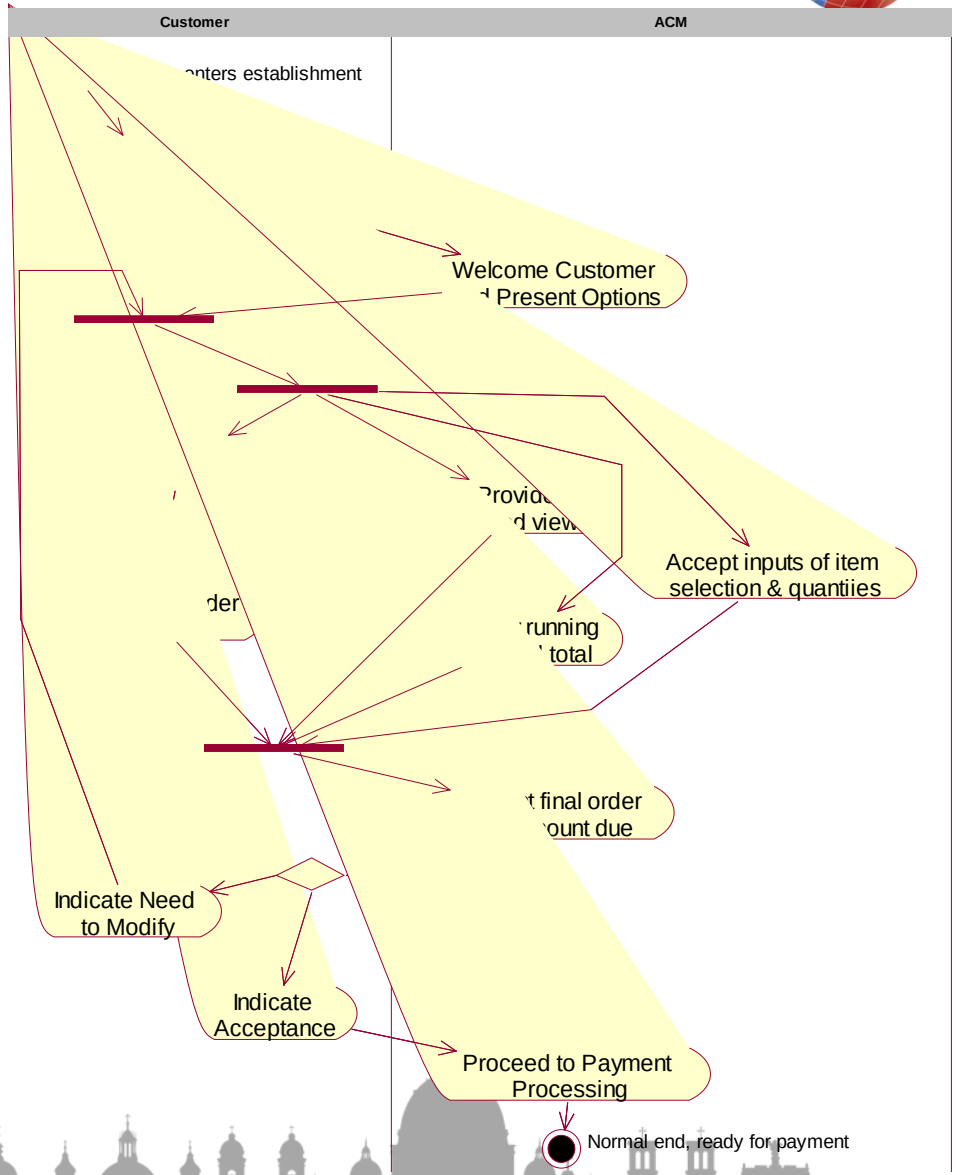
Operational Concepts/Scenarios

- Describes “How well” and “Under what conditions” system will serve users
  - Operational need, environment, sequences, interfaces, constraints
  - Mission analysis, profiles, threats, performance parameters
  - Organization and roles of users, maintainers, supporters
  - Conditions/events to which system must respond

ACM Order Meal As-Is



ACM Order Meal To-be



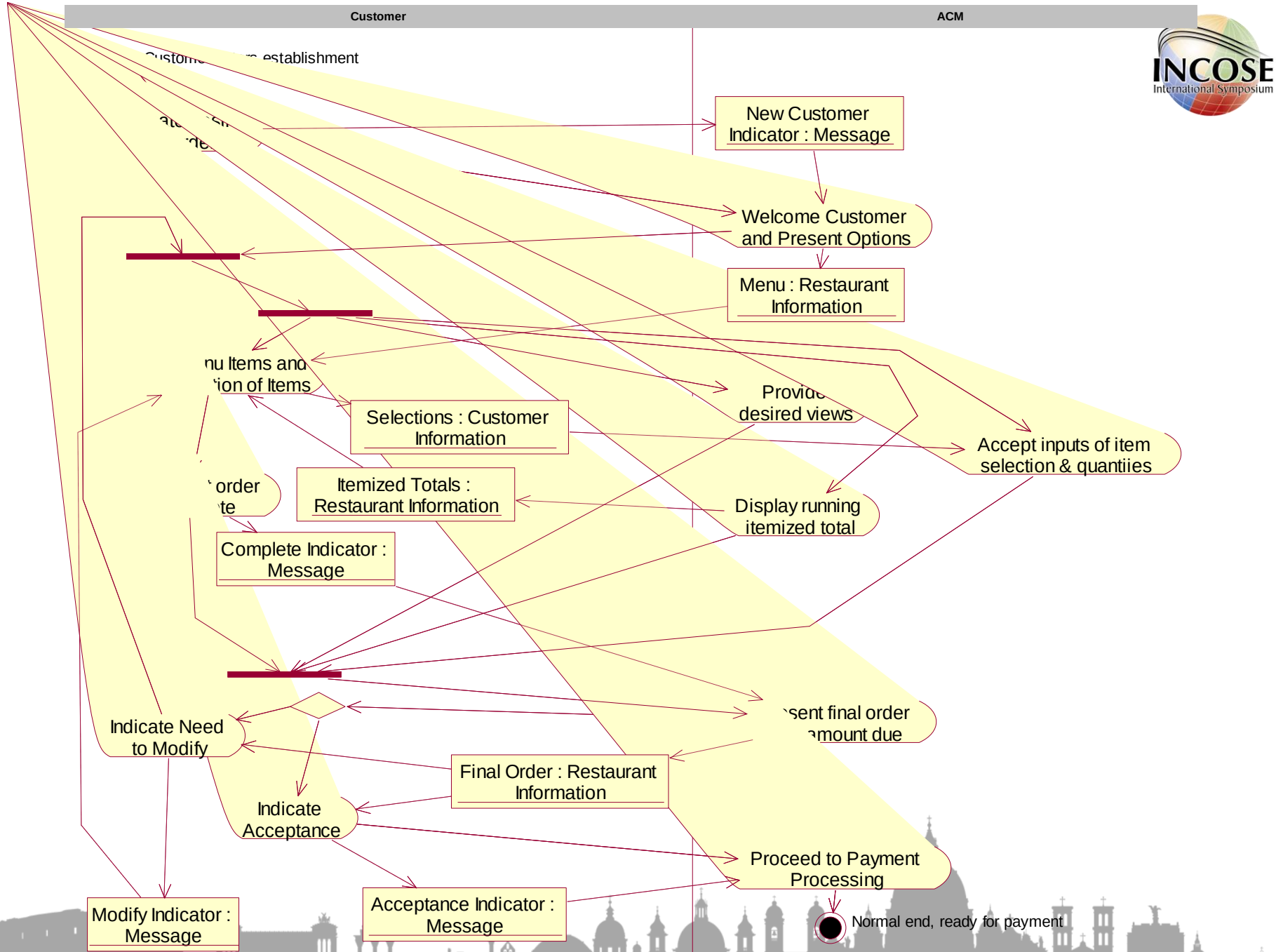
Workshop Case Study
Use-Case Activity Flow

- Review As-is

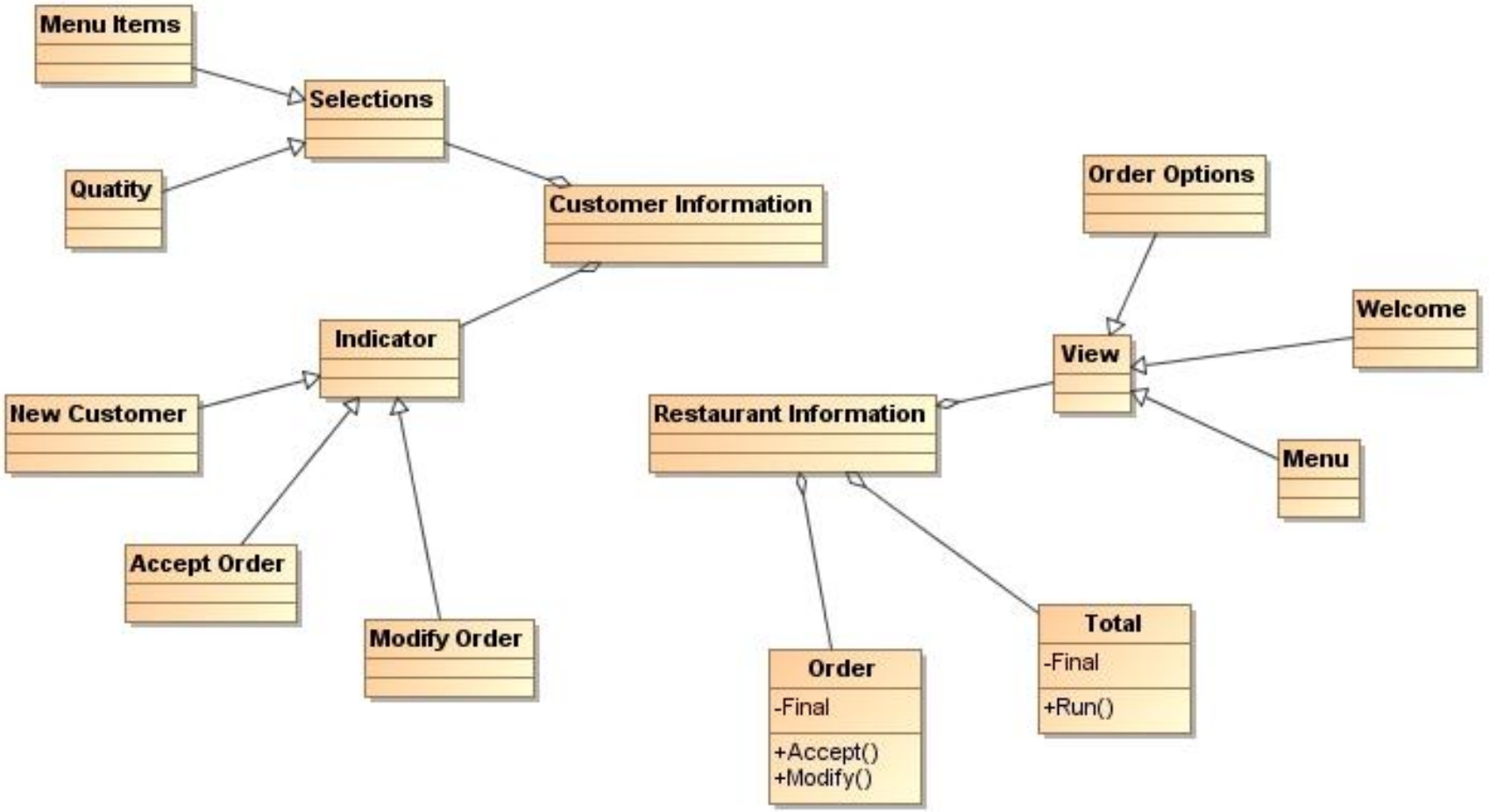
- Create a To-be Concept

Adding the Structural View

- Structure is based on the things (nouns) that are being identified by analyzing the problem and domain
- Structure elements include:
  - Stakeholders (people and systems)
    - Often used as swim lanes
  - Information or objects being passed
- Start with Activity Diagrams
- Mine nouns from any of the Use Cases words or Activities


Customer
ACM
establishment
New Customer Indicator : Message
Welcome Customer and Present Options
Menu : Restaurant Information
nu Items and
ion of Items
Selections : Customer Information
Provide
desired views
Accept inputs of item selection & quantiies
order
te
Itemized Totals : Restaurant Information
Display running itemized total
Complete Indicator : Message
sent final order
amount due
Indicate Need to Modify
Final Order : Restaurant Information
Indicate Acceptance
Proceed to Payment Processing
Modify Indicator : Message
Acceptance Indicator : Message
Normal end, ready for payment

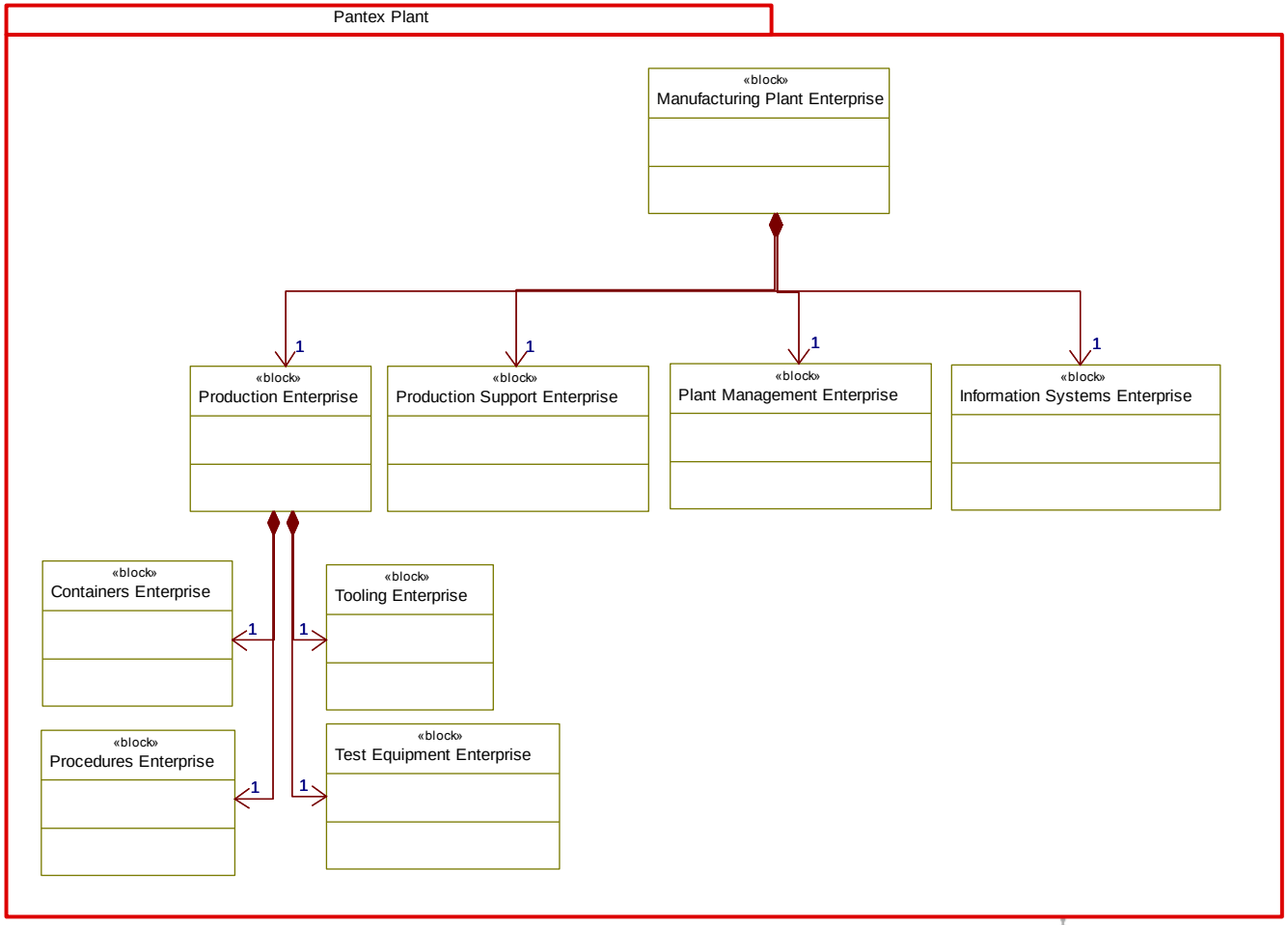
Using Nouns for Structure: ACM



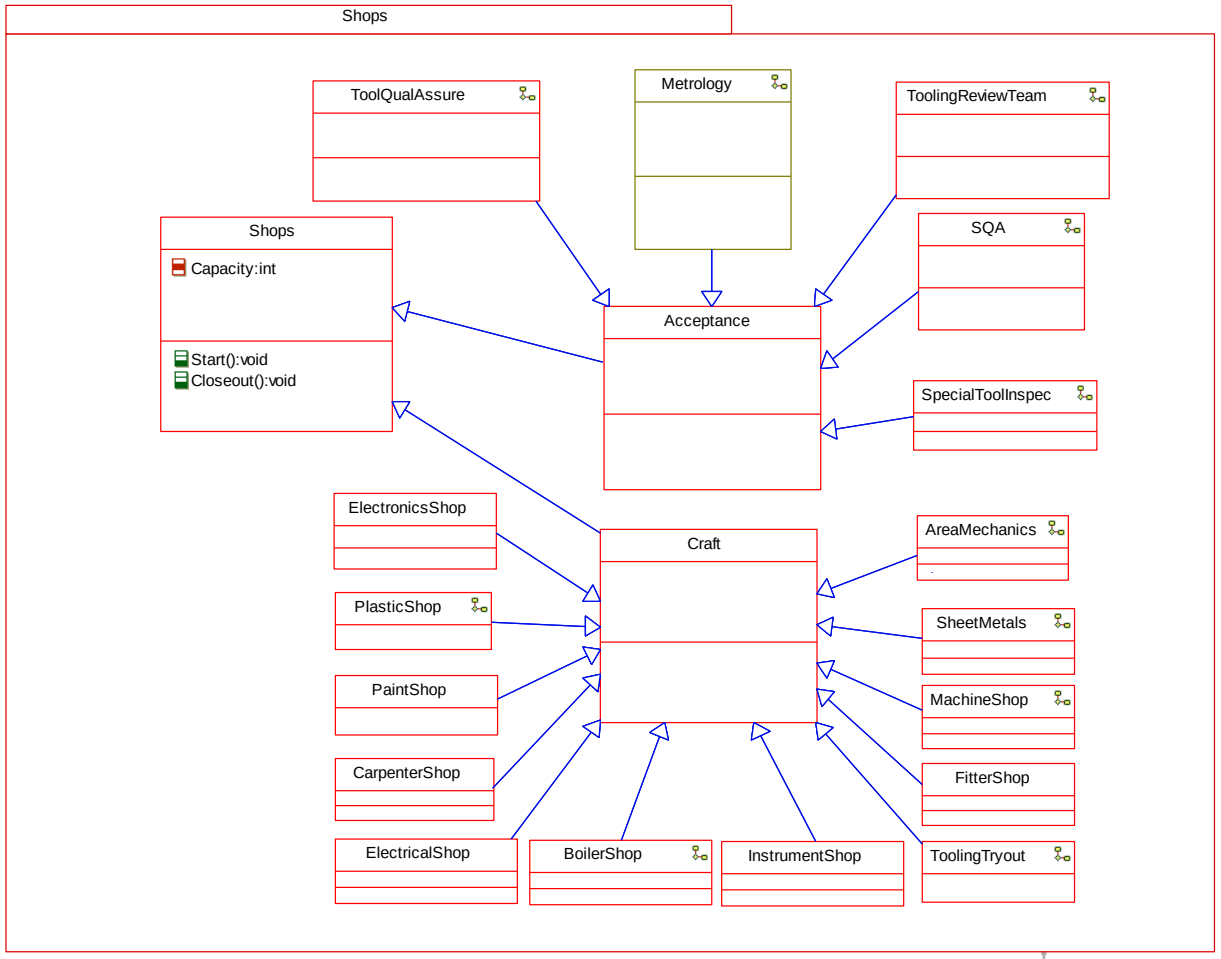
Elicitation from Structure

- Structure Evolves
  - Start asking questions
    - Are there other indicators or views?
    - What does the lifecycle of each of these objects? Would a state diagram be appropriate?
  - As you interact with the stakeholders, they will explain or draw pictures
    - Various kinds of information, nouns that might be a part of a data model, physical components that are part of system, enterprise entities that for a larger context
    - Put them in a model and review it with them
  - Use the problem statement and diagram sentences, entity-relationship-entity
- Structure and behavior feed one another and enable completeness

External Block Diagram Example: Manufacturing Plant



Structure Example: Manufacturing Shops



Concept Development Process

S_1, S_2 - Stakeholders

p(n) - problem

$m_1(n)$, $m_2(n)$ - Stakeholder models

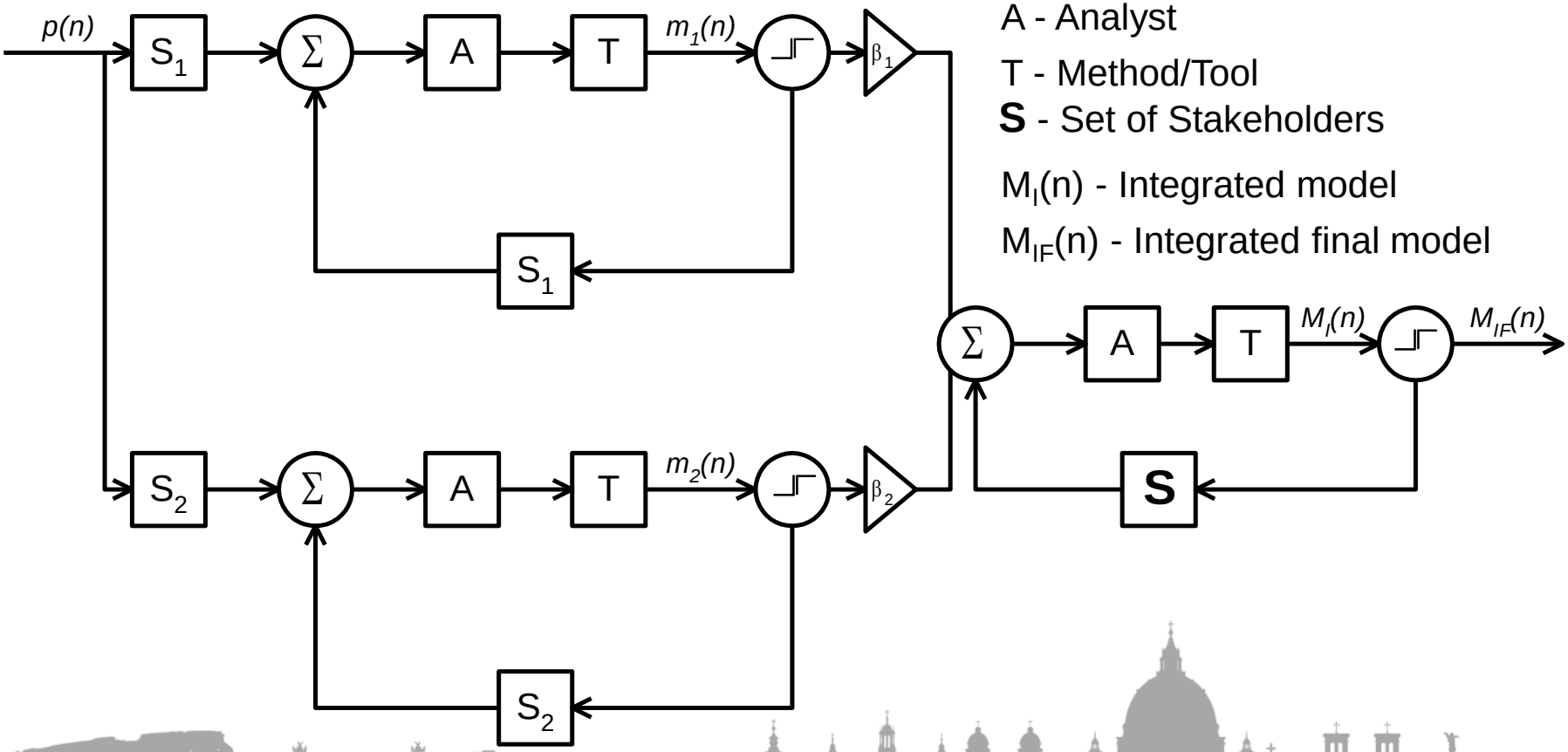
A - Analyst

T - Method/Tool

S - Set of Stakeholders

$M_I(n)$ - Integrated model

$M_{IF}(n)$ - Integrated final model



Concept Document as a Vehicle for the Elicitation

- Establishing a Shared Vision with a Concept Document
  - If you don't know where you are any road will get you further lost
- A commercial necessity before requirements
  - Marketing documents don't cut it
  - Project Plans main focus on the project not product
  - Requires a rigorous approach – lifecycle
- Keystone in the process
  - Sets up the full definition of requirements
  - Basis for Validation
  - Basis for V&V Plan
  - Input to iteration of Project Plan

Ingredients in a Concept Document

- Introduction
- Product Positioning
  - Why are we doing this?
  - Static domain model - context
- Stakeholders
  - Stakeholder interaction diagram
  - Stakeholder analysis tables
- Current System
  - As-is operational process model
  - Very important to capture the situation

Ingredients in a Concept Document (Continued)

- Planned system
  - Conceptual model of planned system
  - To-be operational process model
- Justification and analysis of changes
  - Why do we need the changes?
  - What are the impacts all the way around?
- Summary of features
  - This is what gets traced to the requirements
- Brief description of critical system requirements

Stakeholder Requirements Definition Summary

- Stakeholder requirements definition is about understanding the problem you are trying to solve
- Complete understanding of the problem means understanding the context of the potential solution including stakeholders
- Articulation of the solutions begins by understanding the goals that the stakeholders using the systems have
- Use Cases are a method of expressing what becomes solution operational scenarios
- Developing and reviewing a Concept Document for a system is the bridge between the levels of requirements