西安电子科技大学
XIDIAN UNIVERSITY

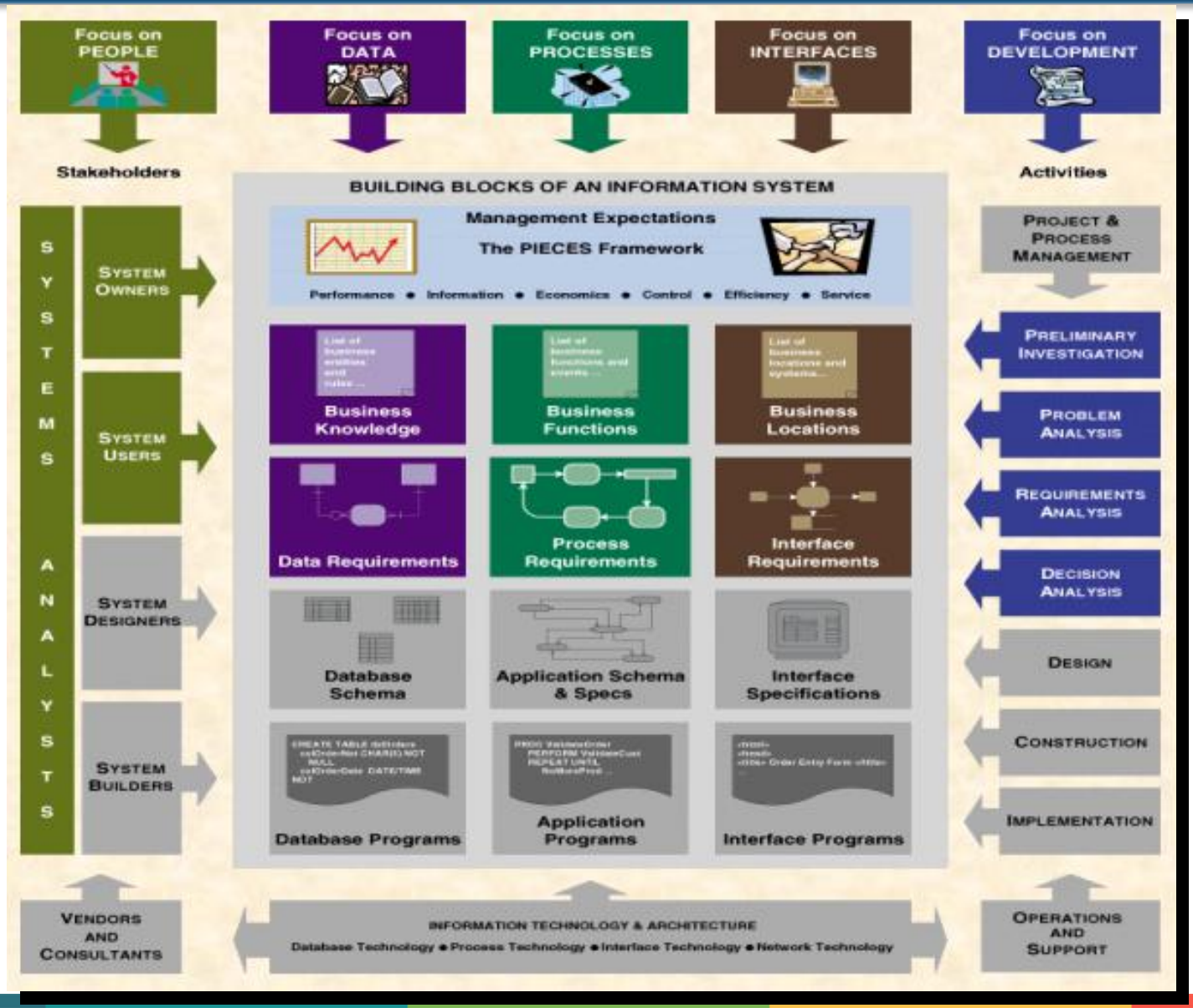
05 系统分析与设计
（System Analysis and Design）

Systems Analysis

Content Structure

- What is Systems Analysis?
- **Systems Analysis Approaches**
  - 5种系统分析方法。
- **The Preliminary Investigation Phase**
- **The Problem Analysis Phase**
- **The Requirements Analysis Phase**
- **The Decision Analysis Phase**
- The Next Generation of Systems Analysis

Chapter Map


Focus on PEOPLE
Focus on DATA
Focus on PROCESSES
Focus on INTERFACES
Focus on DEVELOPMENT
Stakeholders
Activities
BUILDING BLOCKS OF AN INFORMATION SYSTEM
Management Expectations
The PIECES Framework
Performance • Information • Economics • Control • Efficiency • Service
SYSTEMS ANALYSTS
System Owners
System Users
System Designers
System Builders
Business Knowledge
Business Functions
Business Locations
Data Requirements
Process Requirements
Interface Requirements
Database Schema
Application Schema & Specs
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Application Programs
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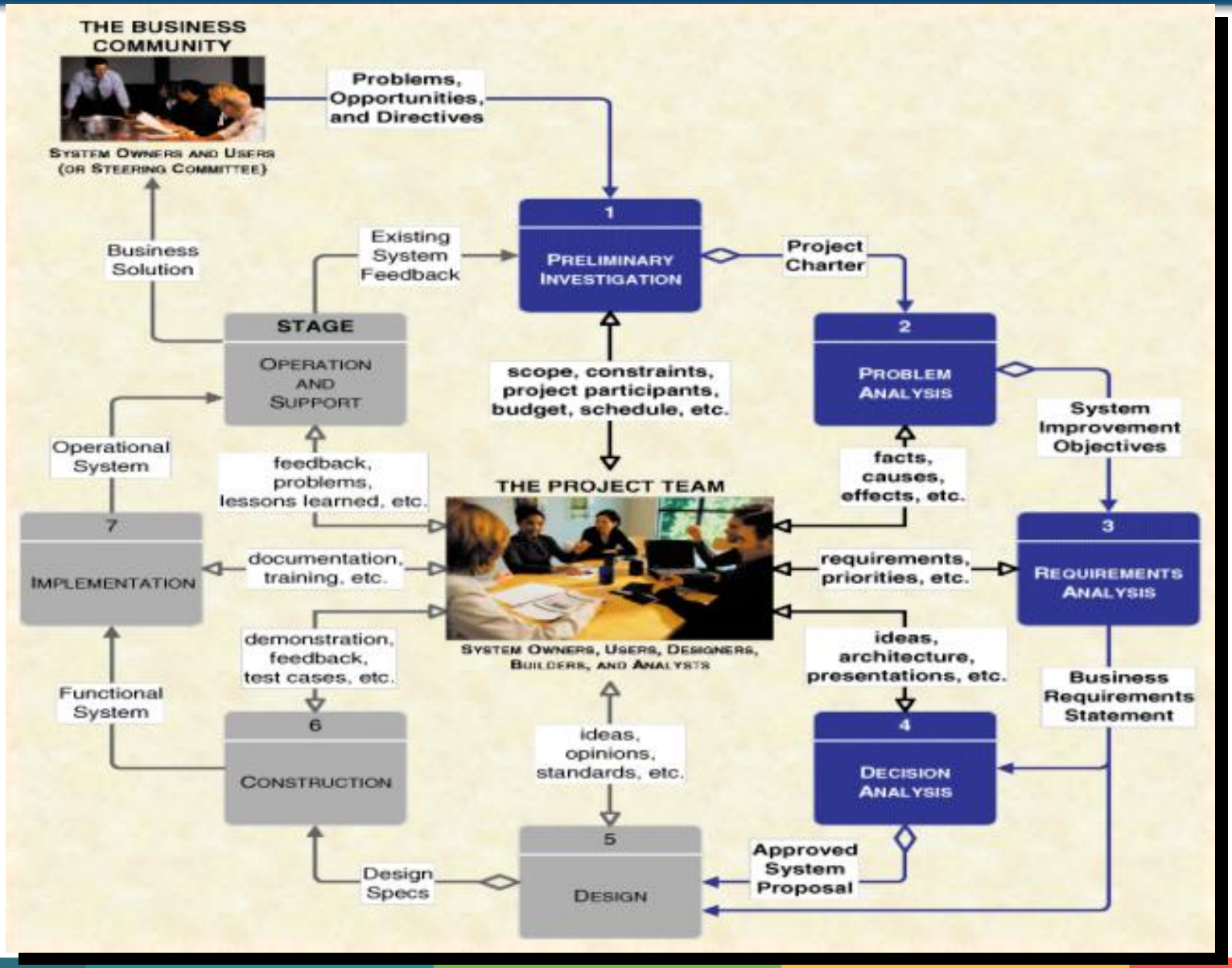
Project & Process Management
Preliminary Investigation
Problem Analysis
Requirements Analysis
Decision Analysis
Design
Construction
Implementation
Vendors and Consultants
INFORMATION TECHNOLOGY & ARCHITECTURE
Database Technology • Process Technology • Interface Technology • Network Technology
Operations and Support

What is Systems Analysis?

Systems Analysis vs. Systems Design

- **Systems Analysis** is a problem-solving technique that decomposes a system into its component pieces for the purpose of studying how well those component parts work and interact to accomplish their purpose.
- **Systems design** (also called systems synthesis（系统合成）) is a complementary problem-solving technique (to systems analysis) that reassembles a system's component pieces back into a complete system—hopefully, an improved system. This may involves adding, deleting, and changing pieces relative to the original system.

Context of Systems Analysis



Information Systems Analysis

- **Information Systems Analysis** is defined as those development phases in a project that primarily focus on the **business** problem, independent of any technology that can or will be used to implement a solution to that problem.

Information Systems Analysis

- System analysis is driven by the business concerns of system owners and system users.
- System analysis addresses the Data, Process, and Interface building blocks from system owners' and system users' perspective.
- The system analysts serve as facilitators of system analysis.

Repository

A **Repository** is a location (or set of locations) where systems analysts, systems designers, and system builders keep all of the documentation associated with one or more systems or projects.

- A network directory of computer-generated files that contain project correspondence, reports, and data.
- One or more CASE tool dictionary or encyclopedia（百科全书）.
- Printed documentation (such as that stored in binders （活页夹） and system libraries).
- An intranet website interface to the above components (useful for communication).

Systems Analysis Approaches

Popular Systems Analysis Approaches

- Model-driven Analysis Approaches:
  - Structured Analysis
  - Information Engineering
  - Object-oriented Analysis
- Accelerated Analysis Approaches:
  - Discovery Prototyping
  - Rapid Architecture Analysis

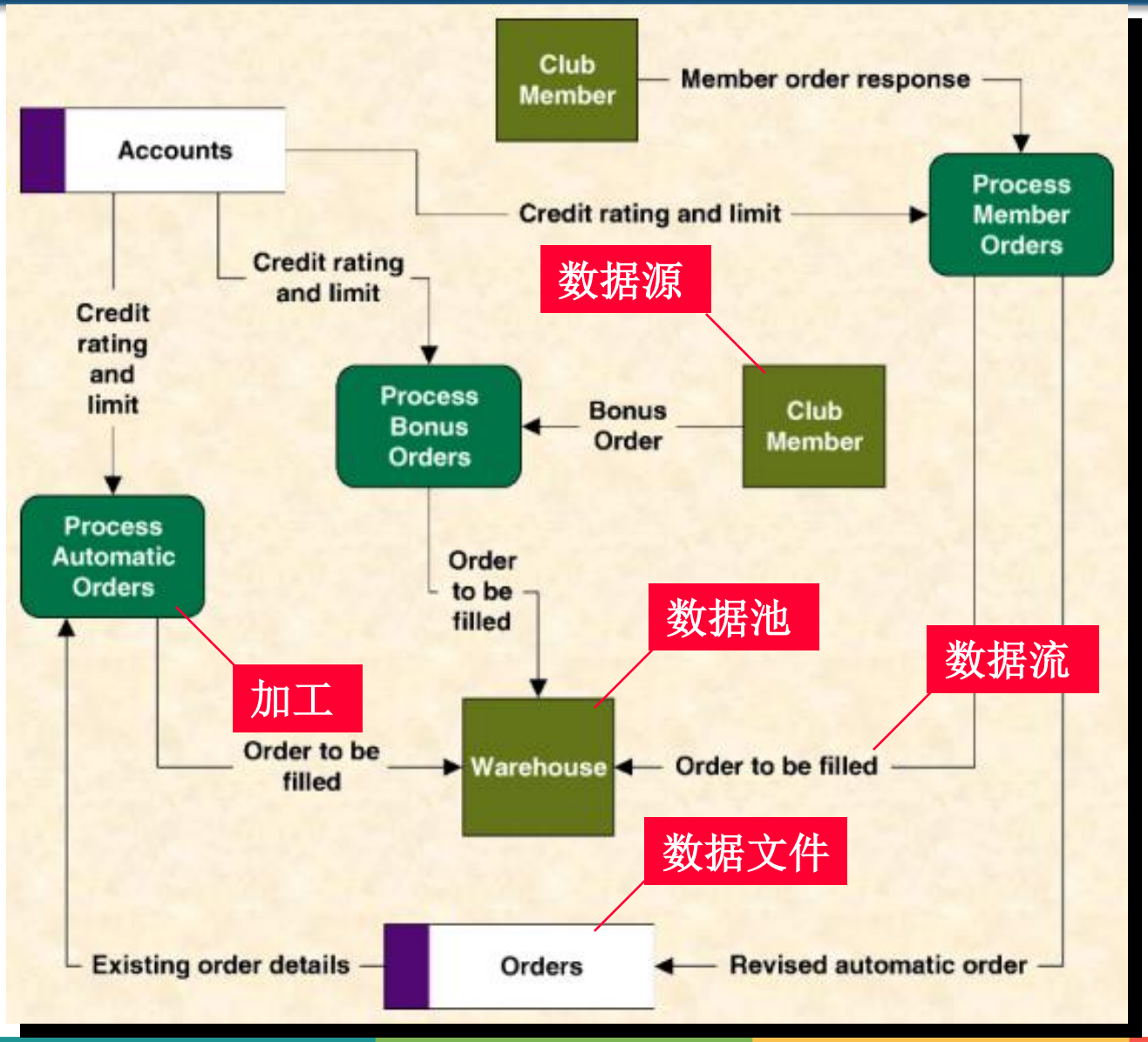
Model-Driven Analysis Methods

- **Model-Driven Analysis** emphasizes the drawing of pictorial system models to document and validate both existing and/or proposed systems. Ultimately, the system model becomes the blueprint for designing and constructing an improved system.
- A model is a representation of either reality or vision. Just as "a picture is worth a thousand words," most models use pictures to represent the reality or vision.

Structured Analysis

- **Structured Analysis** is a model-driven, process-centered technique used to either analyze an existing system, define business requirements for a new system, or both. The models are pictures that illustrate the system's component pieces: processes and their associated inputs, outputs, and files.
- The emphasis in this technique is on the Process building blocks. The technique has evolved to also model the Data and Interface building blocks as a secondary emphasis.
- Systems analysts draw a series of process models called data flow diagrams (DFD)（数据流图）.

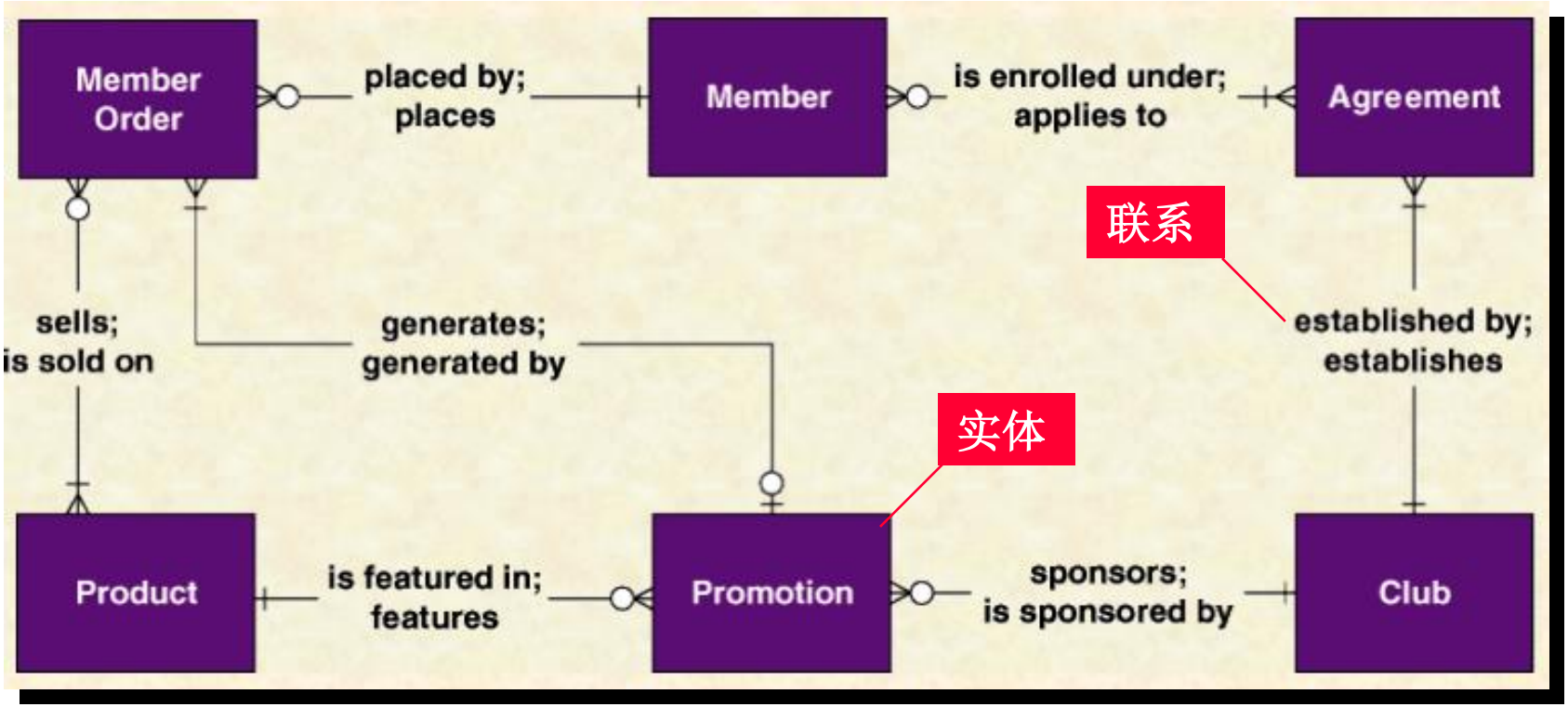
A Simple Process Model



Information Engineering

- **Information Engineering** (IE) is a model-driven and data-centered, but process-sensitive technique to plan, analyze, and design information systems. IE models are pictures that illustrate and synchronize the system's data and processes.
- This technique emphasizes the study and requirements analysis of Data requirements before those of the Process and Interface requirements.
- Systems analysts draw entity relationship diagrams (ERDs) to model the system's raw data before they draw DFDs that illustrate how the data will be captured, stored, used, and maintained.

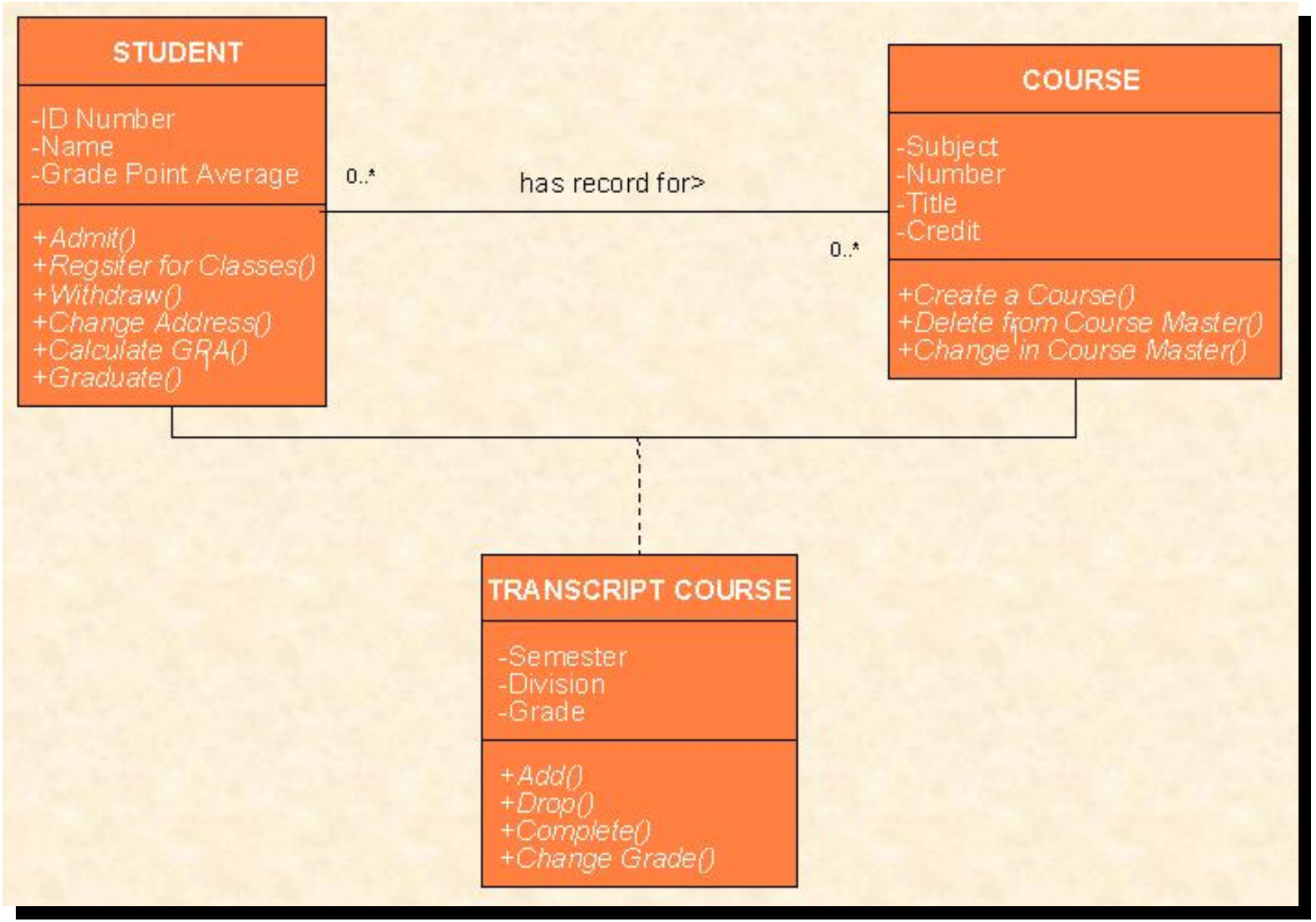
A Simple Data Model



Object-Oriented Analysis

- **Object-Oriented Analysis** (OOA) is a model-driven technique that integrates data and process concerns into constructs called objects. OOA models are pictures that illustrate the system's objects from various perspectives such as structure and behavior.
- Object technologies have emerged to eliminate the artificial separation of concerns about data and processes, i.e., to integrate them into constructs called Objects.
- The Unified Modeling Language (UML) provides a graphical syntax for an entire series of object models.

A Simple Object Model



Accelerated Analysis Methods

- **Accelerated Analysis** approaches emphasize the construction of prototypes to more rapidly identify business and user requirements for a new system.
- A prototype is a small-scale, incomplete, but working sample of a desired system. Prototypes cater to the "I'll know what I want when I see it" way of thinking that is characteristic of many users and managers.

Accelerated Analysis Methods

- **Discovery Prototyping** (sometimes called requirements prototyping) is used to identify the users' business requirements by having them react to a quick-and-dirty implementation of those requirements.
- **Rapid Architecture Analysis** is an approach that attempts to derive system models from existing systems or discovery prototypes. Rapid architecture analysis is made possible by reverse engineering technology.
  - Reverse engineering technology reads the program code for a database, application program, and/or user interface and automatically generates the equivalent system model.

Requirements Discovery Methods

Requirements discovery includes those techniques to be used by systems analysts to identify or extract system problems and solution requirements from the user community.

- Fact-finding (or information gathering) is a classical set of techniques used to collect information about system problems, opportunities, solution requirements, and priorities.
- Joint requirements planning (JRP) techniques use facilitated workshops to bring together all of the system owners, system users, systems analysts, and some systems designer and builders to jointly perform systems analysis.

Business Process Redesign Methods

- **Business Process Redesign** is the application of systems analysis methods to the goal of dramatically changing and improving the fundamental business processes of an organization, independent of information technology.

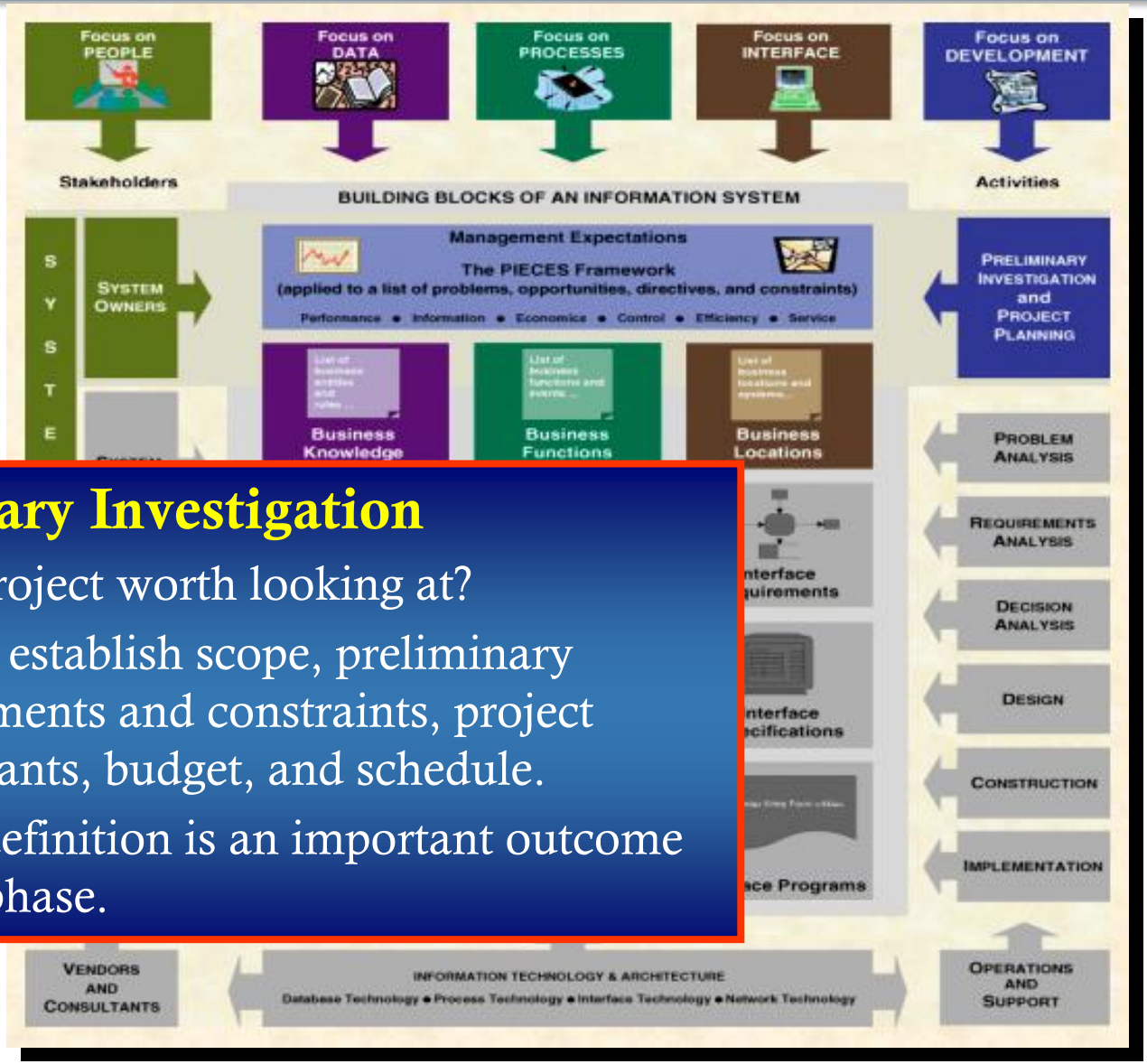
Systems Analysis Methods and Agile Methods

Agile method – the integration of various approaches of systems analysis and design for applications as deemed appropriate to the problem being solved and the system being developed.

- Most commercial methodologies do not impose a single approach (structured analysis, IE, OOA) on systems analysts.
- Instead, they integrate all popular approaches into a collection of agile methods.
- System developers are given the flexibility to select from a variety of tools and techniques to best accomplish the tasks at hand.
- The hypothetical *FAST* methodology operates this way

The Preliminary Investigation Phase

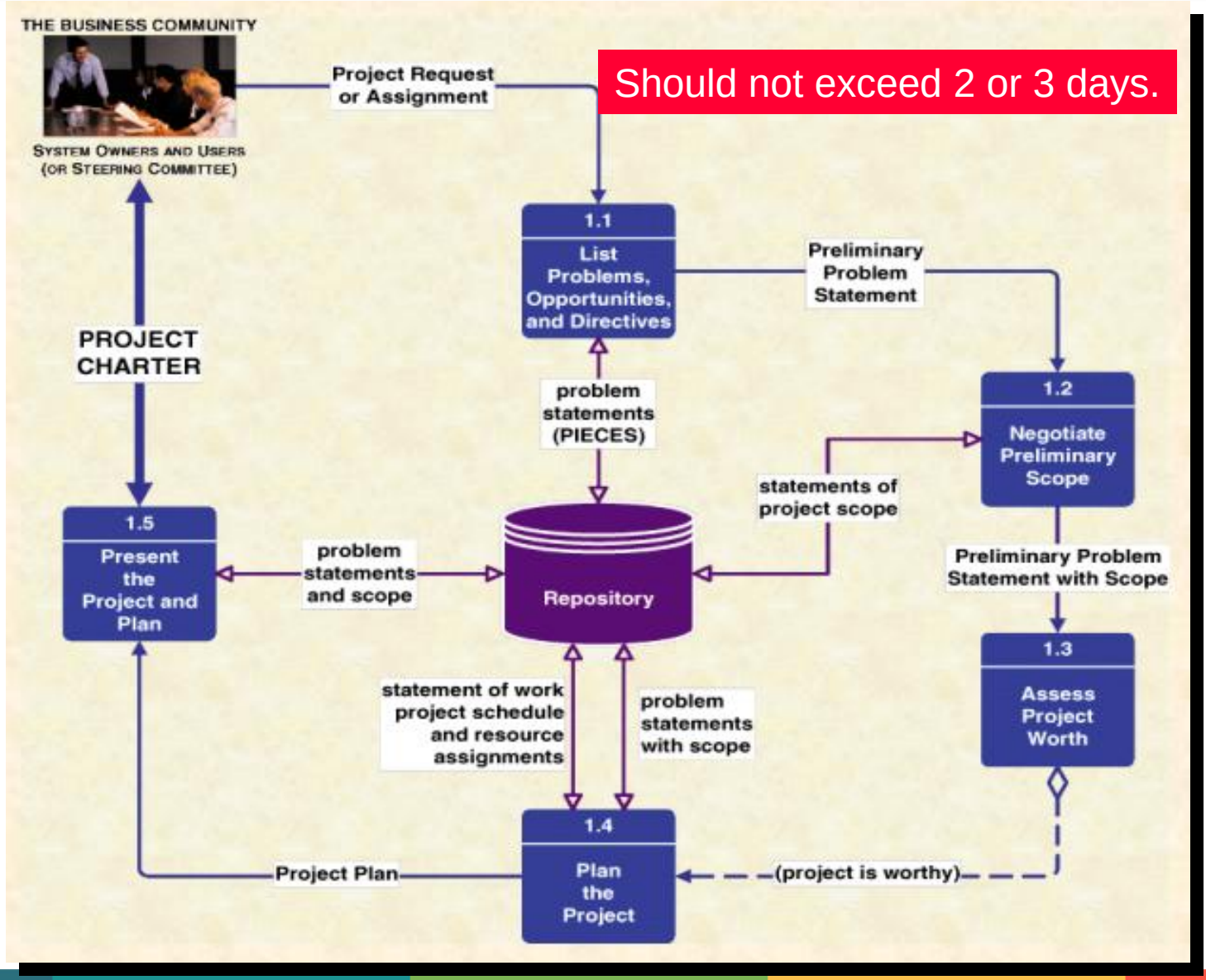
Preliminary Investigation Phase Context



Preliminary Investigation

- Is the project worth looking at?
- If so, to establish scope, preliminary requirements and constraints, project participants, budget, and schedule.
- Scope definition is an important outcome of this phase.

IT Vendors and Consultants



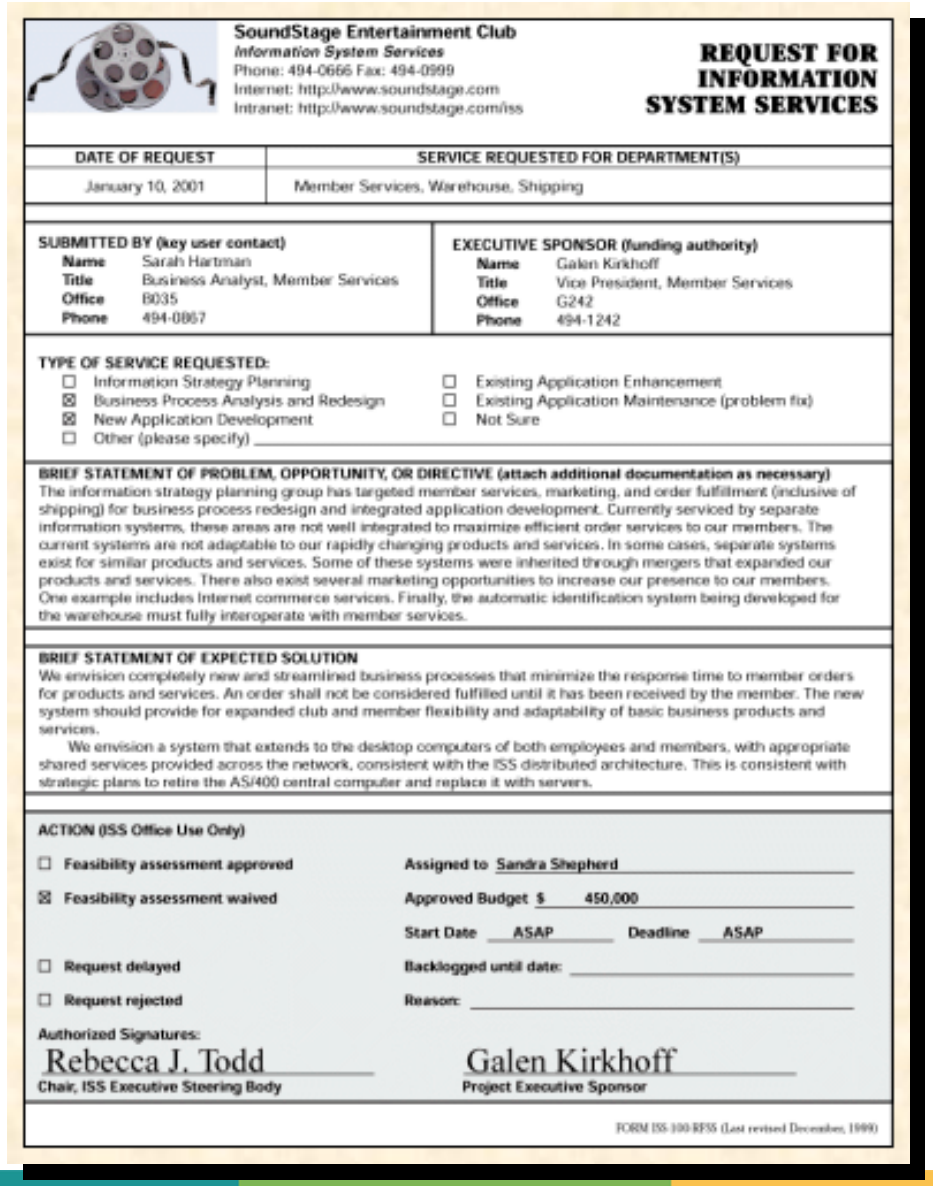
The Final Deliverable and Milestone

- Project Charter: A project charter defines the project scope, plan, methodology, standards, and so on.

Task 1.1 List Problems, Opportunities, and Directives

- One Important task in the preliminary investigation phase is to establish an initial baseline（基线 — 已经过正式评审和认可，作为以后进一步开发的基础，并且只有通过正式的更改控制规程才能进行修改的规格说明或产品） of the problems, opportunities, and/or directives that triggered the project.

Sample Request for System Services



SoundStage Entertainment Club
Information System Services
Phone: 494-0666 Fax: 494-0999
Internet: http://www.soundstage.com
Intranet: http://www.soundstage.com/iss

REQUEST FOR INFORMATION SYSTEM SERVICES

DATE OF REQUEST	SERVICE REQUESTED FOR DEPARTMENT(S)
January 10, 2001	Member Services, Warehouse, Shipping

SUBMITTED BY (key user contact)
Name Sarah Hartman
Title Business Analyst, Member Services
Office B035
Phone 494-0867

EXECUTIVE SPONSOR (funding authority)
Name Galen Kirkhoff
Title Vice President, Member Services
Office G242
Phone 494-1242

TYPE OF SERVICE REQUESTED:
- ☐ Information Strategy Planning
- ☒ Business Process Analysis and Redesign
- ☒ New Application Development
- ☐ Other (please specify) _____
- ☐ Existing Application Enhancement
- ☐ Existing Application Maintenance (problem fix)
- ☐ Not Sure

BRIEF STATEMENT OF PROBLEM, OPPORTUNITY, OR DIRECTIVE (attach additional documentation as necessary)
The information strategy planning group has targeted member services, marketing, and order fulfillment (inclusive of shipping) for business process redesign and integrated application development. Currently serviced by separate information systems, these areas are not well integrated to maximize efficient order services to our members. The current systems are not adaptable to our rapidly changing products and services. In some cases, separate systems exist for similar products and services. Some of these systems were inherited through mergers that expanded our products and services. There also exist several marketing opportunities to increase our presence to our members. One example includes Internet commerce services. Finally, the automatic identification system being developed for the warehouse must fully interoperate with member services.

BRIEF STATEMENT OF EXPECTED SOLUTION
We envision completely new and streamlined business processes that minimize the response time to member orders for products and services. An order shall not be considered fulfilled until it has been received by the member. The new system should provide for expanded club and member flexibility and adaptability of basic business products and services.

We envision a system that extends to the desktop computers of both employees and members, with appropriate shared services provided across the network, consistent with the ISS distributed architecture. This is consistent with strategic plans to retire the AS/400 central computer and replace it with servers.

ACTION (ISS Office Use Only)

- ☐ **Feasibility assessment approved**
- ☒ **Feasibility assessment waived**
- ☐ **Request delayed**
- ☐ **Request rejected**

Assigned to Sandra Shepherd
Approved Budget $ 450,000
Start Date ASAP **Deadline** ASAP
Backlogged until date: _____
Reason: _____

Authorized Signatures:

Rebecca J. Todd
Chair, ISS Executive Steering Body

Galen Kirkhoff
Project Executive Sponsor

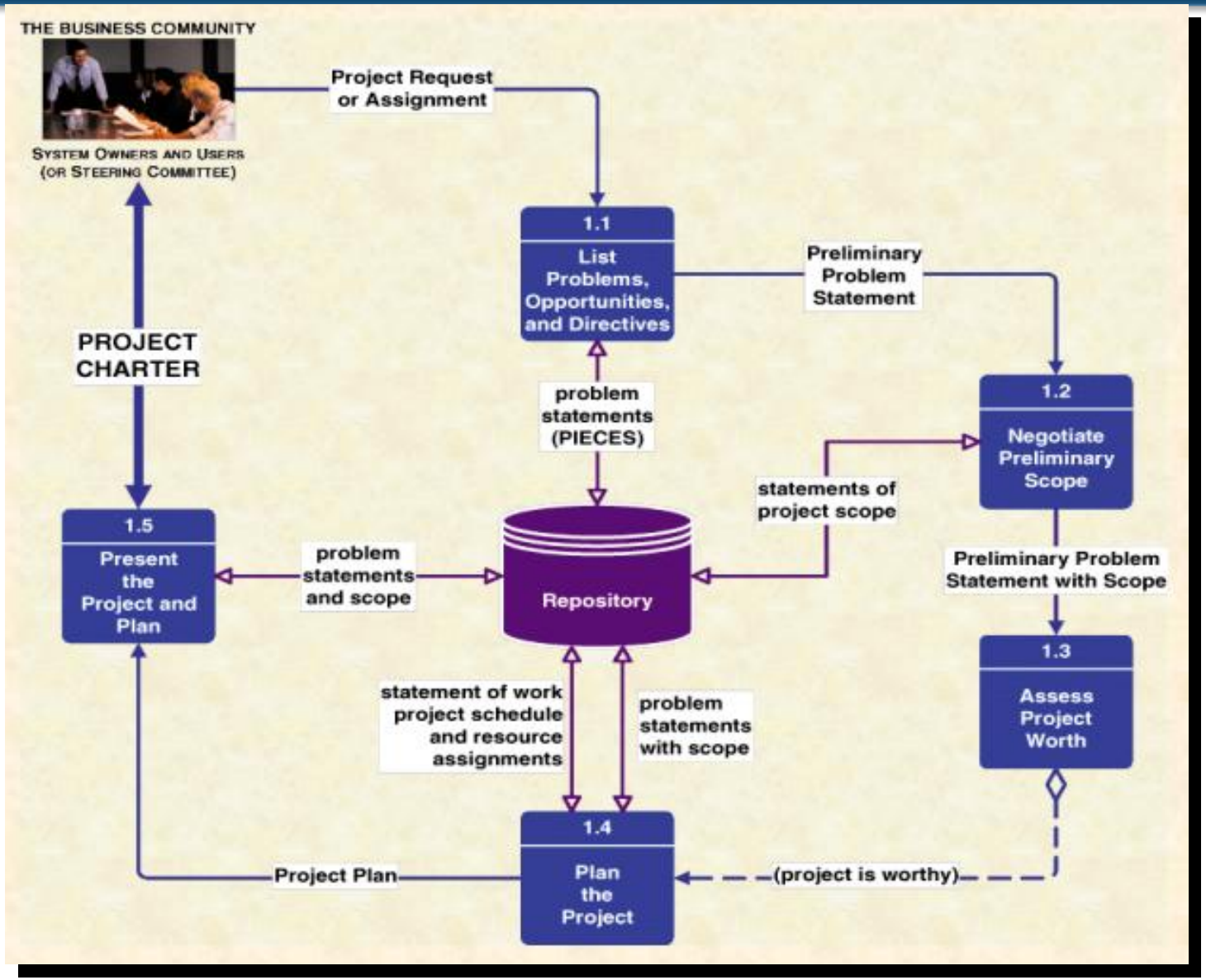
FORM ISS-100-RFSS (Last revised December, 1999)

Problem Statements

PROJECT:	Member Services Information System	**PROJECT MANAGER:**	Sandra Shepherd
CREATED BY:	Sandra Shepherd	**LAST UPDATED BY:**	Robert Martinez
DATE CREATED:	January 15, 2001	**DATE LAST UPDATED:**	January 17, 2001

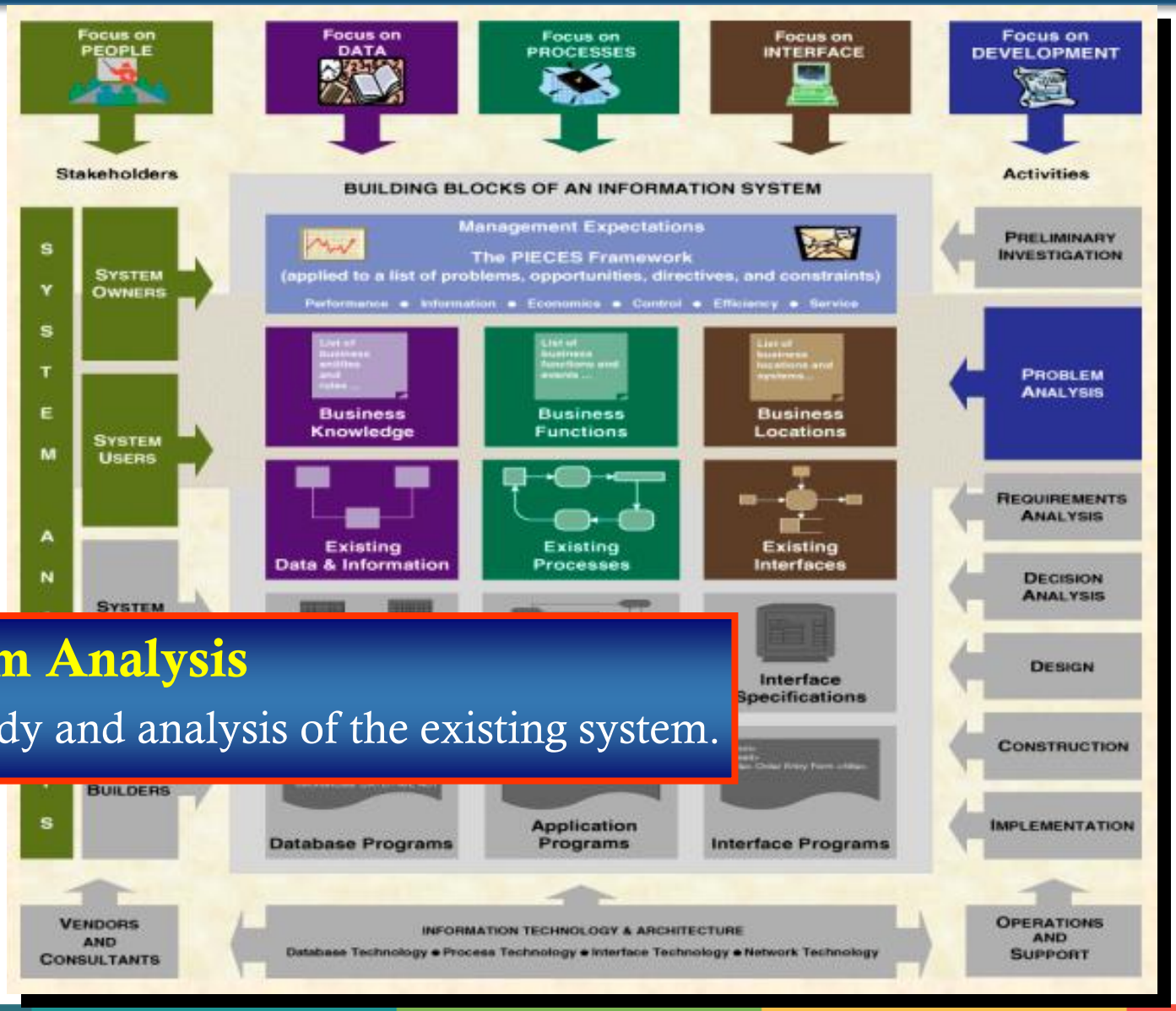
Brief Statements of Problem, Opportunity, or Directive	Urgency	Visibility	Annual Benefits	Priority or Rank	Proposed Solution
1. Order response time as measured from time of order receipt to time of customer delivery has increased to an average of 15 days.	ASAP	High	$175,000	2	New development
2. The recent acquisitions of Private Screenings Video Club and GameScreen will further stress the throughput requirements for the current system.	6 months	Med	75,000	2	New development
3. Currently, three different order entry systems service the audio, video, and game divisions. Each system is designed to interface with a different warehousing system; therefore, the intent to merge inventory into a single warehouse has been delayed.	6 months	Med	515,000	2	New development
4. There is a general lack of access to management and decision-making information. This will become exasperated by the acquisition of two additional order processing systems (from Private Screenings and GameScreen)	12 months	Low	15,000	3	After new system is developed, provide users with easy-to-learn and use reporting tools.
5. There currently exists data inconsistencies in the member and order files.	3 months	High	35,000	1	Quick fix; then new development
6. The Private Screenings and GameScreen file systems are incompatible with the SoundStage equivalents. Business data problems include data inconsistencies and lack of input edit controls.	6 months	Med	unknown	2	New development. Additional quantification of benefit might increase urgency.
7. There is an opportunity to open order systems to the Internet, but security and control is an issue.	12 months	Low	unknown	4	Future version of newly developed system
8. The current order entry system is incompatible with the forthcoming automatic identification (bar coding) system being developed for the warehouse.	3 months	High	65,000	1	Quick fix; then new development

Task 1.2 ~ 1.5


THE BUSINESS COMMUNITY
SYSTEM OWNERS AND USERS (OR STEERING COMMITTEE)
Project Request or Assignment
1.1 List Problems, Opportunities, and Directives
Preliminary Problem Statement
PROJECT CHARTER
problem statements (PIECES)
1.2 Negotiate Preliminary Scope
statements of project scope
1.5 Present the Project and Plan
problem statements and scope
Repository
Preliminary Problem Statement with Scope
1.3 Assess Project Worth
statement of work project schedule and resource assignments
problem statements with scope
1.4 Plan the Project
Project Plan
(project is worthy)

The Problem Analysis Phase

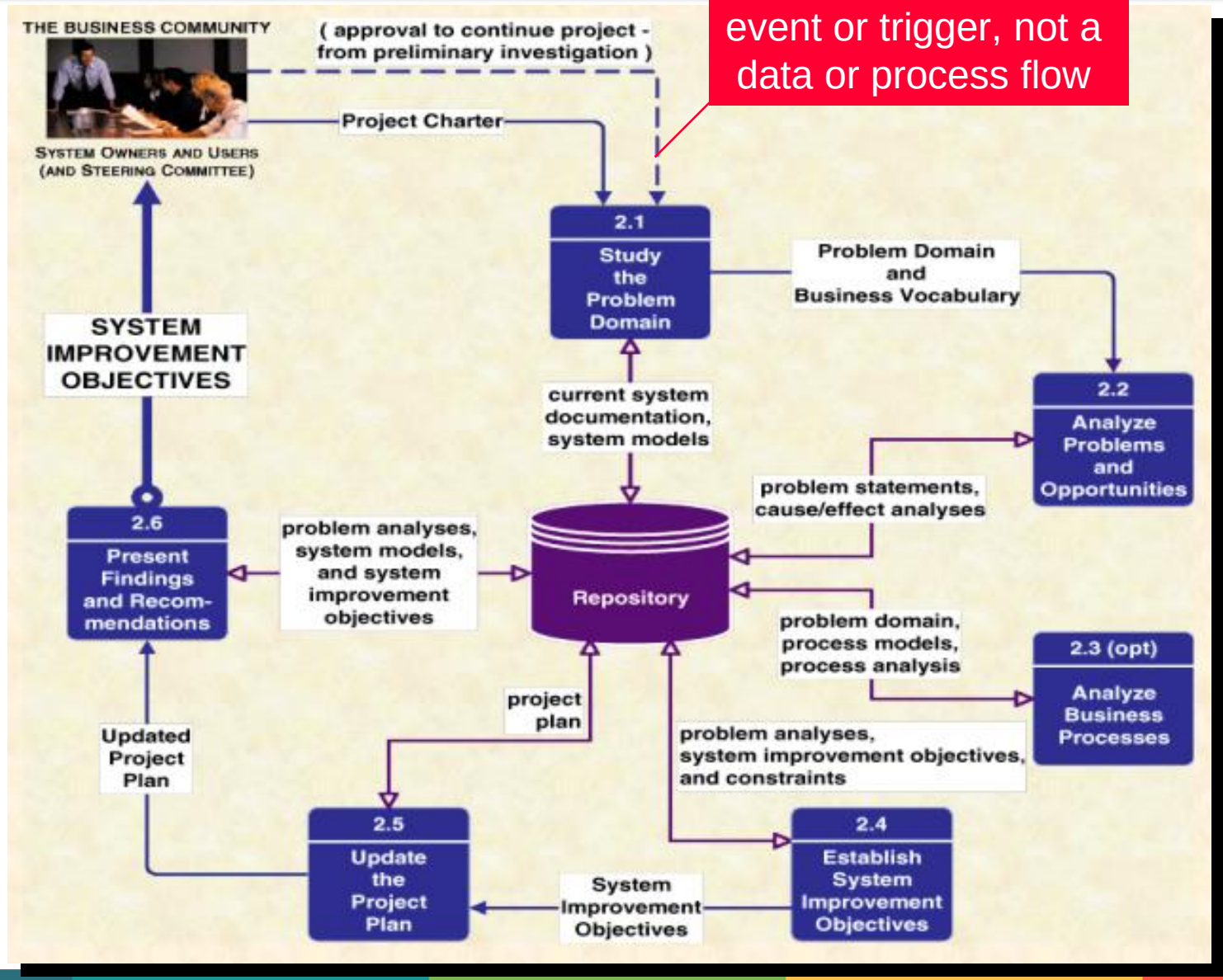
Problem Analysis Phase Context



Problem Analysis

- A study and analysis of the existing system.

Problem Analysis Phase Tasks



The Final Deliverable and Milestone

- System Improvement Objectives: System improvement objectives address problems, opportunities, and directives.

Task 2.1 Study the Problem Domain

- The key informational input is the project charter and any current system documentation that may exist in the repository and program libraries for the current system.
- Using system building blocks as a framework to list and define the system domain:
  - Data — List all the things about which the system currently stores data. Define each thing in business terms.
  - Processes — Define each business event for which a business response (process) is currently implemented.
  - Interfaces — Define all the location that the current system serves and all the users at each of those locations.

Task 2.2 Analyze Problems and Opportunities

- It needs to analyze each perceived problem for causes and effects.
- Cause-and-effect analysis is a technique in which problems are studied to determine their causes and effects.
- In practice, effects can be symptomatic（有症状的） of a different, more deeply rooted or basic problems which, in turn, must be analyzed for causes and effects until such a time as the causes and effects do not yield symptoms of other problems.

Task 2.3 Analyze Business Processes

- This task is appropriate only to business process redesign (BPR) projects or system development projects that build on or require significant business process redesign.

Task 2.4 Establish System Improvement Objectives

- This task establishes the criteria against which any improvements to the system will be measured and identifies any constraints that may limit flexibility in achieving those improvements.
- An objective is a measure of success. It is something that you expect to achieve, if given sufficient resources. For instance:
  - Reduce the number of uncollectible customer accounts by 50 percent within the next year.
- A constraint is something that will limit your flexibility in defining a solution to your objectives. Essentially, constraints cannot be changed.

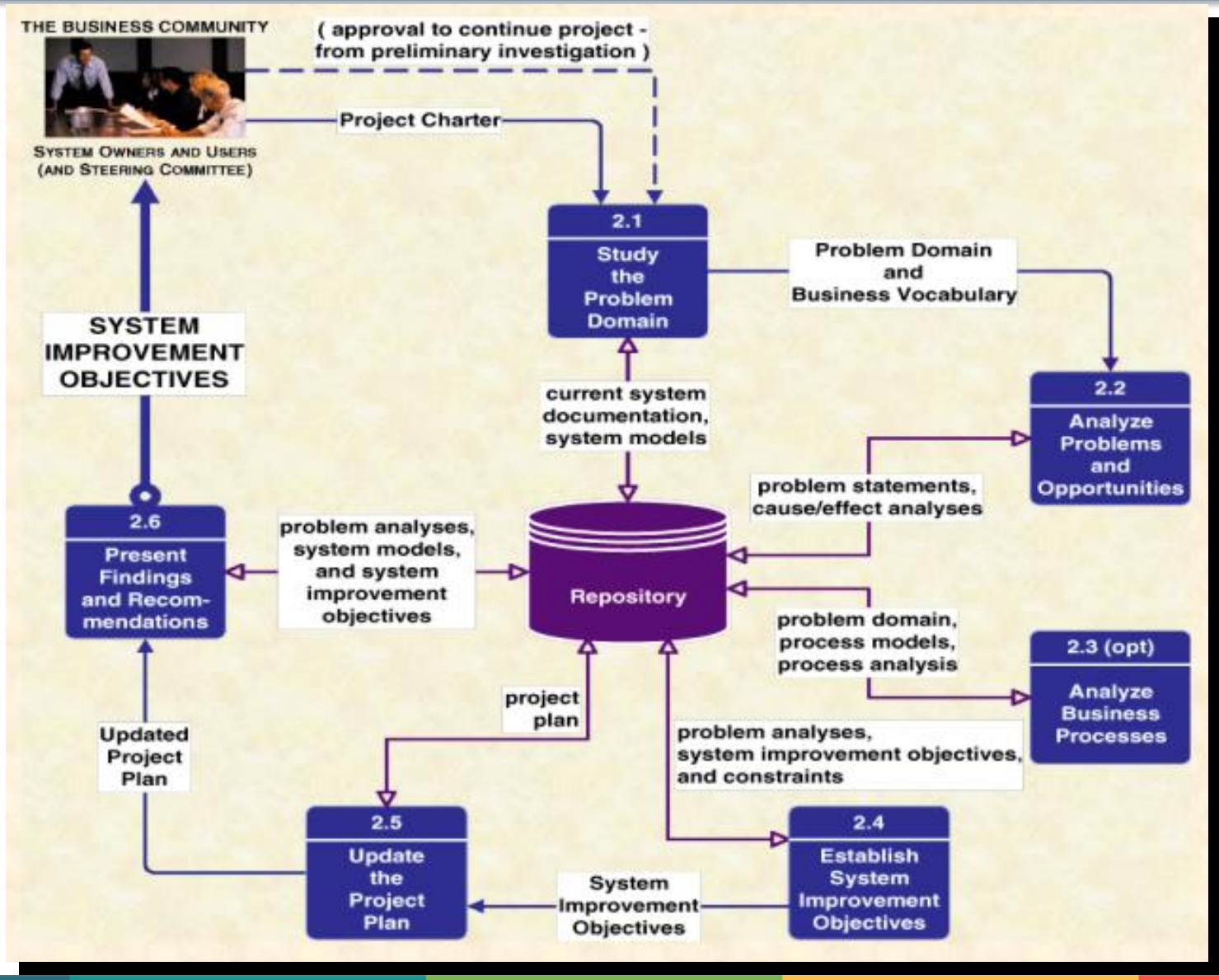
Cause-and-Effect / System Improvement Objectives

PROBLEMS, OPPORTUNITIES, OBJECTIVES, AND CONSTRAINTS MATRIX

Project:	Member Services Information System	**Project Manager:**	Sandra Shepherd
Created by:	Robert Martinez	**Last Updated by:**	Robert Martinez
Date Created:	January 21, 2001	**Date Last Updated:**	January 31, 2001

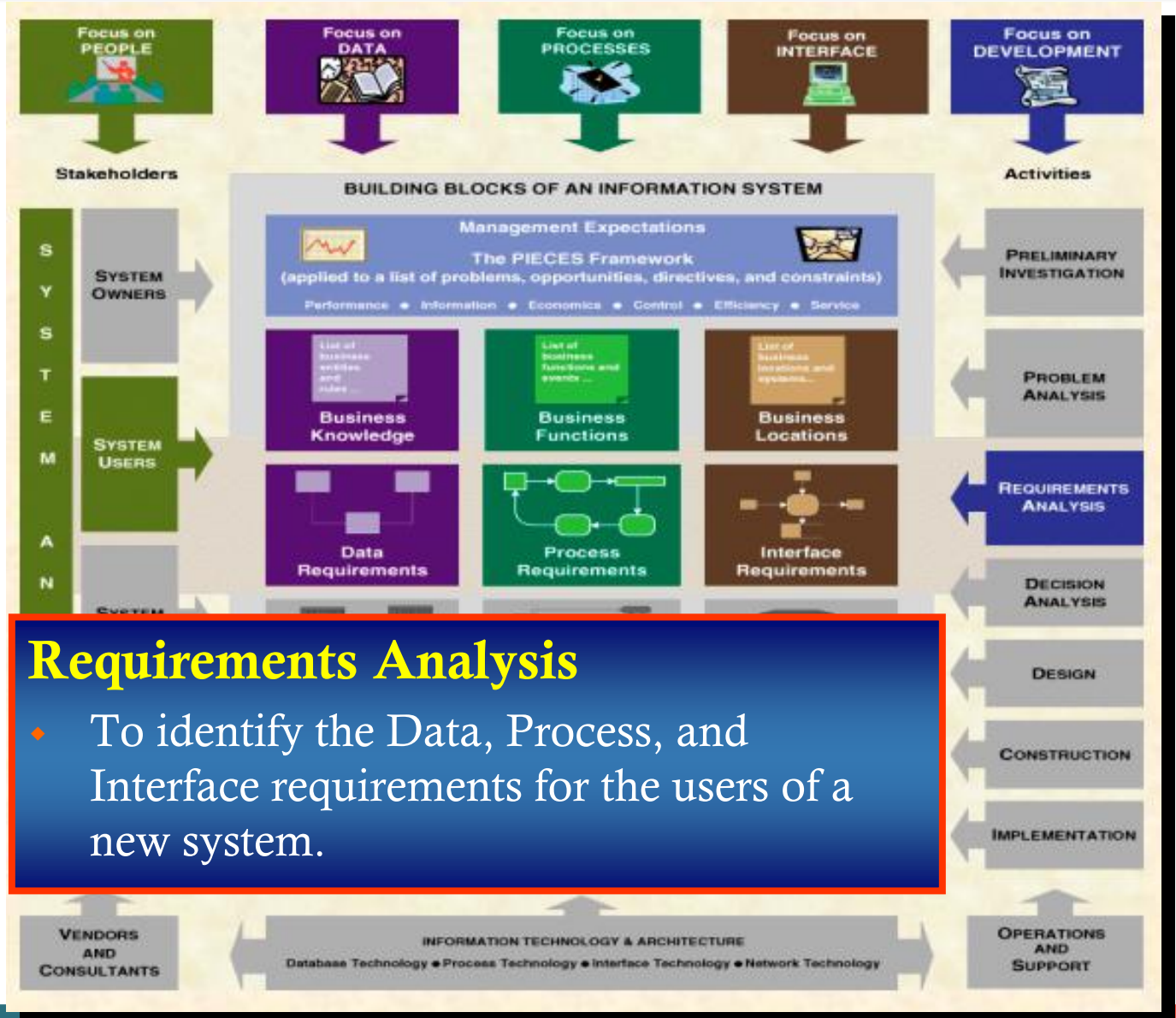
CAUSE-AND-EFFECT ANALYSIS		SYSTEM IMPROVEMENT OBJECTIVES	
Problem or Opportunity	**Causes and Effects**	**System Objective**	**System Constraint**
1. Order response time is unacceptable.	1. Throughput has increased while number of order clerks was downsized. Time to process a single order has remained relatively constant. 2. System is too keyboard dependent. Many of the same values are keyed for most orders. Net result is (with the current system) each order takes longer to process than is ideal. 3. Data editing is performed by the AS/400. As that computer has approached its capacity, order edit responses have slowed. Because order clerks are trying to work faster to keep up with the volume, the number of errors has increased. 4. Warehouse picking tickets for orders were never designed to maximize the efficiency of order fillers. As warehouse operations grew, order filling delays were inevitable.	1. Decrease the time required to process a single order by 30%. 2. Eliminate keyboard data entry for as much as 50% of all orders. 3. For remaining orders, reduce as many keystrokes as possible by replacing keystrokes with point-and-click objects on the computer display screen. 4. Move data editing from a shared computer to the desktop. 5. Replace existing picking tickets with a paperless communication system between member services and the warehouse.	1. There will be no increase in the order processing workforce. 2. Any system developed must be compatible with the existing *Windows 95* desktop standard. 3. New system must be compatible with the already approved automatic identification system (for bar coding).

Task 2.5 and Task 2.6



The Requirements Analysis Phase

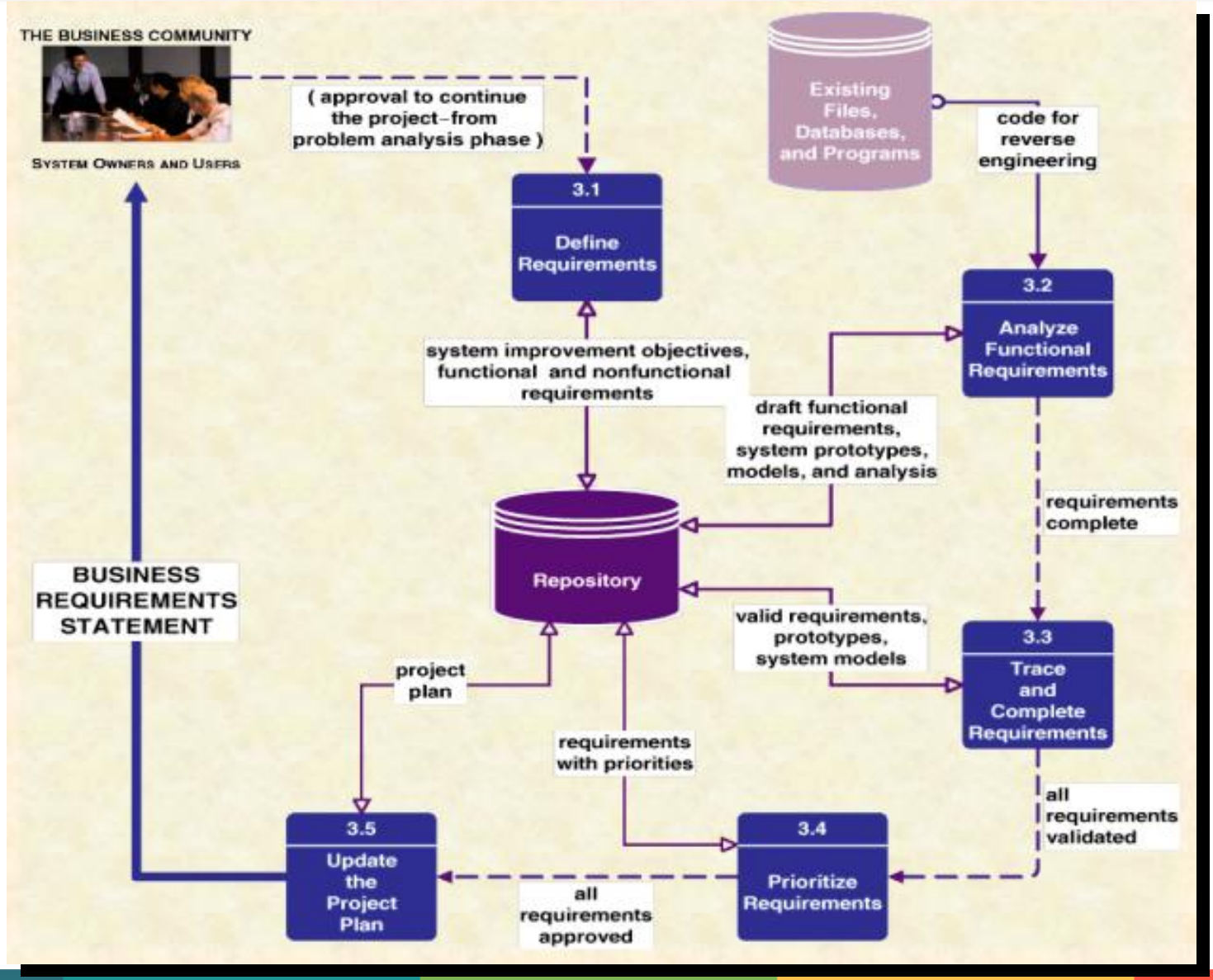
Requirements Analysis Phase Context



Requirements Analysis

- To identify the Data, Process, and Interface requirements for the users of a new system.

Requirements Analysis Phase Tasks



The Final Deliverable and Milestone

- Business Requirements Statement: Business requirements statement will fulfill the system improvement objectives.

Task 3.1 Define Requirements

The foundation for this task was established in the problem analysis phase when we identified system improvement objectives. Minimally, this task translates those objectives into an outline of functional and nonfunctional requirements that will be needed to meet the objective.

- A functional requirement is a description of activities and services a system must provide.
- A nonfunctional requirement is a description of other features, characteristics, and constraints that define a satisfactory system.

Task 3.2 Analyze Functional Requirements

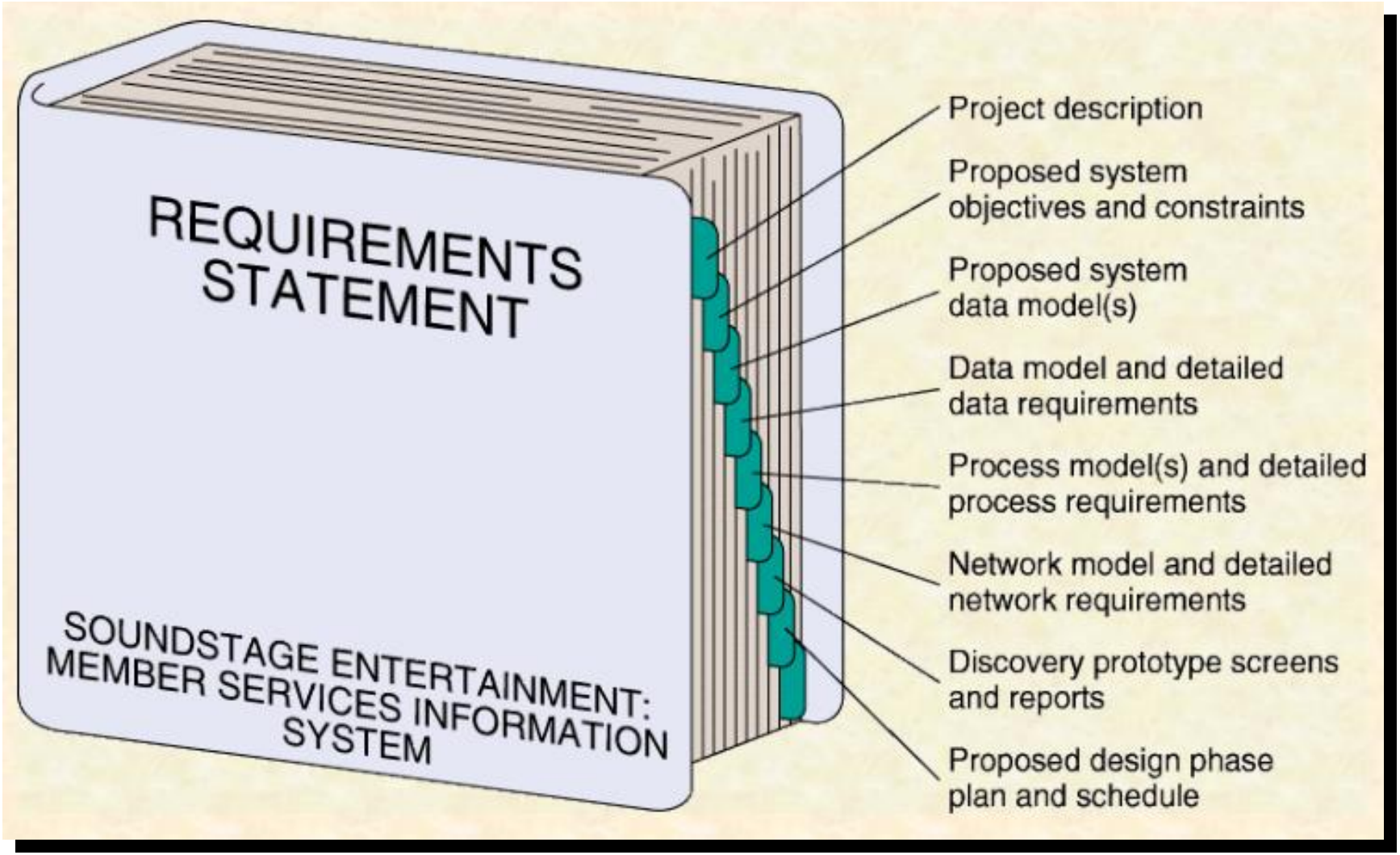
We must analyze functional requirements such that they can be verified and communicated to both business and technical audiences.

- Logical system models depict what a system is or what a system must do—not how the system will be implemented. Because logical models depict the essential requirements of a system, they are sometimes called essential system models. (The opposite of logical system models are physical system models that are used to depict how a system will implement the logical system requirements.)
- Logical models express business requirements—sometimes referred to as the logical design—as opposed to the technical solution, which is called the physical design.

Task 3.3~Task 3.5

- Task 3.3 Trace and Complete Requirements
  - It is recommended that system owners and users be given a final opportunity to validate requirements.
- Task 3.4 Prioritize Requirements
  - If a project gets behind schedule or over budget, it may be useful to recognize which requirements are more important than others. Thus, given the validated requirements, system owners and users should prioritize business requirements.
- Task 3.5 Update the Project Plan
  - When we've identified the business system requirements, we should step back and redefine our understanding of the project scope and update our project plan accordingly.

A Typical Hard-Copy Requirements Statement

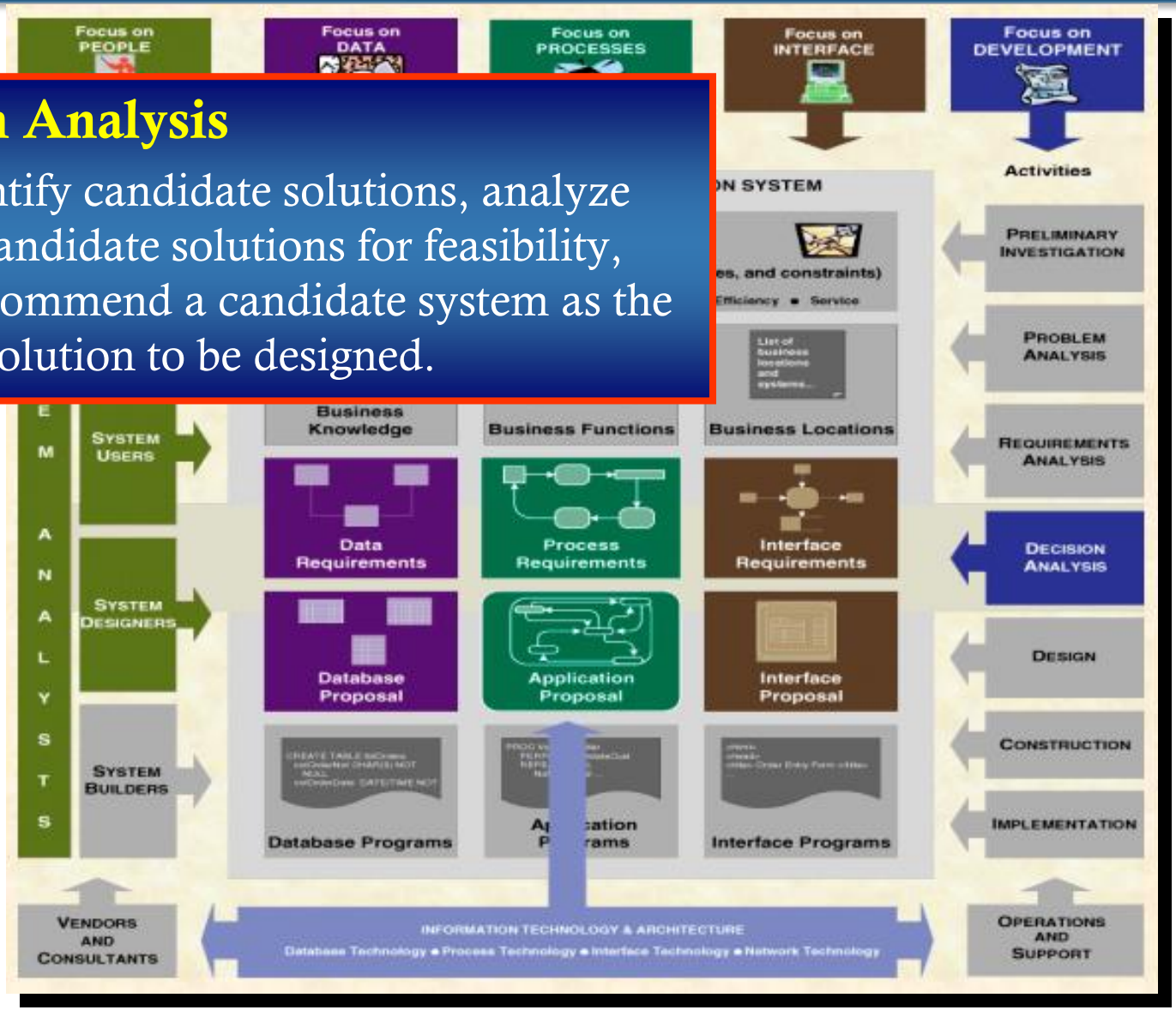


The Decision Analysis Phase

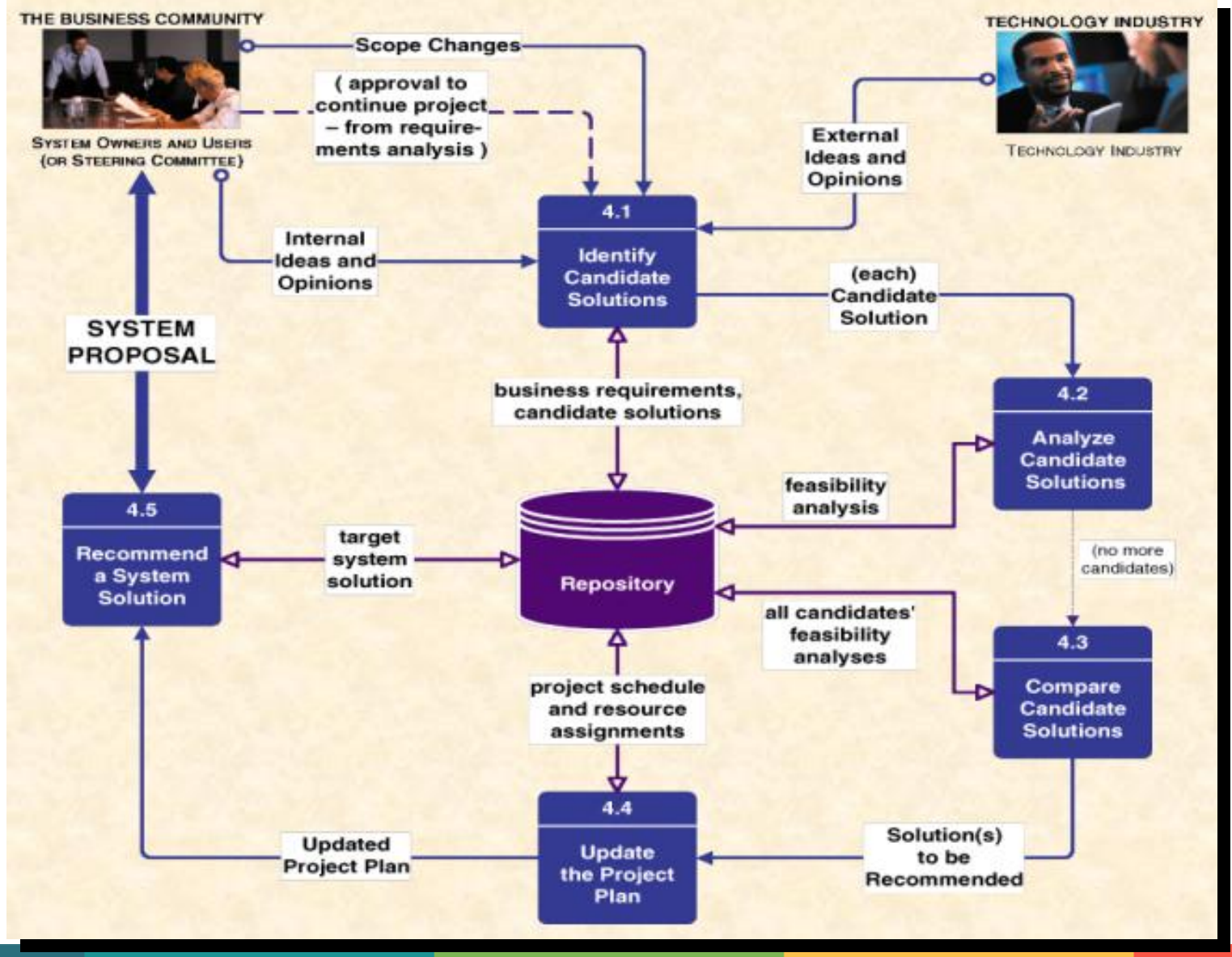
Decision Analysis Phase Context

Decision Analysis

- To identify candidate solutions, analyze those candidate solutions for feasibility, and recommend a candidate system as the target solution to be designed.



Decision Analysis Phase Tasks



The Final Deliverable and Milestone

- System Proposal: System proposal will fulfill the business requirements.

Task 4.1 Identify Candidate Solutions

- Some candidate solutions will be posed by design ideas and opinions from system owners and users. Others may come from various sources including: system analysts, system designers, technical consultants, and other IS professionals. And some technical choices may be limited by a predefined approved technology architecture.
- It is not the intent of this task to evaluate the candidates. Rather, it is simply defines possible candidate solutions to be considered.

Task 4.2 Analyze Candidate Solutions

- Each candidate system solution must be analyzed for feasibility.
  - Technical feasibility. Is the solution technically practical? Does our staff have the technical expertise to design and build this solution?
  - Operational feasibility. Will the solution fulfill the users' requirements? To what degree? How will the solution change the users' work environment? How do users feel about such a solution?
  - Economic feasibility. Is the solution cost-effective?
  - Schedule feasibility. Can the solution be designed and implemented within an acceptable time period?

Candidate Systems Matrix

Characteristics	Candidate 1	Candidate 2	Candidate 3	Candidate ...
Portion of System Computerized Brief description of that portion of the system that would be computerized in this candidate.	COTS package Platinum Plus from Entertainment Software Solutions would be purchased and customized to satisfy Member Services required functionality.	Member Services and warehouse operations in relation to order fulfillment.	Same as candidate 2.	
Benefits Brief description of the business benefits that would be realized for this candidate.	This solution can be implemented quickly because it's a purchased solution.	Fully supports user required business processes for SoundStage Inc. Plus more efficient interaction with member accounts.	Same as candidate 2.	
Servers and Workstations A description of the servers and workstations needed to support this candidate.	Technically architecture dictates Pentium Pro, MS Windows NT class servers and Pentium, MS Windows NT 4.0 workstations (clients).	Same as candidate 1.	Same as candidate 1.	
Software Tools Needed Software tools needed to design and build the candidate (e.g., database management system, emulators, operating systems, languages, etc.). Not generally applicable if applications software packages are to be purchased.	MS Visual C++ and MS Access for customization of package to provide report writing and integration.	MS Visual Basic 5.0 System Architect 3.1 Internet Explorer	MS Visual Basic 5.0 System Architect 3.1 Internet Explorer	
Application Software A description of the software to be purchased, built, accessed, or some combination of these techniques.	Package Solution	Custom Solution	Same as candidate 2.	

Task 4.3 Compare Candidate Solutions

Feasibility Criteria	Weight	Candidate 1	Candidate 2	Candidate 3	Candidate . . .
Operational Feasibility **Functionality**. A description of to what degree the candidate would benefit the organization and how well the system would work. **Political**. A description of how well received this solution would be from both user management, user, and organization perspective.	30%	Only supports Member Services requirements and current business processes would have to be modified to take advantage of software functionality **Score: 60**	Fully supports user required functionality. **Score: 100**	Same as candidate 2. **Score: 100**	
Technical Feasibility **Technology**. An assessment of the maturity, availability (or ability to acquire), and desirability of the computer technology needed to support this candidate. **Expertise**. An assessment of the technical expertise needed to develop, operate, and maintain the candidate system.	30%	Current production release of Platinum Plus package is version 1.0 and has only been on the market for 6 weeks. Maturity of product is a risk and company charges an additional monthly fee for technical support. Required to hire or train C++ expertise to perform modifications for integration requirements. **Score: 50**	Although current technical staff has only Powerbuilder experience, the senior analysts who saw the MS Visual Basic demonstration and presentation have agreed the transition will be simple and finding experienced VB programmers will be easier than finding Powerbuilder programmers and at a much cheaper cost. MS Visual Basic 5.0 is a mature technology based on version number. **Score: 95**	Although current technical staff is comfortable with Powerbuilder, management is concerned with recent acquisition of Powerbuilder by Sybase Inc. MS SQL Server is a current company standard and competes with SYBASE in the Client/Server DBMS market. Because of this we have no guarantee future versions of Powerbuilder will "play well" with our current version SQL Server. **Score: 60**	
Economic Feasibility **Cost to develop:** **Payback period (discounted):** **Net present value:** **Detailed calculations:**	30%	Approximately $350,000. Approximately 4.5 years. Approximately $210,000. See Attachment A. **Score: 60**	Approximately $418,040. Approximately 3.5 years. Approximately $306,748. See Attachment A. **Score: 85**	Approximately $400,000. Approximately 3.3 years. Approximately $325,500. See Attachment A. **Score: 90**	
Schedule Feasibility An assessment of how long the solution will take to design and implement.	10%	Less than 3 months. **Score: 95**	9–12 months **Score: 80**	9 months **Score: 85**	
Ranking	100%	60.5	92	83.5	

Task 4.4~Task 4.5

- Task 4.4 Update the Project Plan
  - We are continually updating our project plan as we learn more about a system, its problems, its requirements, and its solutions. We are adjusting scope accordingly. Thus, based on our recommended solution(s), we should once again reevaluate project scope and update the project plan accordingly.
- Task 4.5 Recommend a Solution
  - We must recommend a system solution to the business community.

An Outline for a Typical System Proposal

System Proposal

I. Introduction
   A. Purpose of the report
   B. Background of the project leading to this report
   C. Scope of the project
   D. Structure of the report
II. Tools and techniques used
   A. Solution generated statement
   B. Feasibility analysis (cost - benefit)
III. Information systems requirements
IV. Alternative solutions and feasibility analysis
V. Recommendations
VI. Appendixes

要点与引申

- 每一个阶段中的每一项任务都有特定的参与者，请大家自己从教材上找出来，并与系统的角色相关联。
- 每一个阶段都有特定的交付结果和里程碑，这些比将来写的程序可能更有价值。
- 将系统分析划分成多个阶段，是“分而治之”策略的应用。
- 系统分析的首要任务是客观反映既定领域和需要解决的问题。
- 随着认识的深入，项目计划需要不断地修正。

西安电子科技大学
XIDIAN UNIVERSITY

06

系统分析与设计
(System Analysis and Design)

Requirements Discovery

Content Structure

- An Introduction to Requirements Discovery
- **The Process of Requirements Discovery**
  - 发现和分析问题；发现需求；用文档书写需求并加以分析；需求的管理。
- **Requirements Discovery Methods**
  - 几种发现需求的常用方法。
- **A Fact-Finding Strategy**
- Documenting Requirements Methods
  - 几种用文档表示需求的方法。