

The SDOE Program Approach to System Architecting

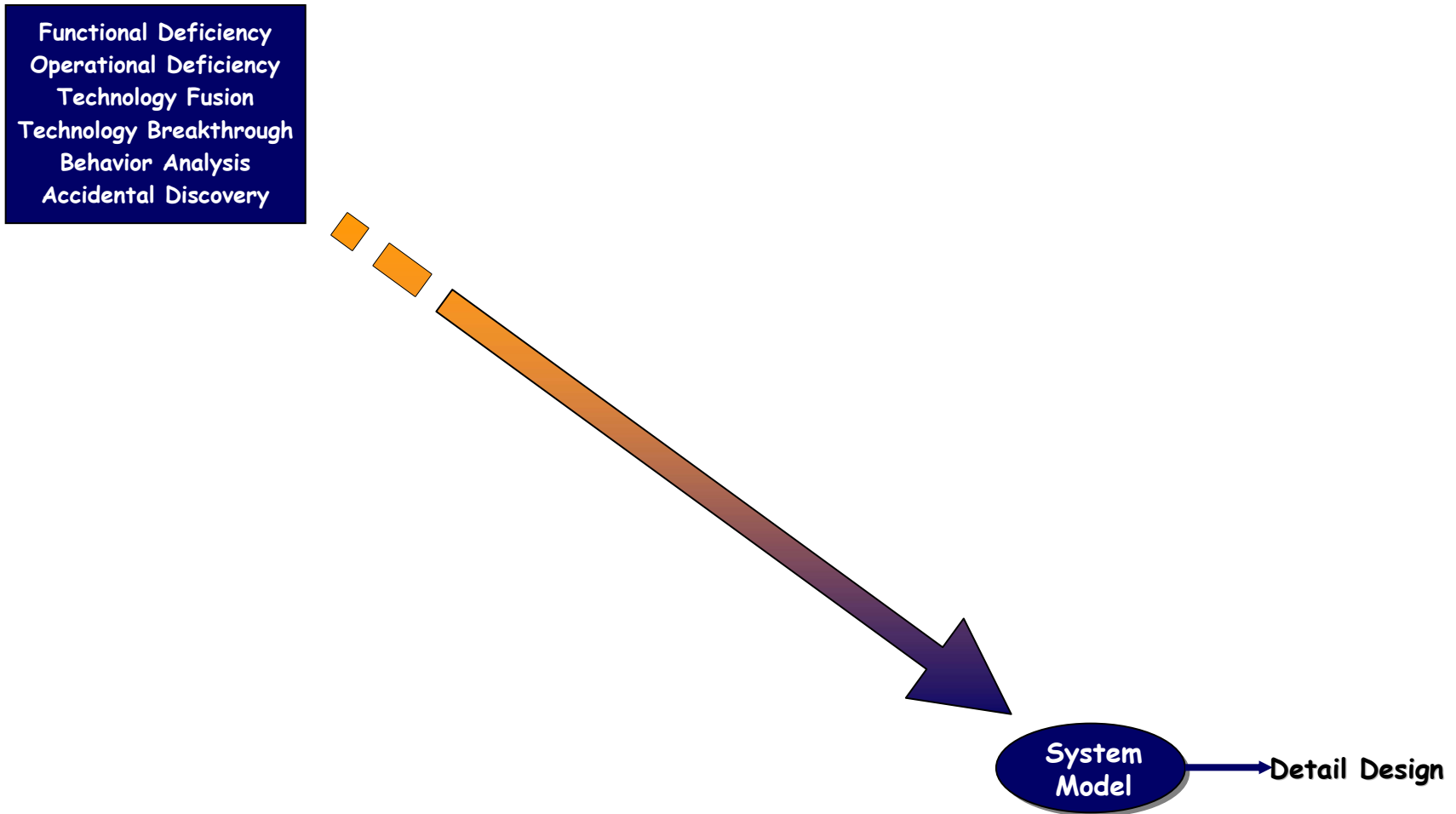
Methodology and a Case Study

Dr. Michael Pennotti
22 May 2003

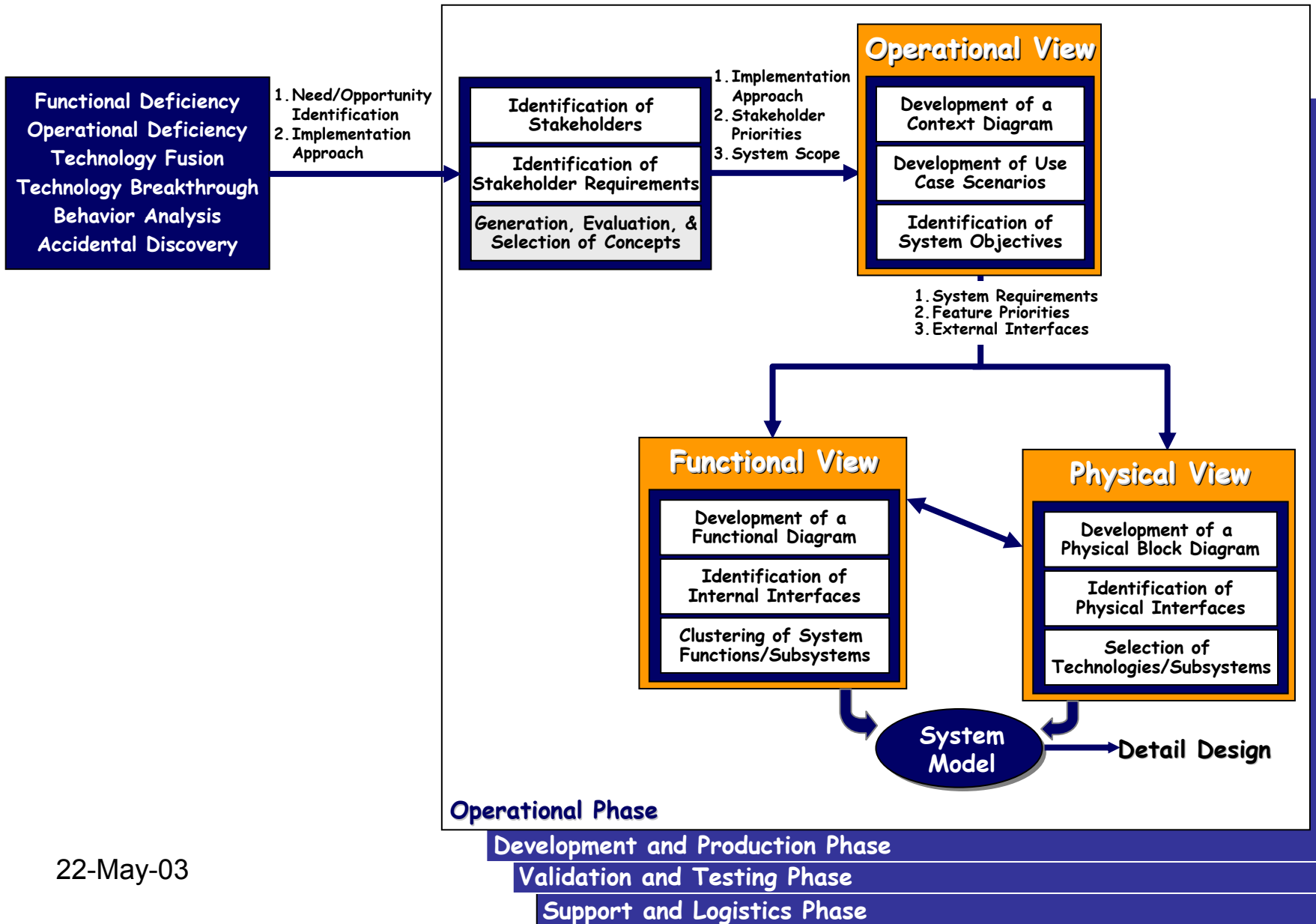


System Design and Operational Effectiveness (SDOE) Program

Systems Engineering – A Process that Transforms a Need into a System Model



The Systems Engineering Process



Identifying a Customer Need

- A need can arise from many places:
 - Functional Deficiency
 - Operational Deficiency
 - Technology Fusion
 - Technology Breakthrough
 - Behavior Analysis
 - Accidental Discovery
- **Key Distinction:** A potential customer has a need *to...* not a need *for...*
 - If they express a need *for...*, ask them *Why?*

SDOE Online – Need Statement

- SDOE Program sponsors want to improve the systems engineering skills of their design teams without the need to send students to a central location or to require them dedicate large blocks of time from their work schedules.

Identifying Stakeholders

- Active Stakeholders
 - Individuals, entities or other systems that will actively interact with the "system" once it is operational and in use
- Passive Stakeholders
 - Individuals, entities, or other systems, standards, protocols, procedures or regulations that will also influence the "success" of the system
 - Example - Global Web Architecture (GWA) Guidelines within IBM
- Customers May be Either Active or Passive Stakeholders
 - Active example: consumers
 - Passive example: program sponsors

SDOE Online – Key Stakeholders

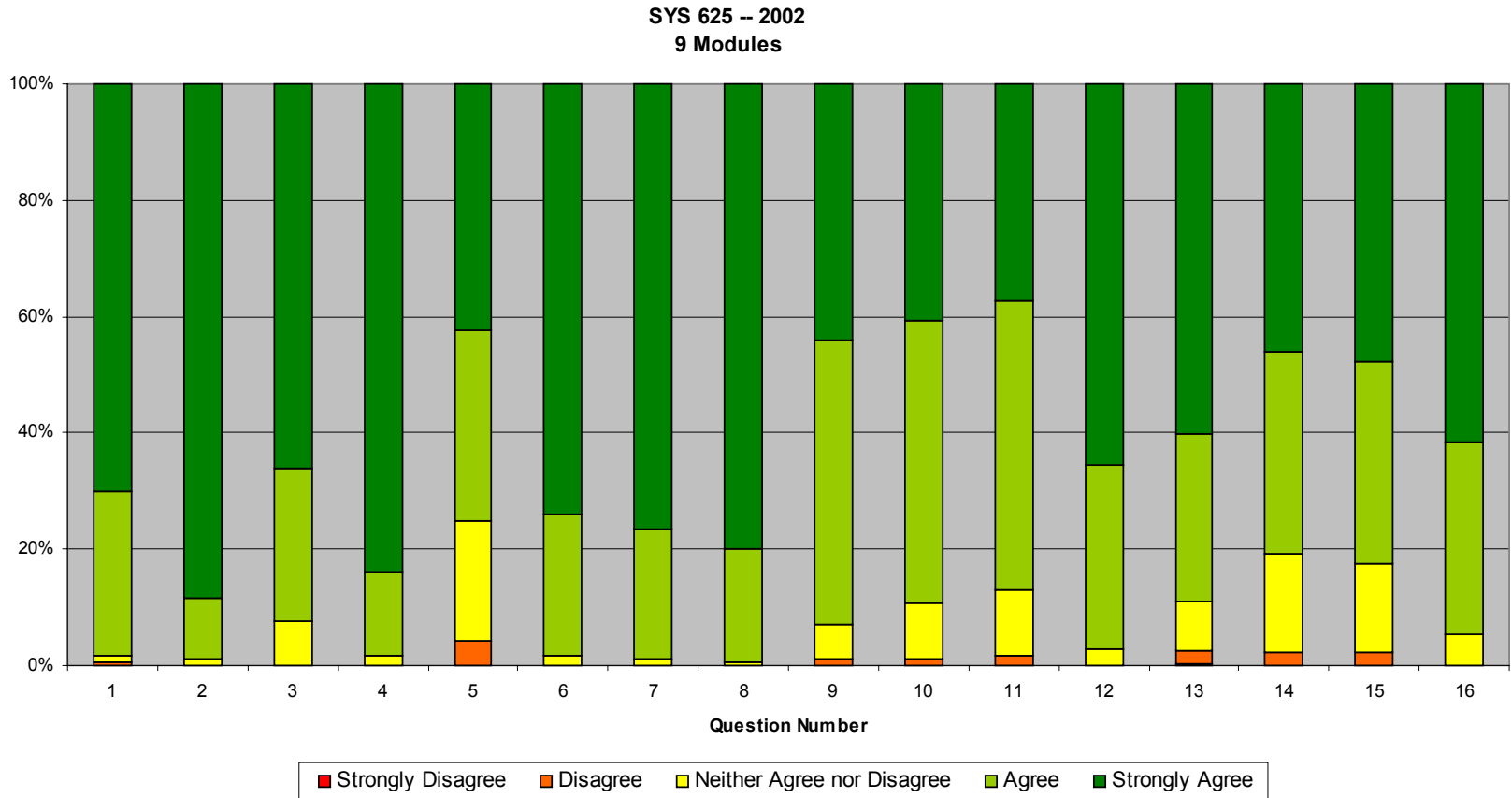
- **Corporate and Government Sponsors**
(Customers; Passive Stakeholders)
- **Students** (Active Stakeholders)
- **Instructors** (Active Stakeholders)

SDOE Online – Stakeholder Requirements

- **Corporate and Government Sponsors** -
 - Provide the same opportunities for students in small, remote locations as are available to those at large, centralized sites
 - Maintain the quality of learning that has been achieved in face-to-face classes
- **Students** - Effective education that is both portable and marketable
- **Instructors** - Time commitments comparable to those of traditional courses

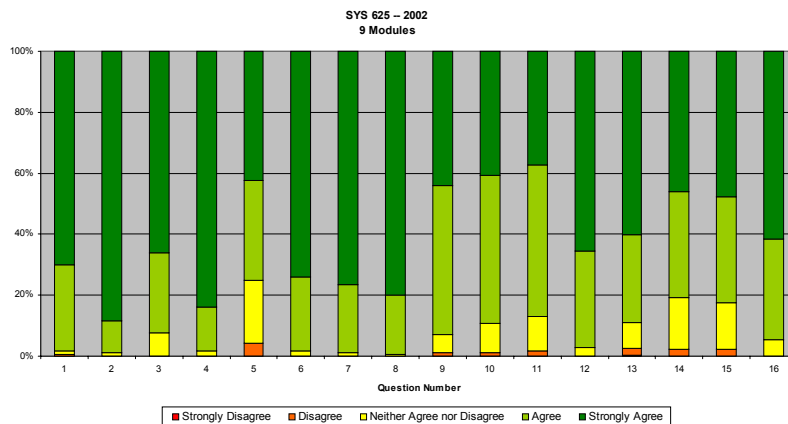
Student Feedback

Fundamentals of Systems Engineering – 2002



Feedback Details

Fundamentals of Systems Engineering – 2002



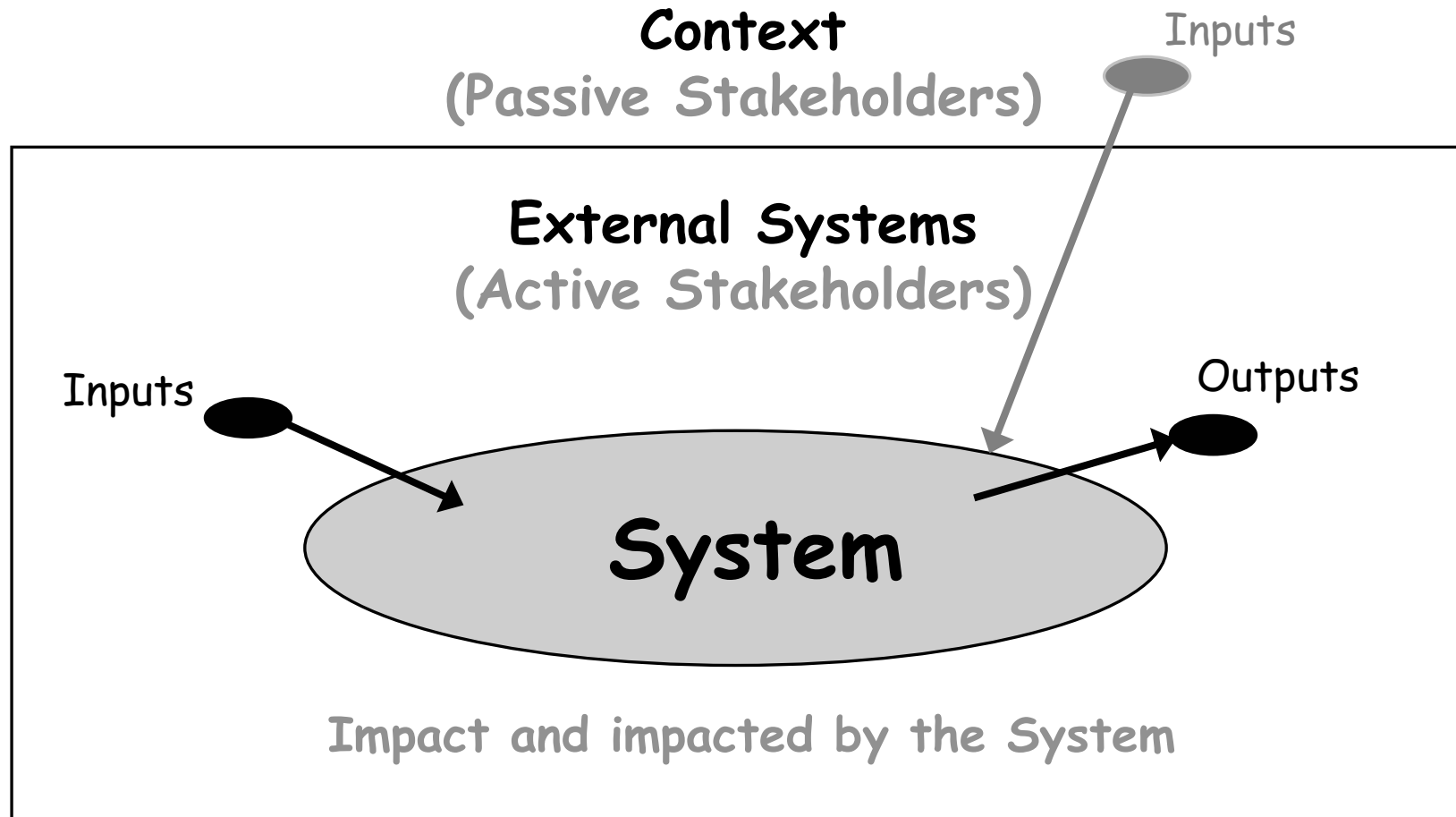
Instructor evaluation:

1. Explains the objectives of the course clearly
2. Is prepared for class
3. Presents material in an organized manner
4. Has command of the subject
5. The guest lecturers were effective during the week
6. Successfully communicates the subject
7. Is fair and consistent
8. OVERALL - The instructor was an effective teacher

Course evaluation:

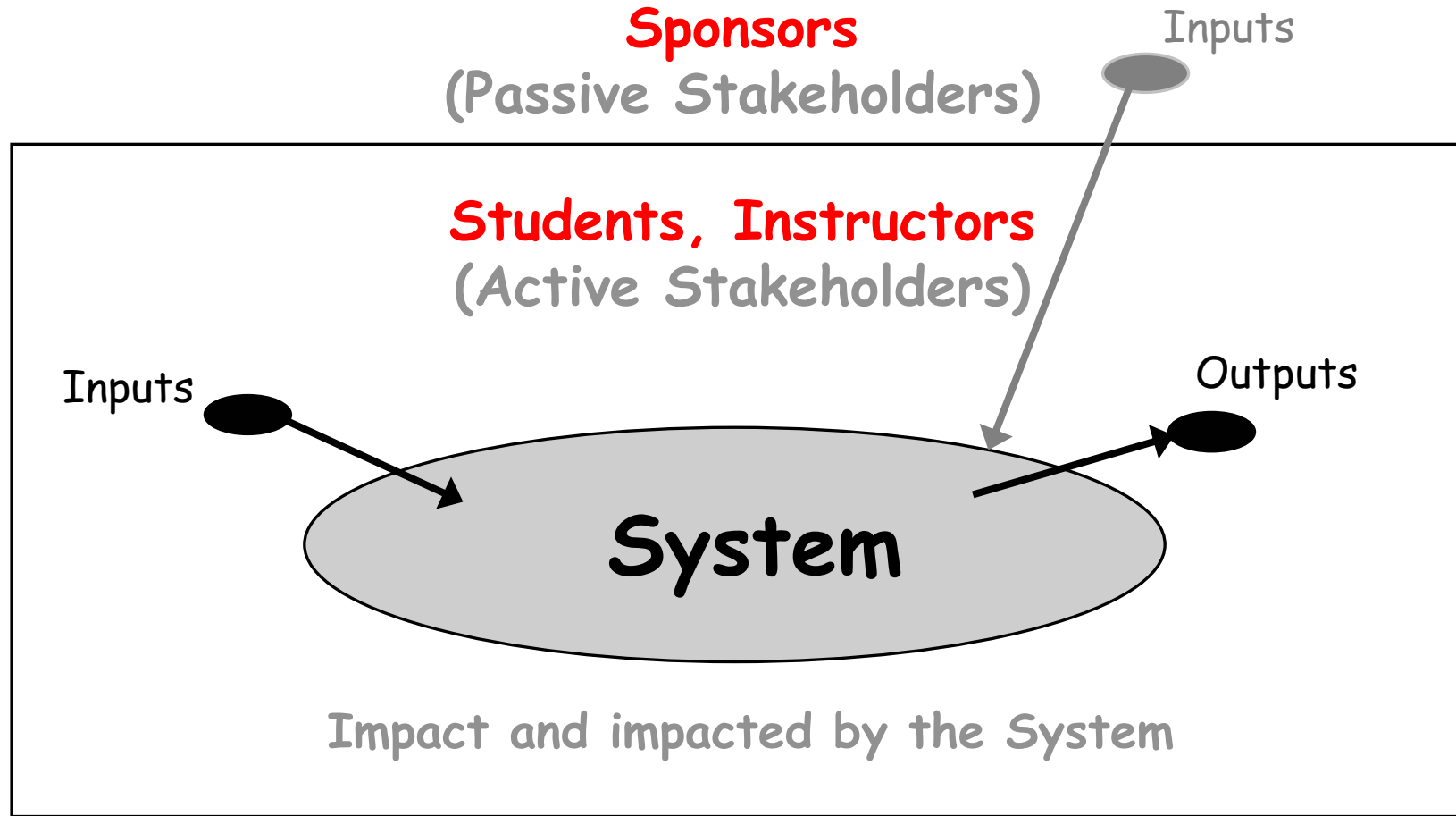
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14. I can apply what I have learned in this course on projects (underway or future) in my organization
15. The course will enable me to enhance my career objectives
16. OVERALL - This was an Excellent Course

Developing the Context Diagram



Impact, but not impacted by, the System

SDOE Online – Context Diagram



Impact, but not impacted by, the System

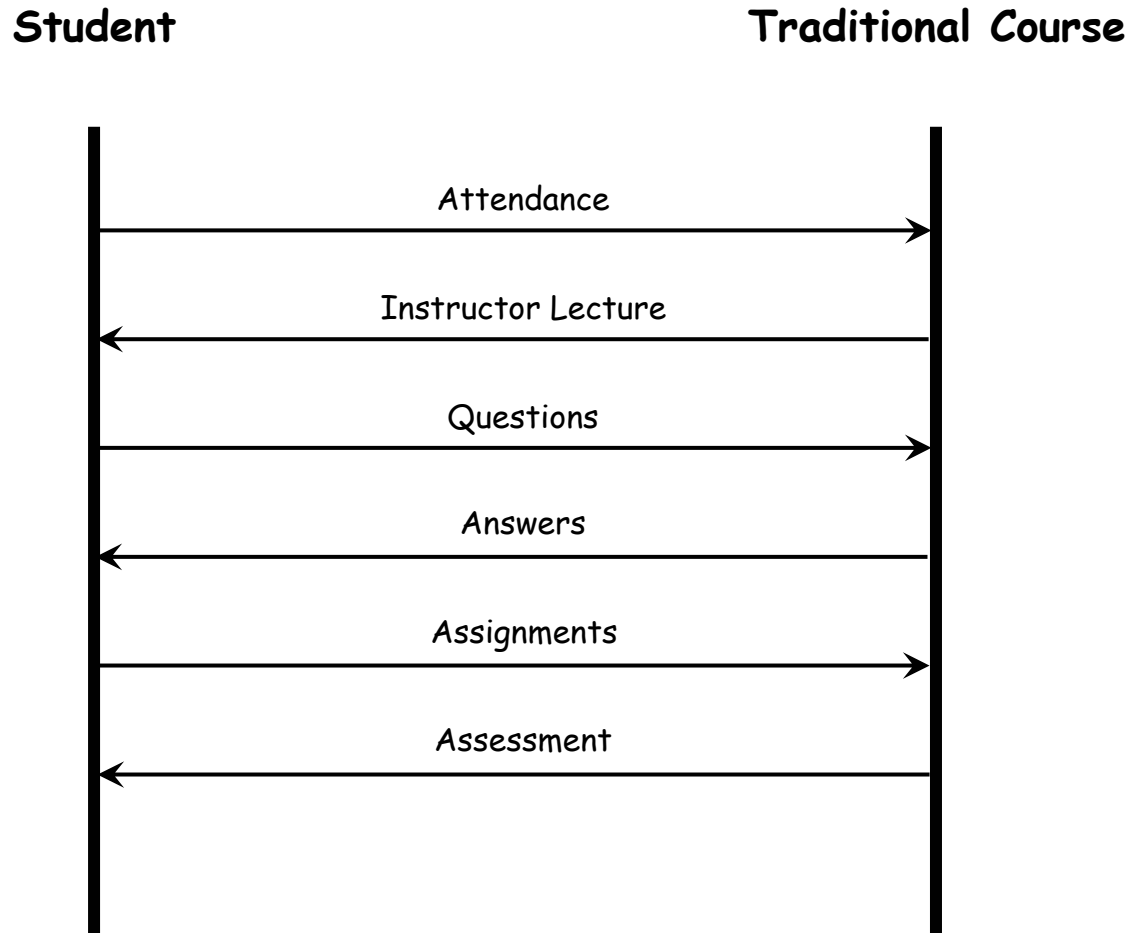
System Operational Concept

- **Vision** - What the system is intended to do
- **Acceptance Criteria (Mission Requirements)** - Three to five measures that represent success
- **Use Case Scenarios** - Detailed interactions that characterize the system in use

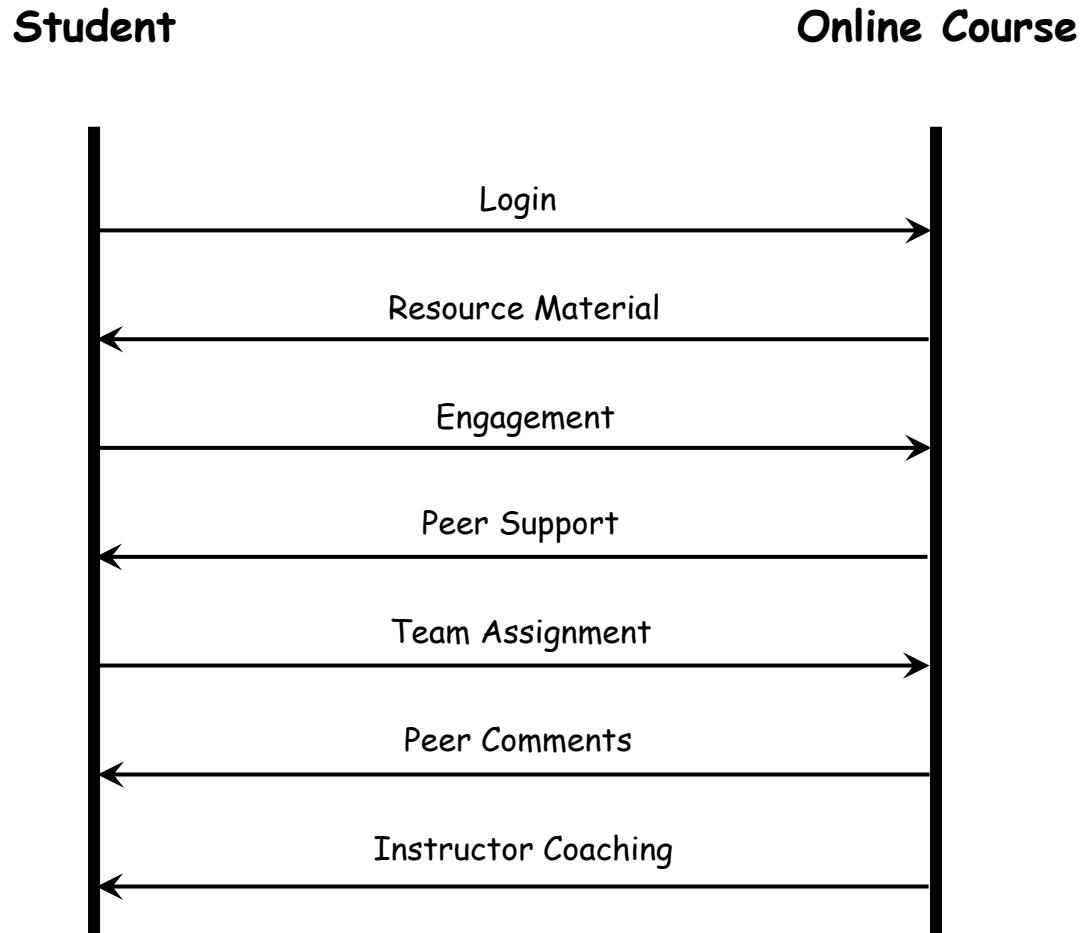
SDOE Online – Operational Concept

- **Vision** - Same opportunities in small, remote locations as available at large, centralized sites
- **Acceptance Criteria**
 - Equivalent Learning
 - Comparable Student Feedback
 - Acceptable Instructor Workload
- **Use Case Scenarios...**

Use Case Scenario – Traditional Learning



Use Case Scenario – SDOE Online

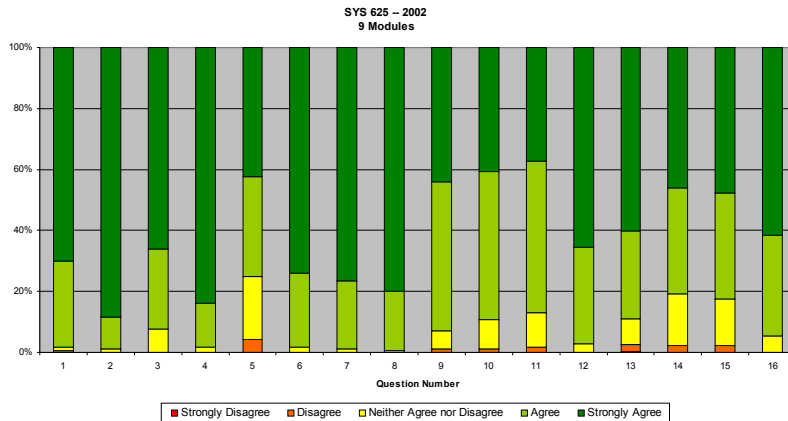


Design Trial – November 2002

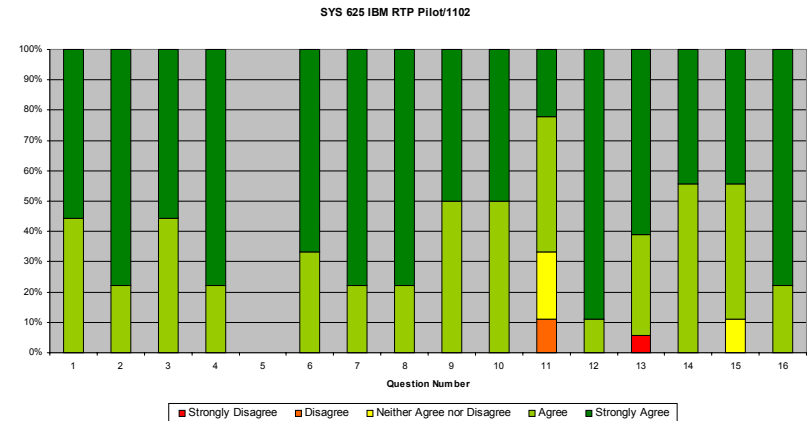
- **Question** - Can equivalent learning be achieved using the online use case scenario?
- **Trial: Research Triangle Park, NC**
 - Sponsored course - 12 students
 - Traditional face-to-face classroom setting
 - Utilized and evaluated the online course scenario
- **Results...**

Feedback: Design Trial – November 2002

Face-to-Face Baseline - 2002



Design Trial - Nov 2002



Instructor evaluation:

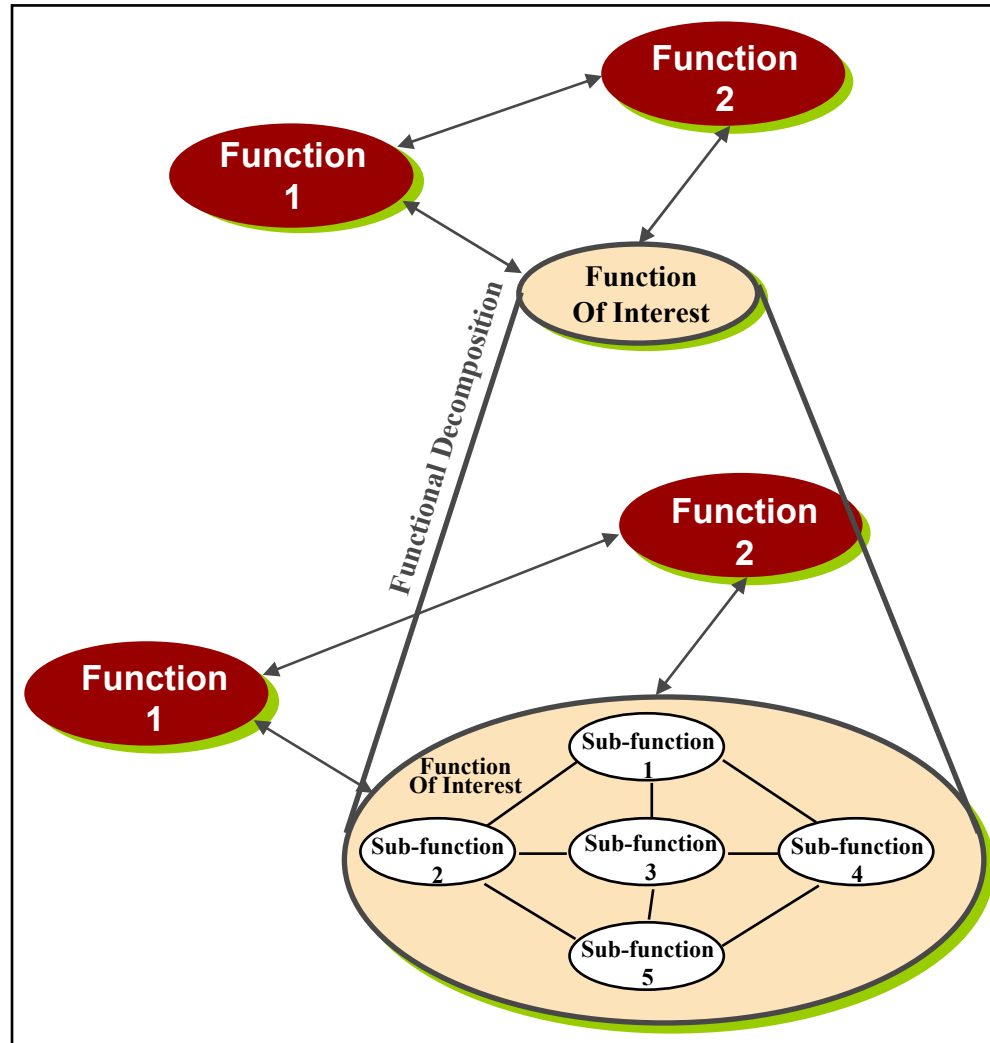
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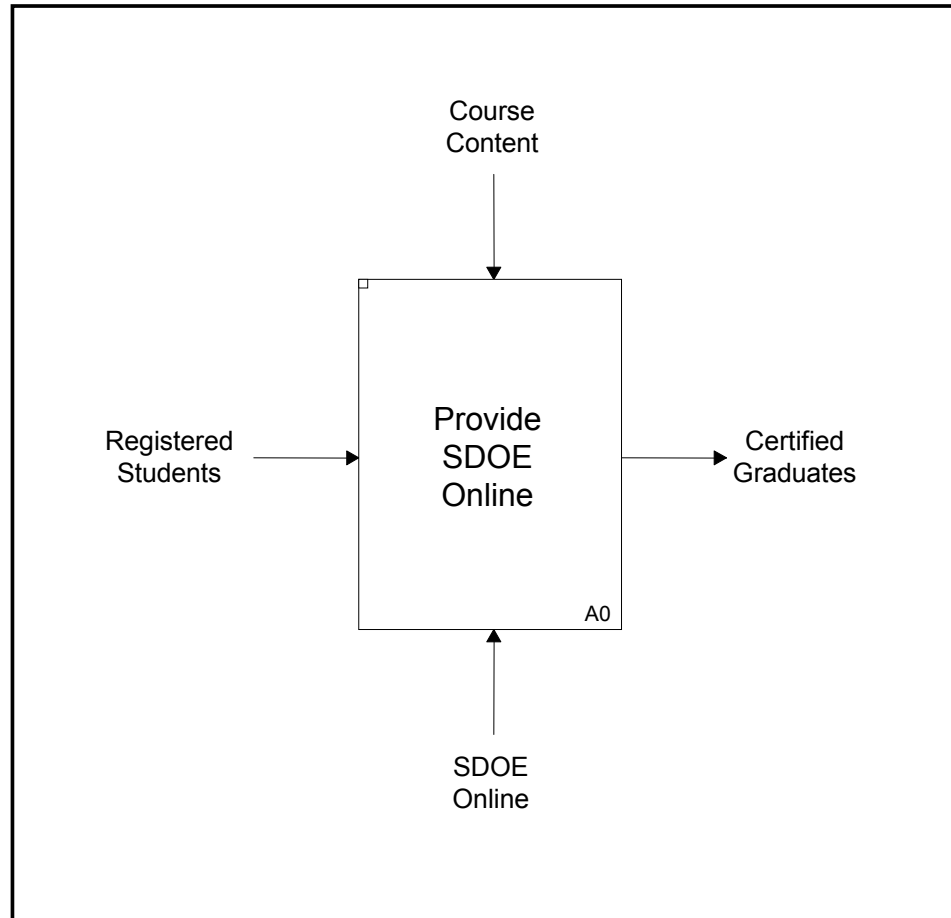
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- A logical architecture that defines **what the system must do**; a decomposition of the system's top-level function.
- A logical model that captures the transformation of inputs into outputs throughout the functional decomposition.
- A logical model to which **input/output requirements have been traced** to specific functions and inputs, outputs, and controls.

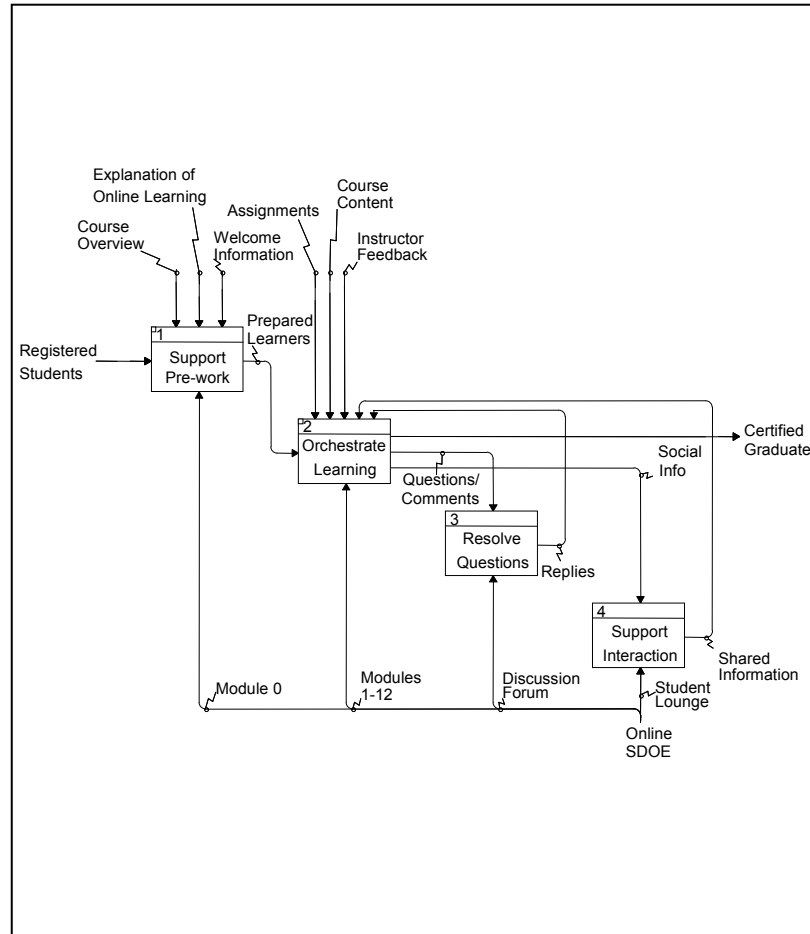
Functional Analysis and Decomposition



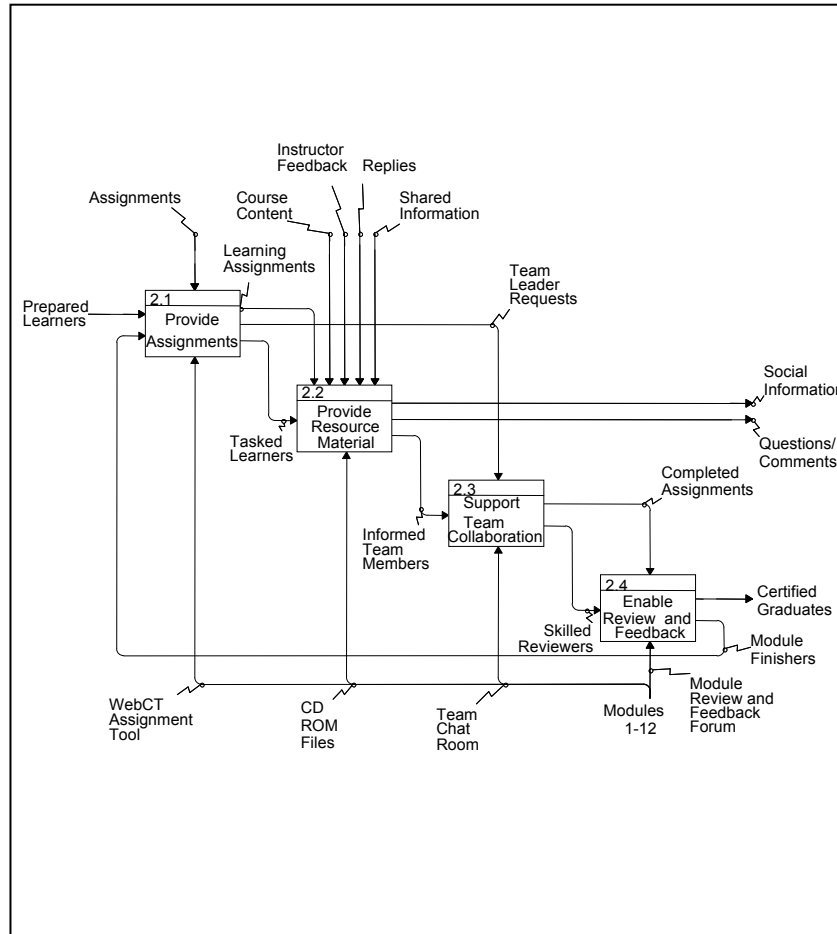
SDOE Online – System Function



SDOE Online – First Level Functional Architecture



Second Level Functional Architecture for “Orchestrate Learning”



Online Prototype – February/March 2003

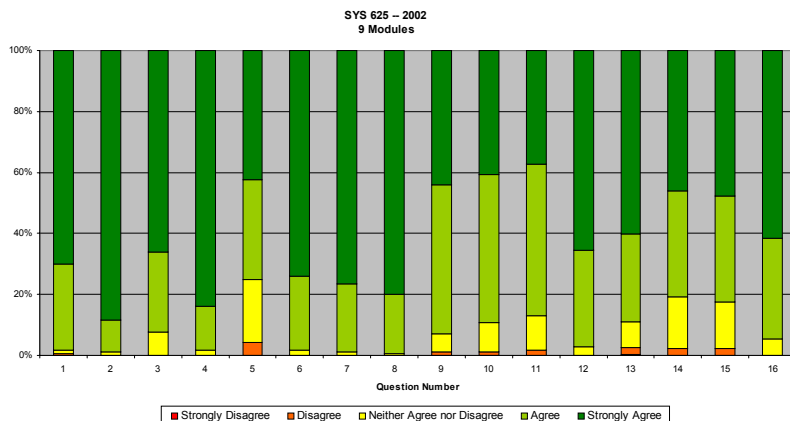
- **Question** - Does the online course meet the stakeholder requirements?
- **Online Prototype:**
 - Sponsored course
 - 16 students/4 teams
 - Six weeks
 - Full online implementation
- **Results...**

Online Pilot Results: Sponsors

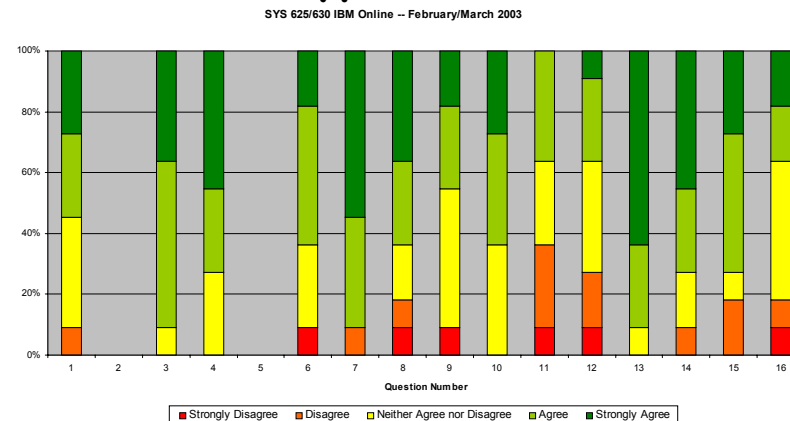
- Provide the same opportunities for students in small, remote locations as are available to those at large, centralized sites
 - Students distributed from San Francisco to Zurich
- Maintain the quality of learning that has been achieved in face-to-face classes
 - Team projects within the range of those produced in face-to-face classes

Online Pilot Results: Students

Face-to-Face Baseline - 2002



Online Prototype - Feb/Mar 2003



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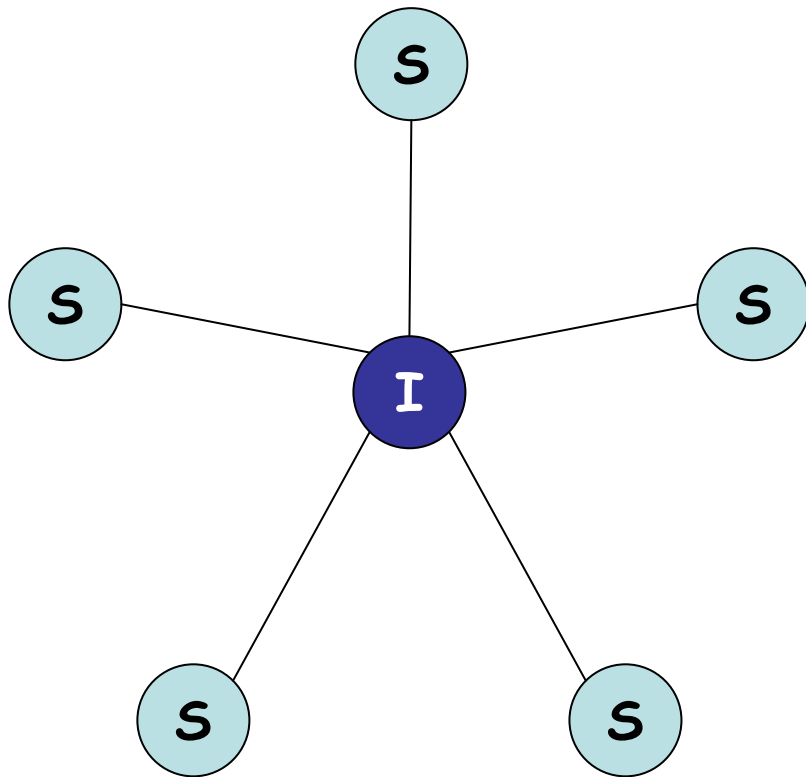
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Modifications Based on Prototype

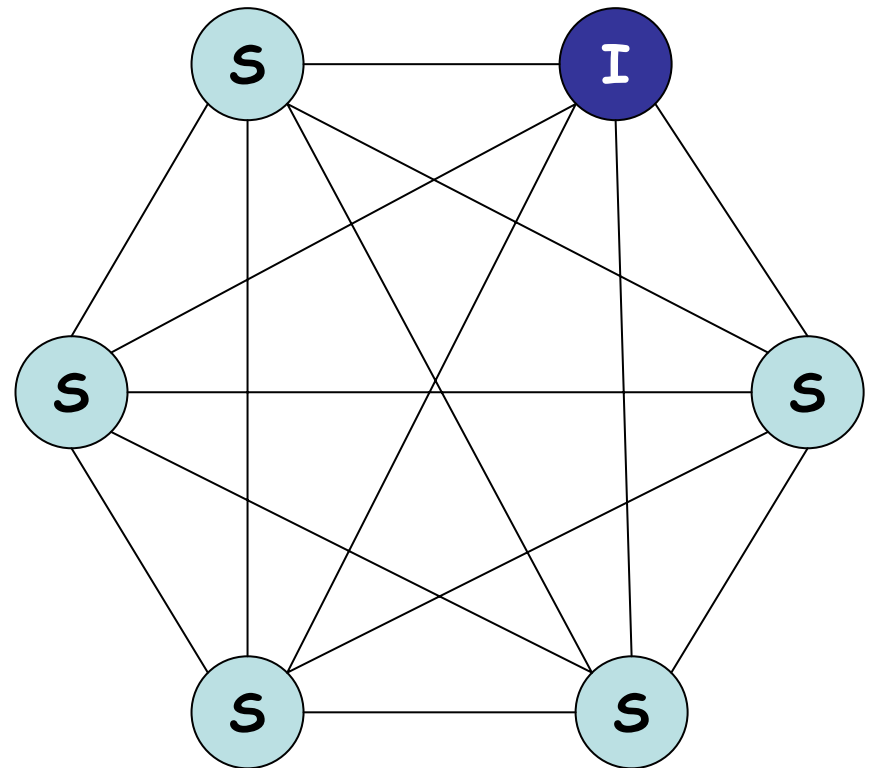
- Improved "Getting Started" instructions
- Kickoff conference call
- More heavily annotated notes
- Streamlined weekly schedule
- Earlier instructor intervention

The Learning Network – Addressing the Instructor Workload Issue

Traditional “Star” Network



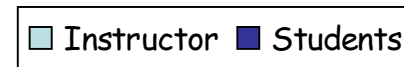
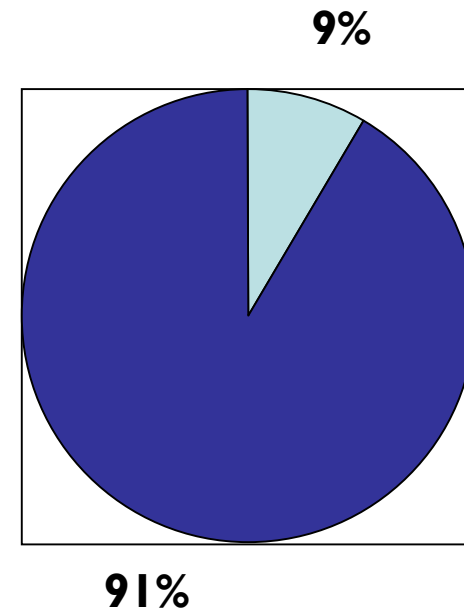
Desired “Node-in-a-Network” Design



Online Pilot Results: Instructors

- More than 90% of discussion messages were posted by students
- A traditional student-instructor dialogue would have required 10 times as many instructor messages

Discussion Messages



SDOE Online – Status

- Online pilot judged to be a successful milestone by both the sponsor and the SDOE Program
- Two follow-on courses underway:
 1. A modified replica of the six week prototype course
 2. A thirteen week full semester course using natural workgroups and actual team projects
- Public offering to be launched in Fall 2003