

Welcome

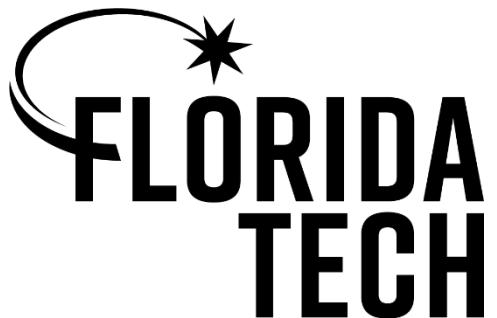
SYS 5460: System Requirements Analysis

Course Admin

- Syllabus
- Assignments
- Overview of CANVAS site
- Available literature
- Software usage
- Expectations and prior work on requirements

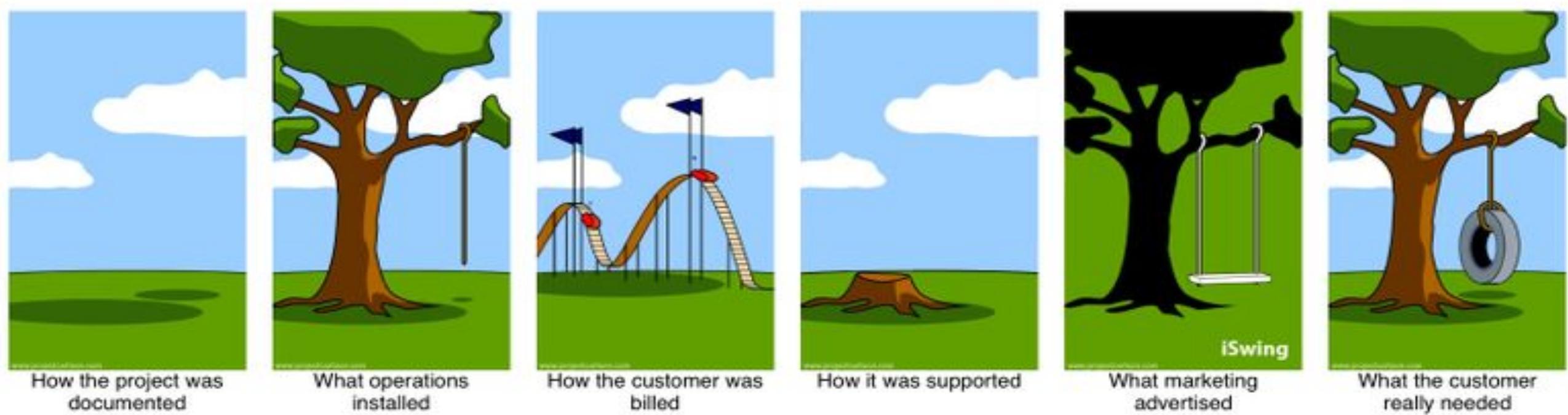
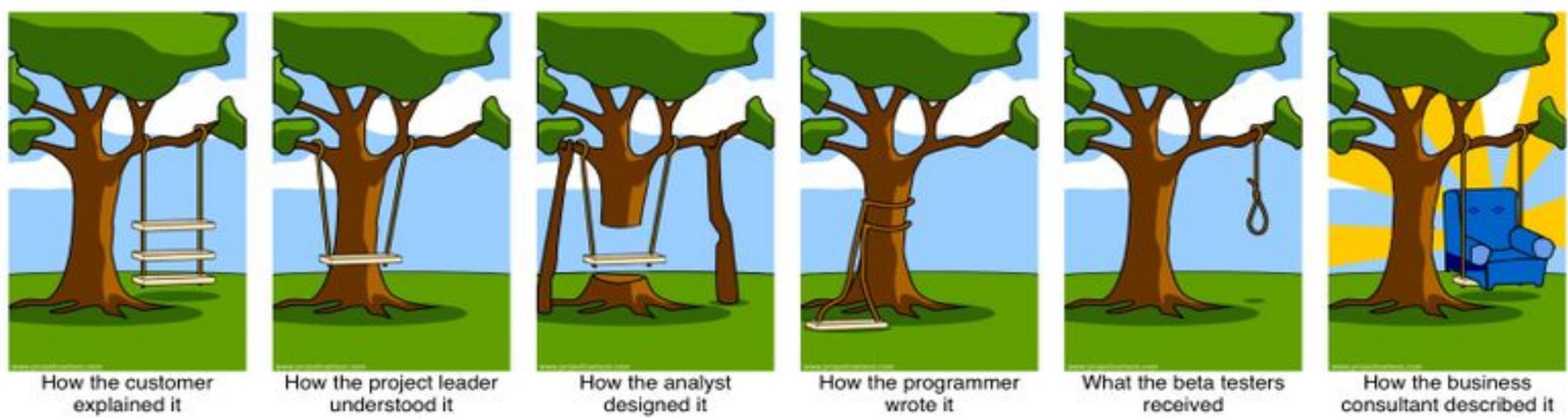
**Department of Computer &
Engineering Sciences**

College of Engineering
Florida Institute of Technology



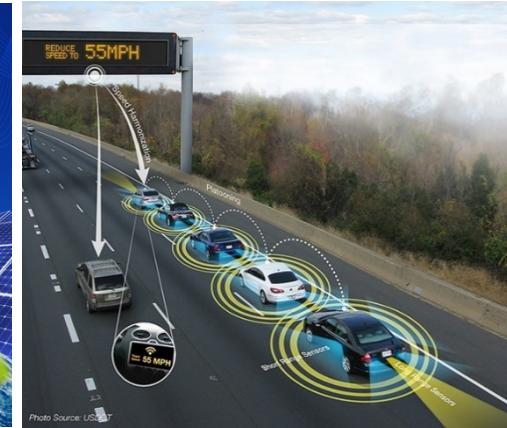
Introduction

- Requirements and Systems Engineering
- Requirement Definition
- Requirements and Project Management
- System Interfaces
- Emergent Properties of a System
- Discussion



Motivation for Systems Engineering

- High expectation for system performance
- Competitive pressure
 - Increased Capabilities
 - Reduced Costs
 - Shorter lifecycles
- Increased complexity, System of Systems
- **Systems engineering** approach used to provide solutions to complex problems



Reasons for Project Failure

* Incomplete requirements	13.1%
* Lack of user involvement	12.4%
Lack of resources	10.6%
* Unrealistic expectations	9.9%
Lack of executive support	9.3%
* Changing requirements/specifications	8.7%
Lack of planning	8.1%
* Didn't need it any longer	7.5%

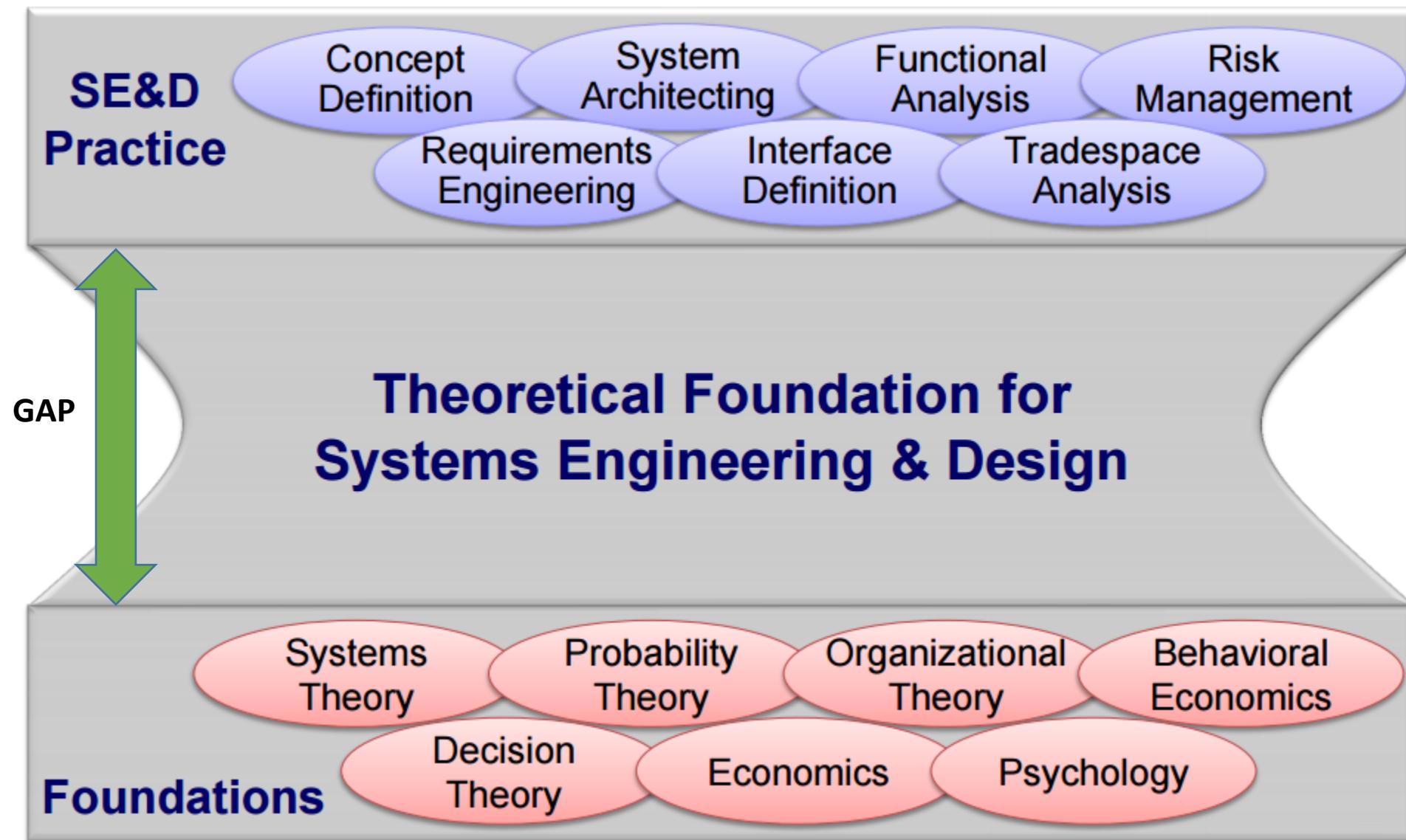
Standish Group 1995 & 1996
Scientific American, Sept. 1994

Reasons for Project Success

* User involvement	15.9%
Management support	13.9%
* Clear statement of requirements	13.0%
Proper planning	9.6%
* Realistic expectations	8.2%
Smaller milestones	7.7%
Competent staff	7.2%
* Ownership	5.3%

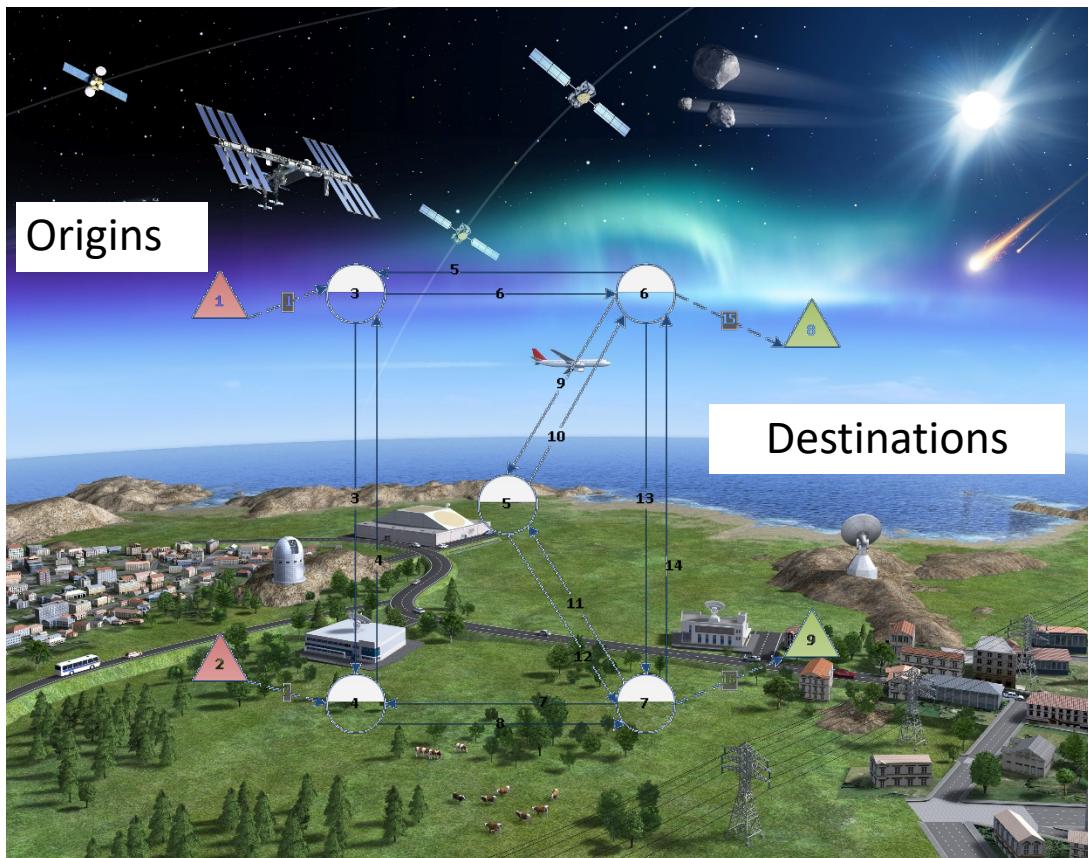
Standish Group 1995 & 1996

Scientific American, Sept. 1994



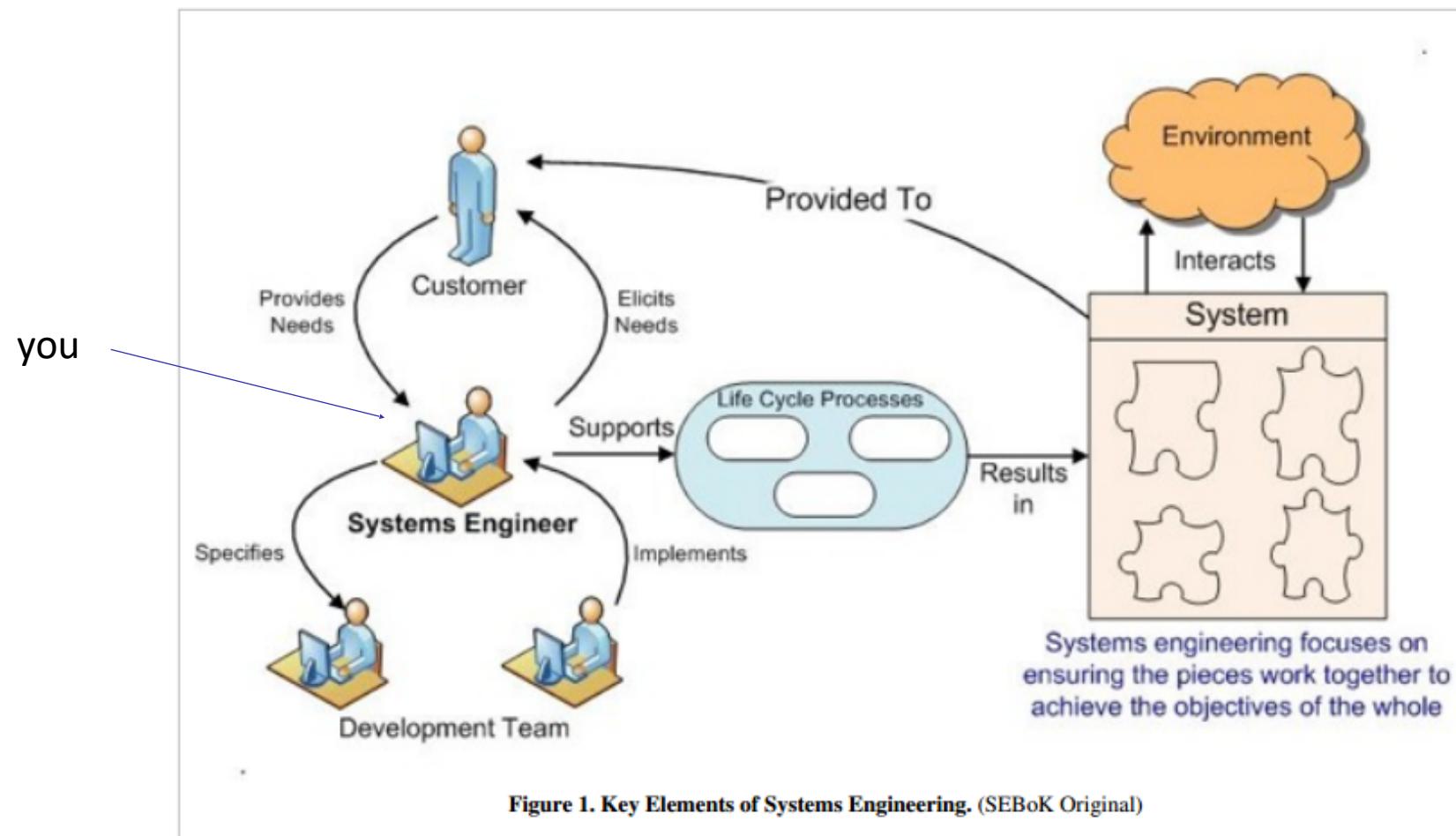
Optimization Model Examples: Optimal Routing

- Consider a communication network consisting of communication links and nodes
- Users need to send data from origin nodes to destination nodes
- A node switches arriving data onto one of the links incident to it
- Routers and protocols are used for these purpose



Systems Engineer

- A systems engineer helps ensure the elements of the system fit together to accomplish the objectives of the whole, and ultimately satisfy the needs of the customers and other stakeholders who will acquire and use the system (SEBoK)

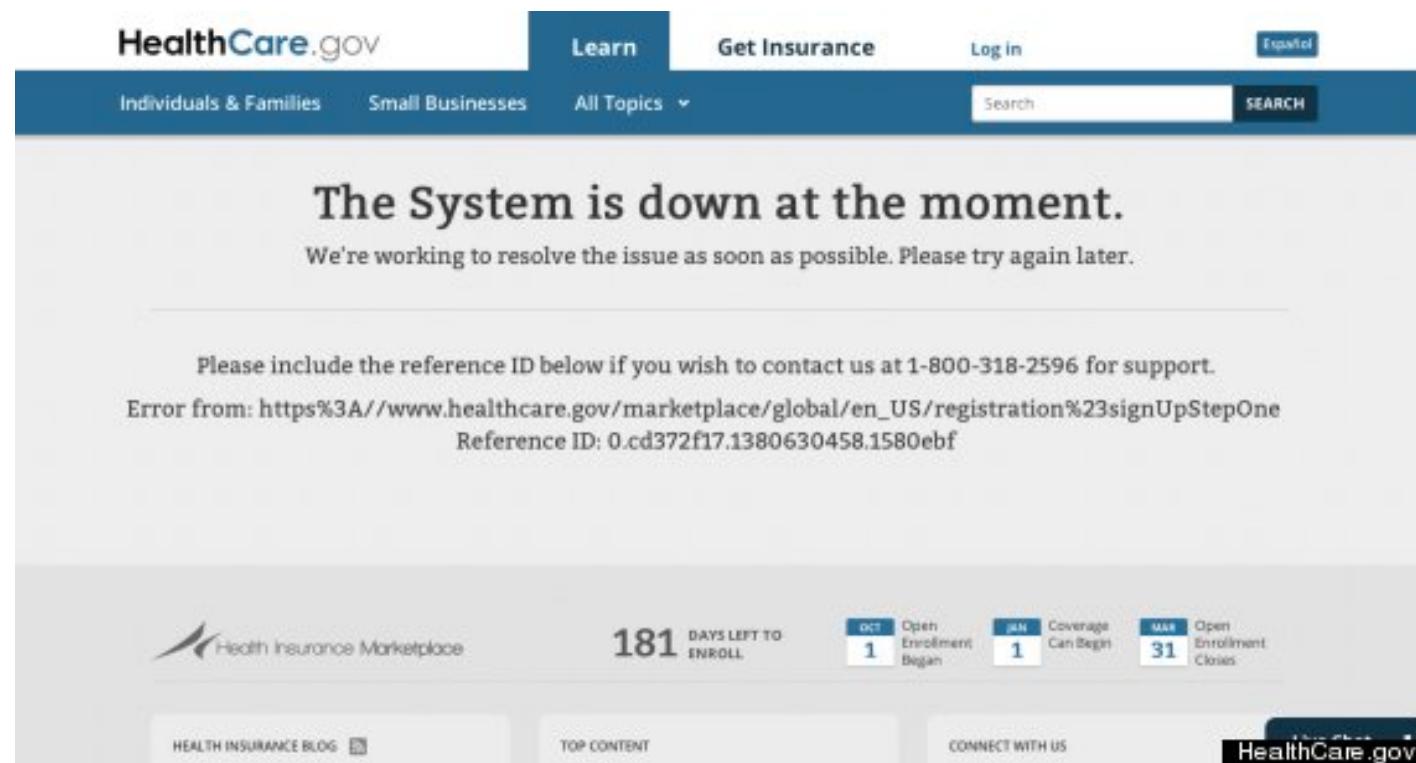


Importance of Requirements

- Requirements Engineering is common sense, but it is perceived to be difficult and is not well understood
- Systems engineering is critical in today's industry and requirements engineering is an important stage of that overall process
- In a global competitive market “**time to market**” and meeting stakeholder requirements are key success factors
- Requirements engineering is also about management. Requirements can be used to manage systems development

Time to Market

- “time to market” is not sufficient.
- The real goal is “time to market with the right product”
- Establishing the requirements enables us to agree on and visualize the “right product”.



Requirements - Importance | TTM

- Time to market must couple with the right product
- Establishing the requirements enables us to agree on and visualize the right product



- What requirement was missing?

Requirements - Importance | TTM

- Time to market must couple with the right product
 - Establishing the requirements enables us to agree on and visualize the right product



Credit: TheBITLINK

- What requirement was missing?

Requirements - Importance | TTM

- Time to market must couple with the right product
- Establishing the requirements enables us to agree on and visualize the right product



Credit: TNOK_GARDEN

- What requirement was missing?

IEEE-STD-1220-1998:

- Requirement: a /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/ (by consumers or internal quality assurance guidelines).

Definition of Requirements (2)

- **Statement:** a set of traceable, manageable elements identified as requirements.
Requirements can be captured in tabular form, in diagrammatic form in notations such as UML or in domain-specific notations
- **Product or process:** Complete solutions contain varying mixtures of product (things that are built in response to requirements) and process (procedures for using the things that are built).

- **Operational, functional, or design characteristic or constraint:** There are many different kinds of requirement, giving rise to different kinds of language, analysis, modelling, process and solution. Design characteristics cover performance, usability, safety, Maintainability and a host of other qualities.
- **Unambiguous:** A requirement should lend itself to a clear, single understanding, common to all parties involved.
- **Testable or measurable:** Requirements are used to test that the design or solution is acceptable. For this to be possible, the requirement should be quantified, thus providing a means of “measuring” the solution against it.

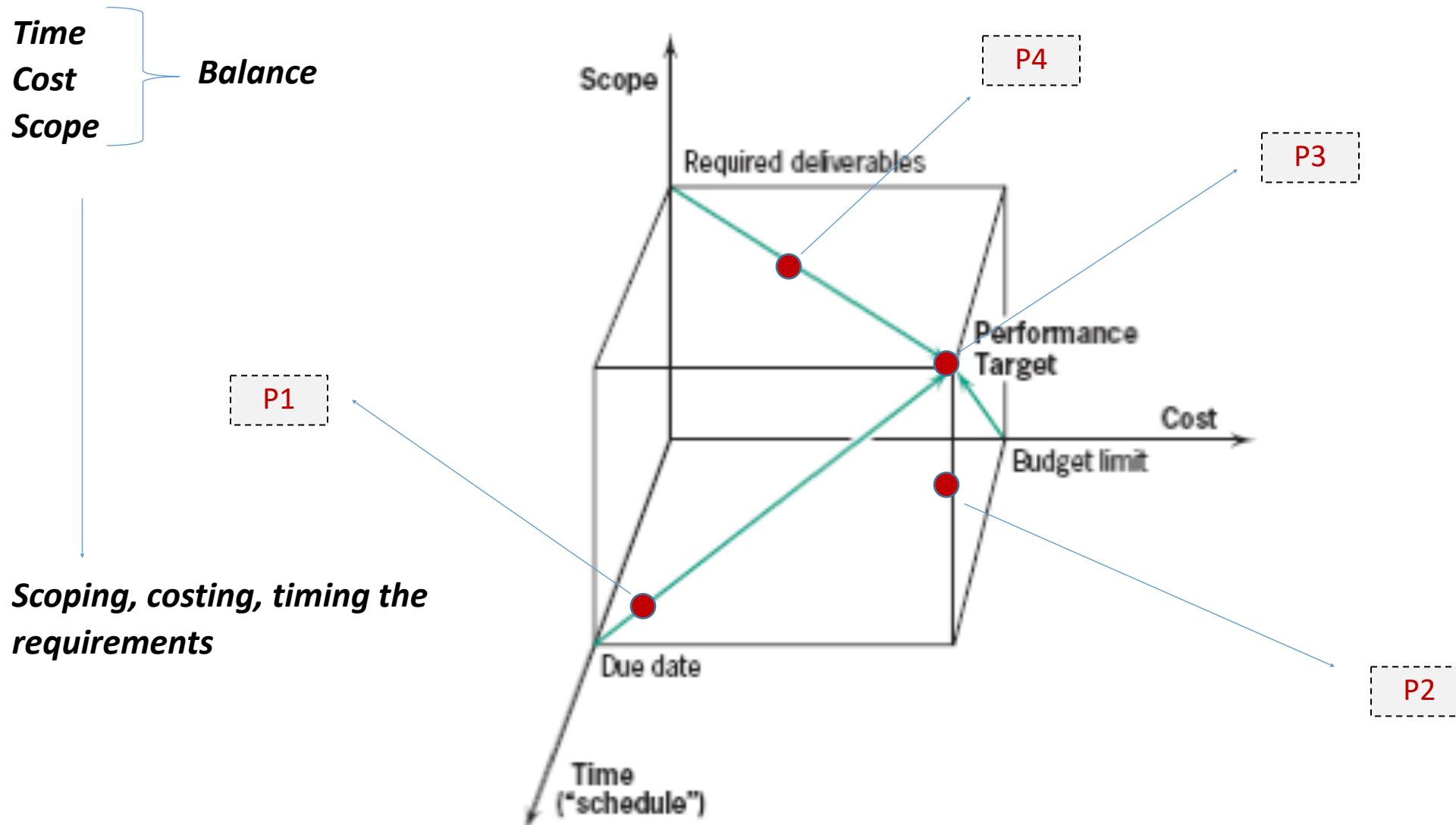
Definition of Requirements (4)

- **Necessary for product or process acceptability:** define how the solution should be tested and accepted. Requirements have an influence in the earliest stages of the development process as well as in the latest stages during acceptance
- **By consumers or internal quality assurance guidelines:** Requirements come from many sources (stakeholders), including but not limited to customers, regulatory bodies, users and internal quality procedures latest stages during acceptance.

- Requirements are essential part of System Engineering Process and Management:
 - They are basis for:
 - Project planning
 - Risk management
 - Acceptance testing
 - Tradeoffs
 - Change control
 - Cost analysis
 - Etc.
- 
- Requirements management

PM vs. Requirements Management

planning, monitoring, analyzing, communicating, and controlling requirements



Is a collection of components which cooperate in an organized way to achieve some desired result → based on REQUIREMENTS

[ISO/IEC 15288]: is a “man-made” or natural combination of elements that are physical and/or abstract and are functioning in harmony. “It may be configured with one or more of the following: hardware, software, data, humans, processes, procedures, facilities, materials and naturally occurring entities”. Systems are classified according to their scope and nature as:

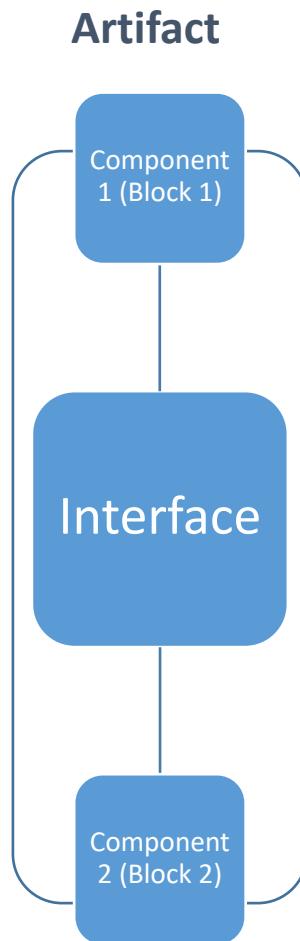
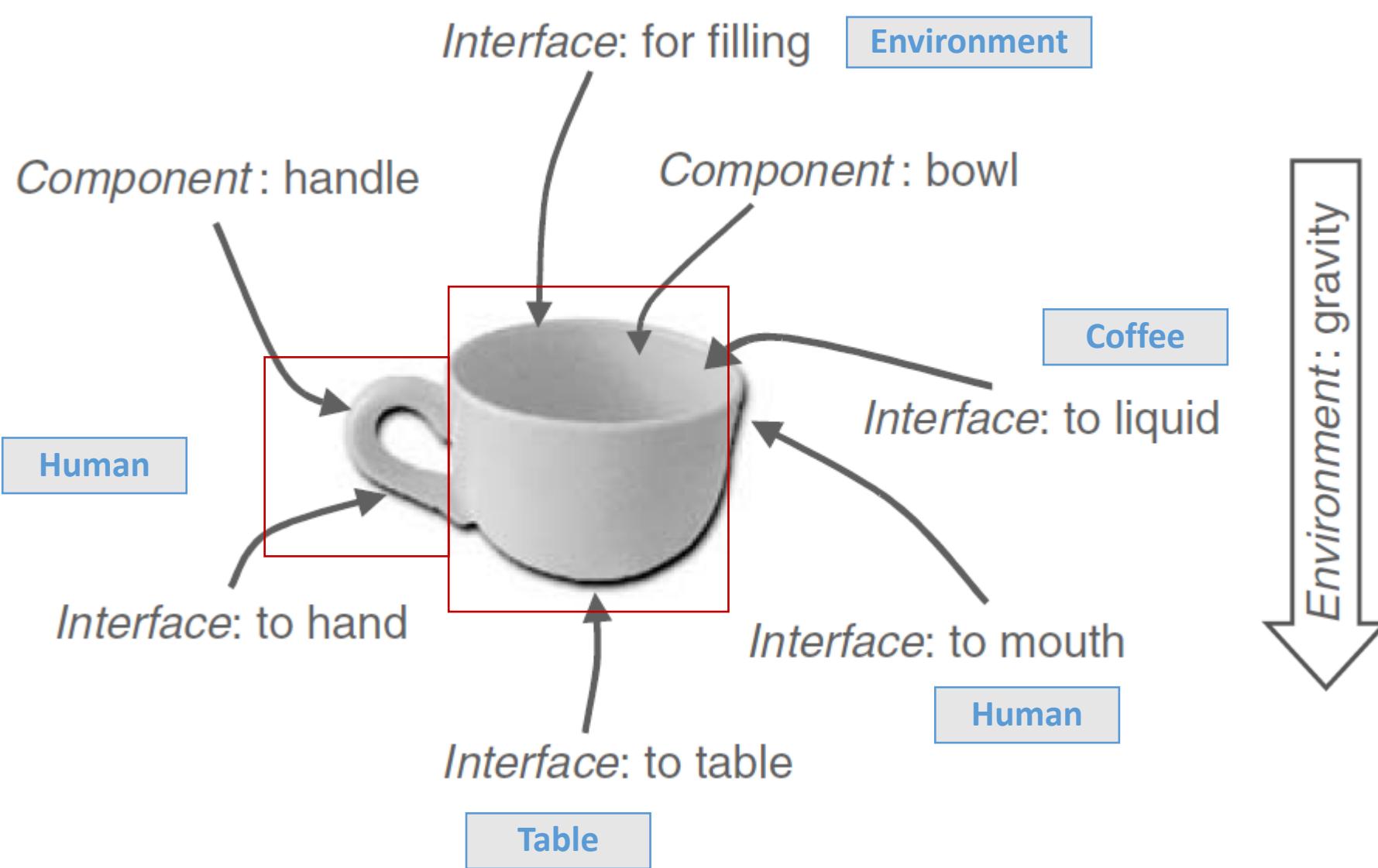
Natural System – “elements, objects or concepts which exist outside of any practical human control. Examples: the real number system, the solar system, planetary atmosphere circulation systems.”

Social System – “elements, either abstract human types or social constructs, or concrete individuals or social groups”.

Technological System – “elements, man-made artifacts or constructs; including physical hardware, software and information”.

SEBOK, INCOSE

Requirements - Example A Cup Viewed as a System



Emergent Properties of a System

- The usefulness of a system does not depend on any particular part of the system, but emerges from the way in which its components interact
- **Emergent properties** may be **desirable**, in that they have been anticipated and designed into the system so as to make the system useful
- **Emergent properties** maybe **undesirable**, unanticipated side effects
- The challenge in systems engineering is to be able to harness desirable emergent properties and avoid the undesirable ones
- Tools to discover emergent properties:
 - Design process
 - VR Simulations
 - HITAL Simulations
 - System use

Cars can be hacked by their tiny, plug-in insurance discount trackers



Karl Koscher and Ian Foster remotely hack a Corvette by tapping into its tracker dongle -- the same used by major insurance companies.

By Jose Pagliery @Jose_Pagliery

Most Popular



Donald Trump calls out Mark Zuckerberg on immigration



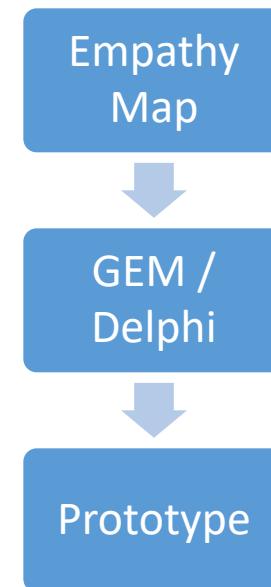
American Apparel warns it may go out of business



UK to test new roads that charge cars as they drive

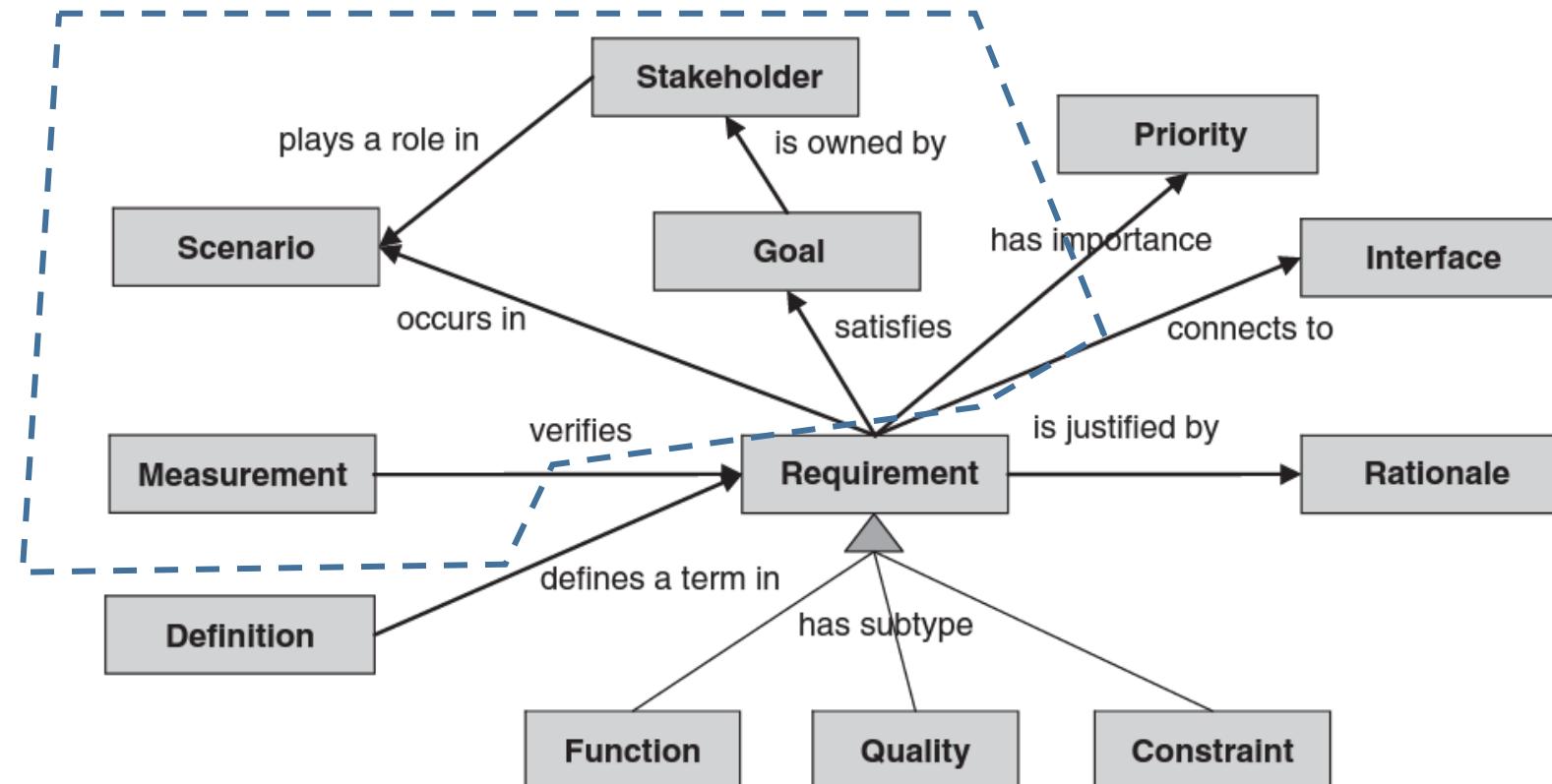
Requirements are created by collaborative work:

- “Discovered, not found”
- “People do not know what they want, it is not enough to ask them”
- Work steadily with the stakeholders towards their goals
- Prototype and test and discover
- Use different techniques



Complementary Views of Requirements

- Requirements cannot be observed or asked for from the users, but have to be created together with all the stakeholders
- People do not know what they want either, so it isn't enough just to ask them
- Use cases do not cover everything



(Alexander,2009)

Questions

Department of Computer & Engineering Sciences

College of Engineering

Florida Institute of Technology

