



Innovation and Technology Management

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Innovation and Technology Management

Goals

Present a systematic approach to innovation and technology management using a generic systems engineering process.

Discuss differences between incremental and disruptive technologies.

Evaluate open source software technology as a disruptive technology.

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Overview

Define Terms

Outline FRAT Process

Discuss:

Organization Research & Development Function

Product System Innovation

Environment System Innovation

New Technology Development and Innovation

Summary and Conclusions: **The product and the product production process should be combined for evaluation - from both an innovation and a management perspective.**

Define Terms

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Define Terms

Technology:

“... the skill, knowledge, experience, body of scientific knowledge, tools, machines, computers, and equipment that are used in the design, production, and distribution of goods and services.”

Innovation:

“... the application of technological change to products and organizations.”

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A Problem Solving Meta Process

Define problem

- What is the problem?
- Who needs to have it fixed?
- Why does it need to be fixed?

INPUT

Constraints - External Environment

Determine **WHAT** is needed to fix problem

- What has to be done?
- How well does it have to be done?

WHAT

Functional Analysis, Requirements

Decide **HOW** to fix the problem

- What are various ways to do it?
- What way will you use to fix the problem, why?
- When done, is the original problem fixed?
- Has the best way been used to fix the problem?

HOW

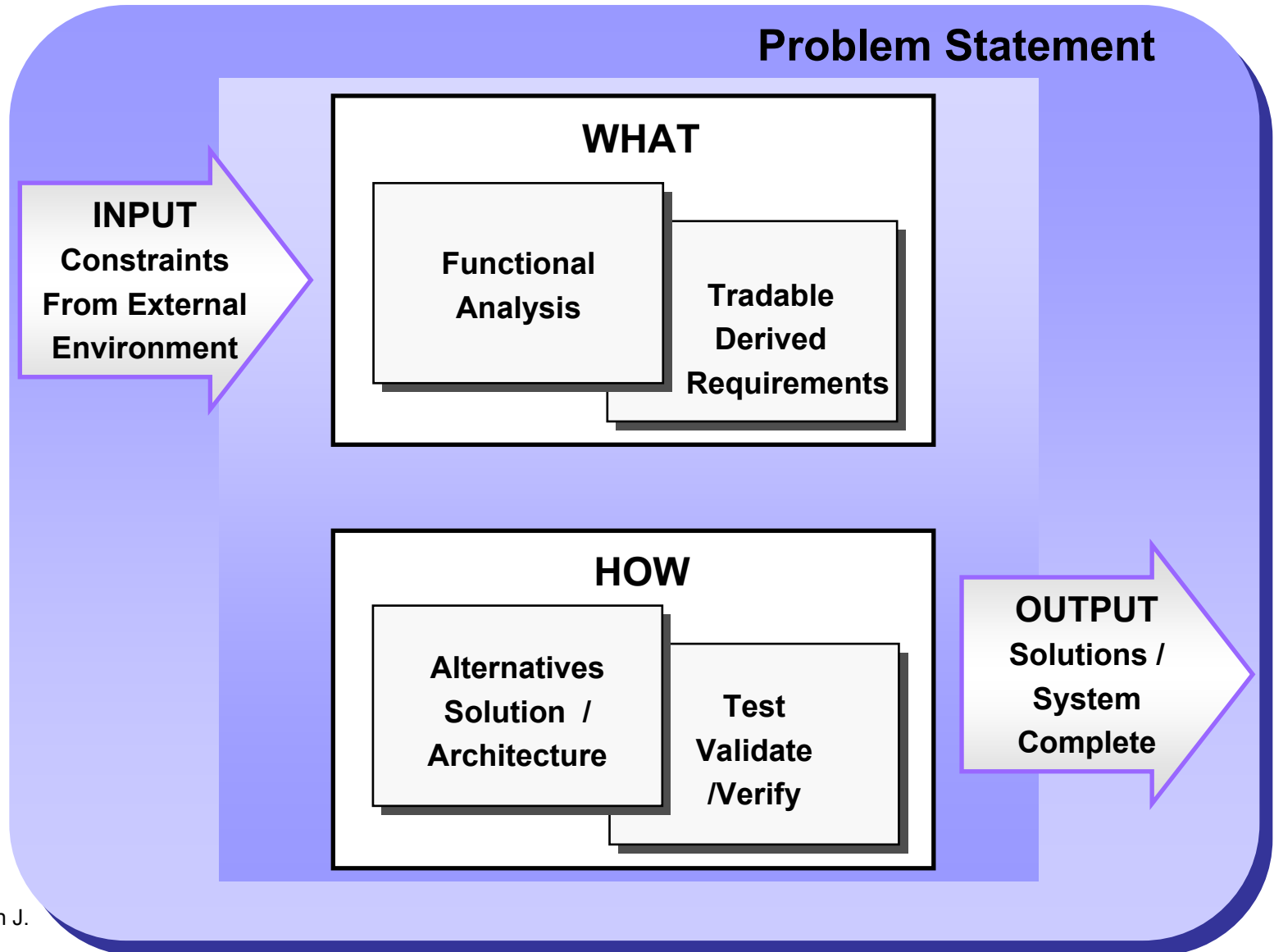
Alternatives, Solution Verification, Validation

Solve problem; provide solution to customer

OUTPUT

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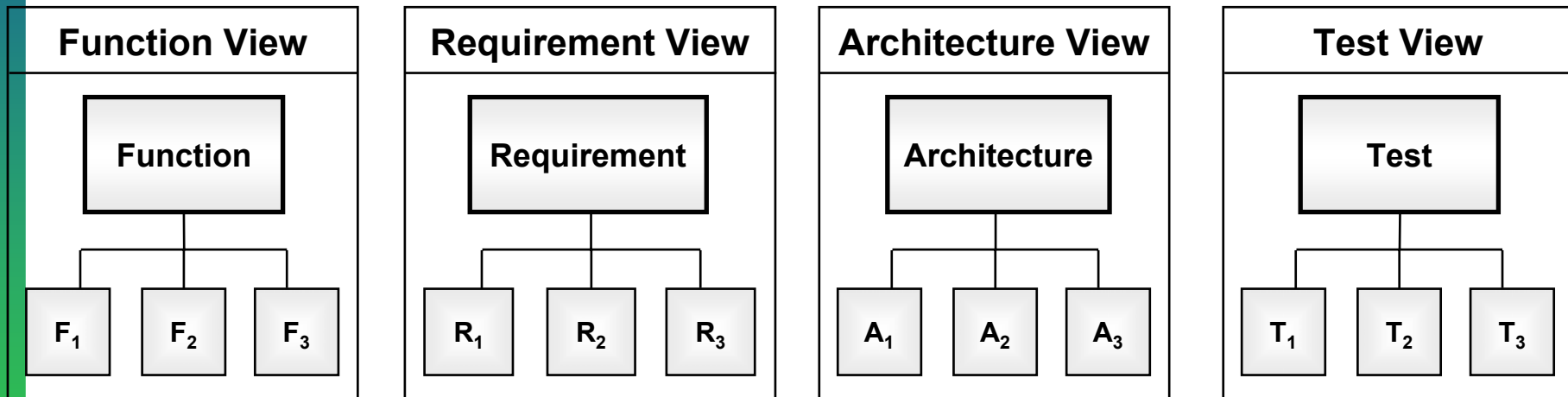
Meta Process in SE Notional Format



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FRAT - System Views*

Any system must be expressed in four views

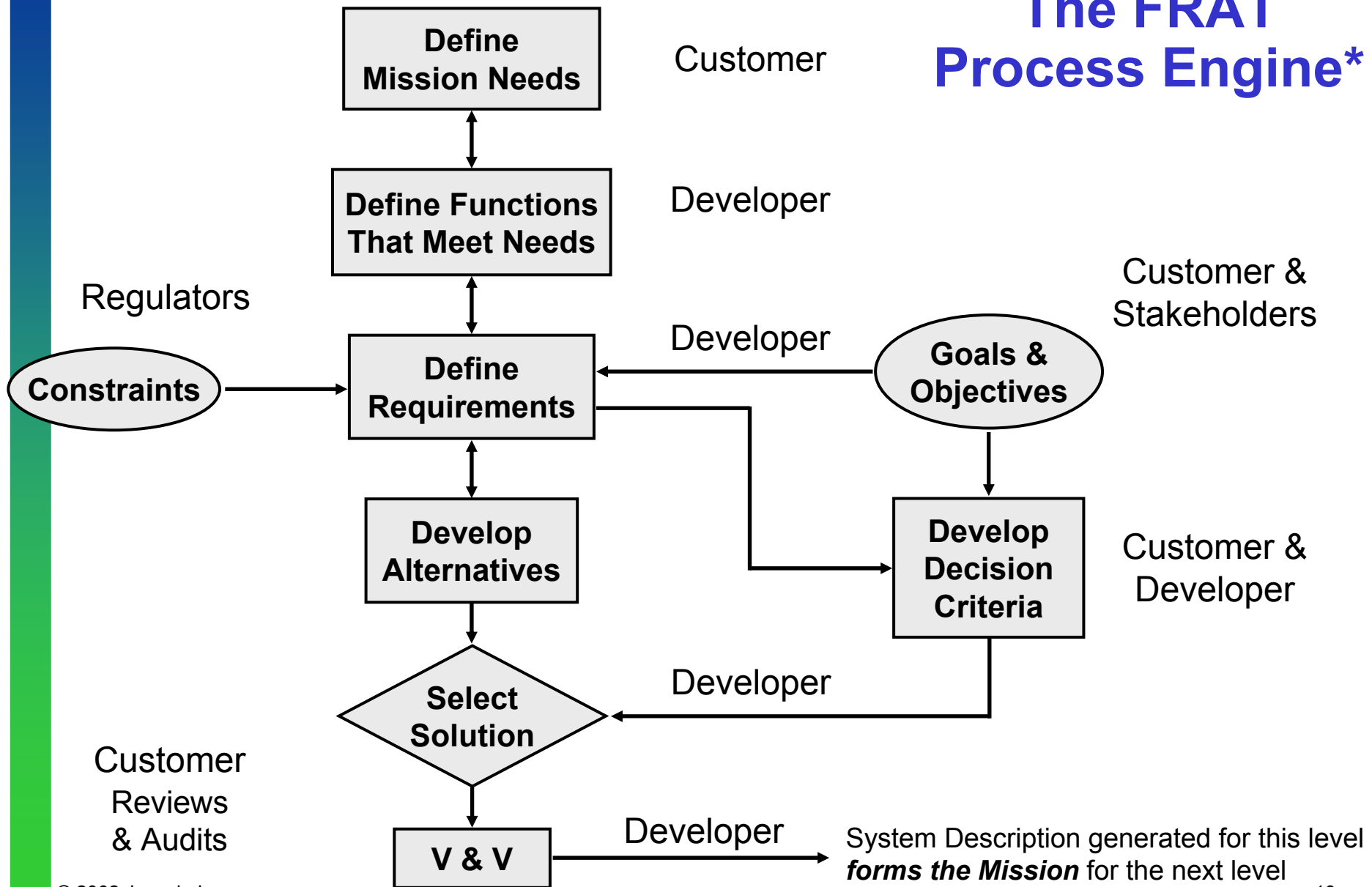


* Mar & Morais

Outline FRAT Process

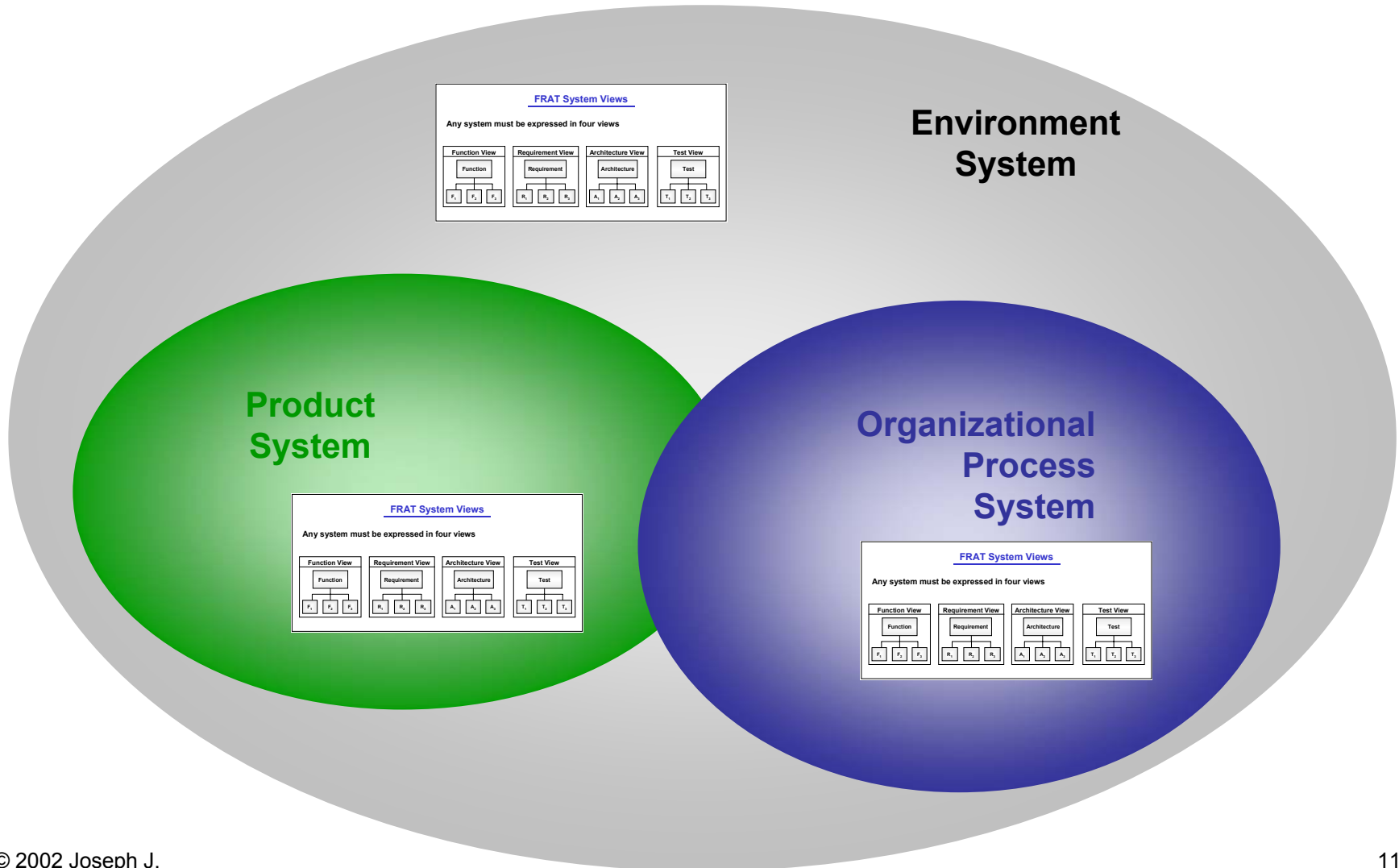
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The FRAT Process Engine*



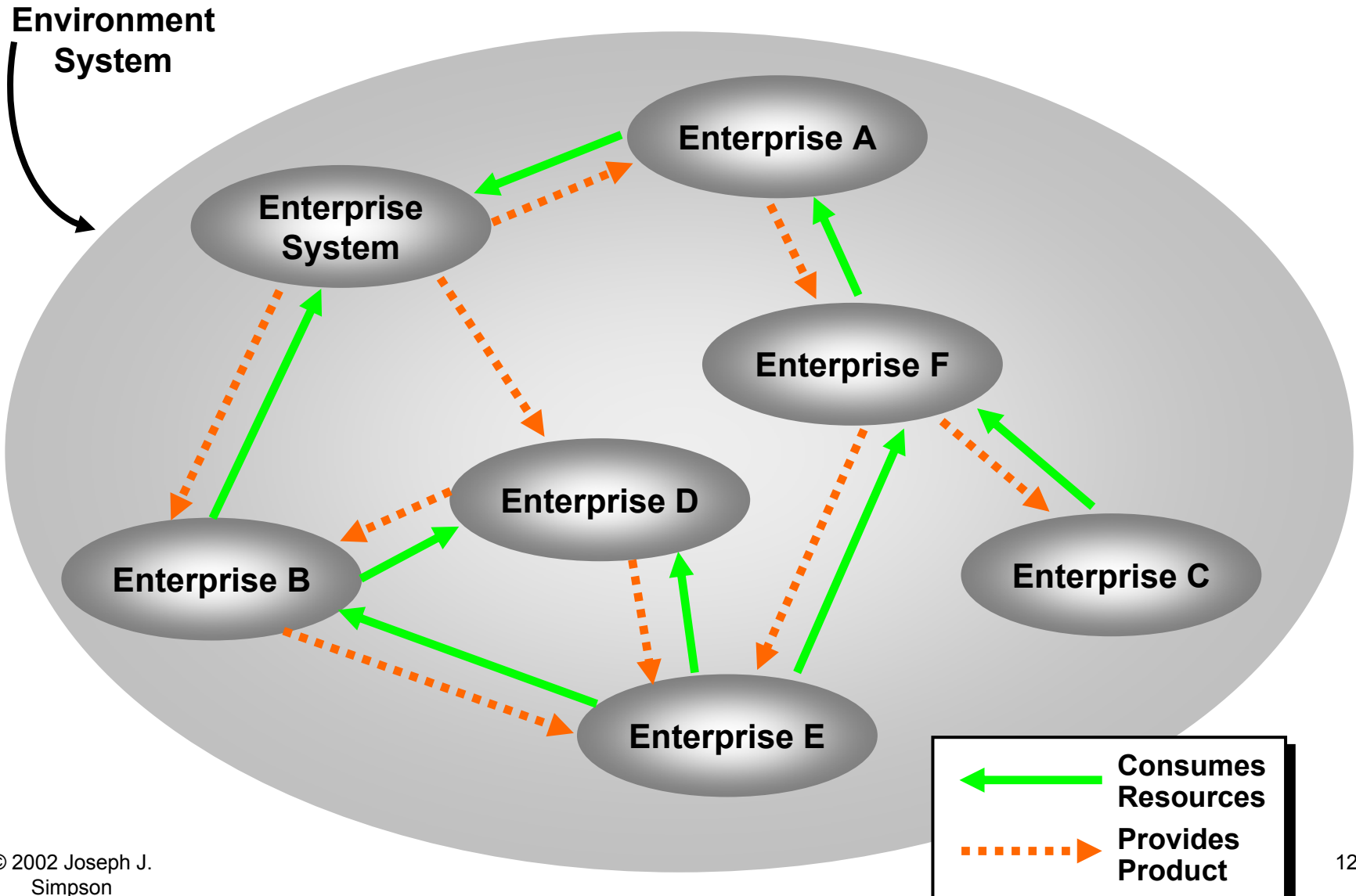
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FRAT Concepts



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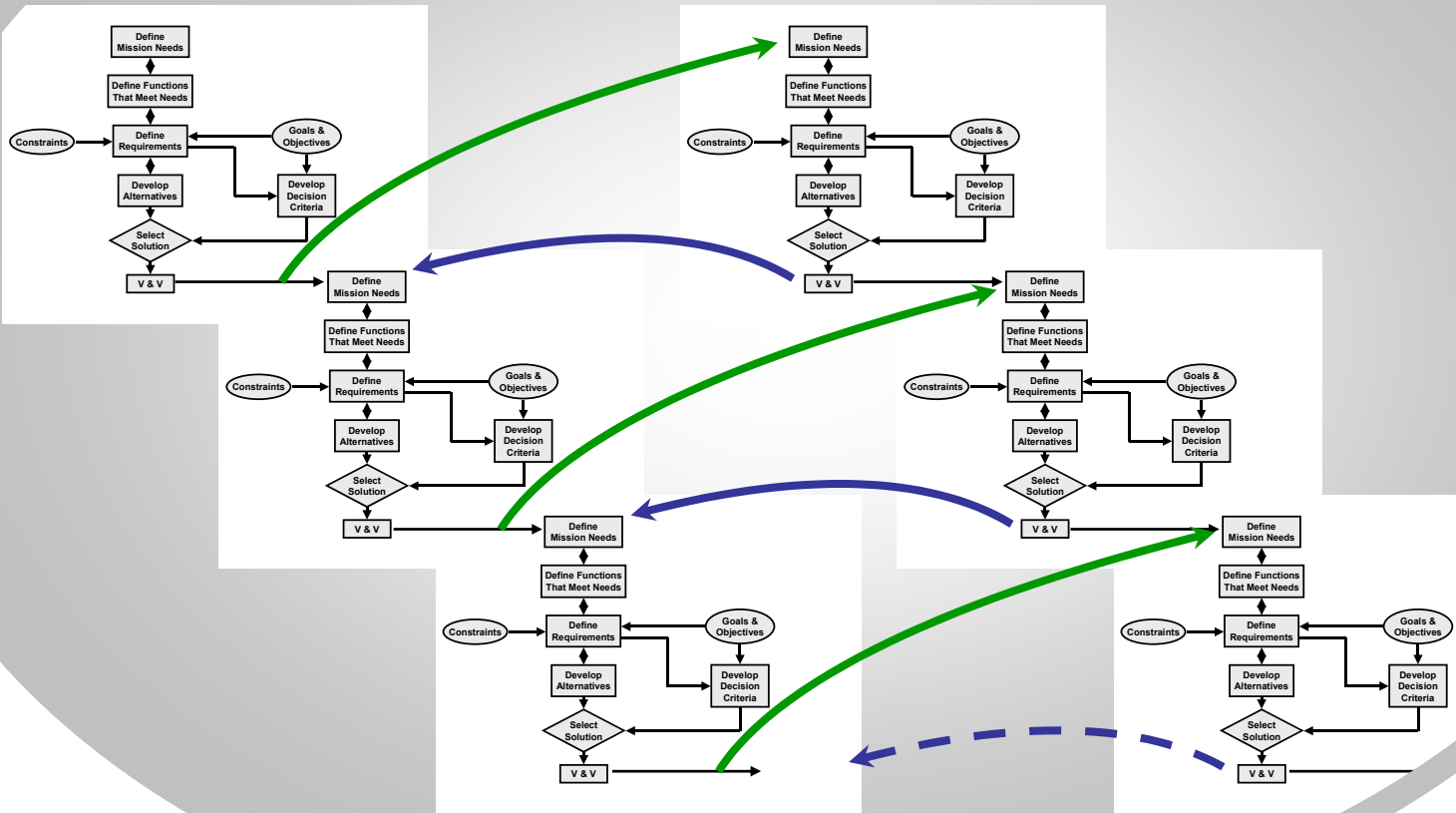
Value Network



Generic Enterprise is Composed of

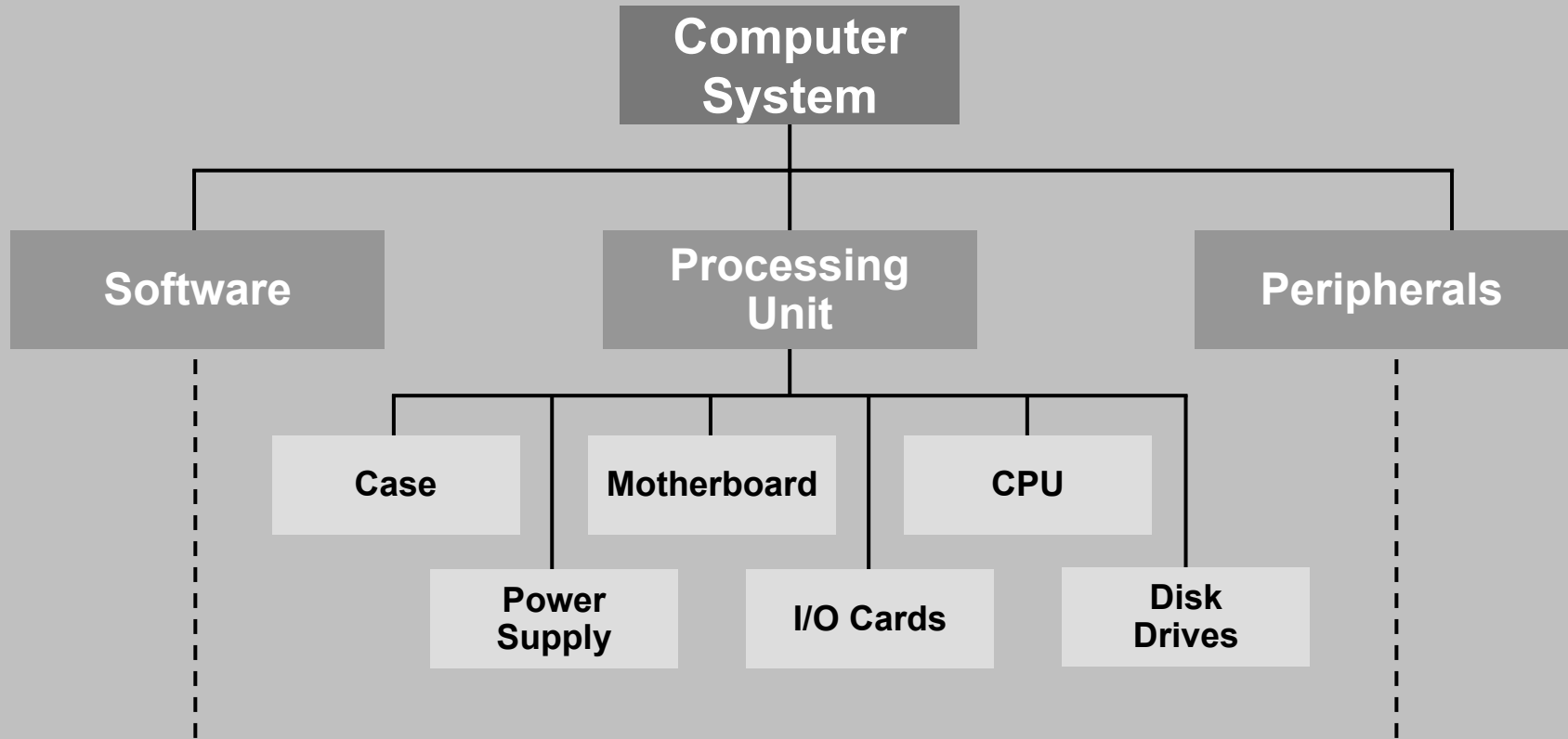
Product System

Process System



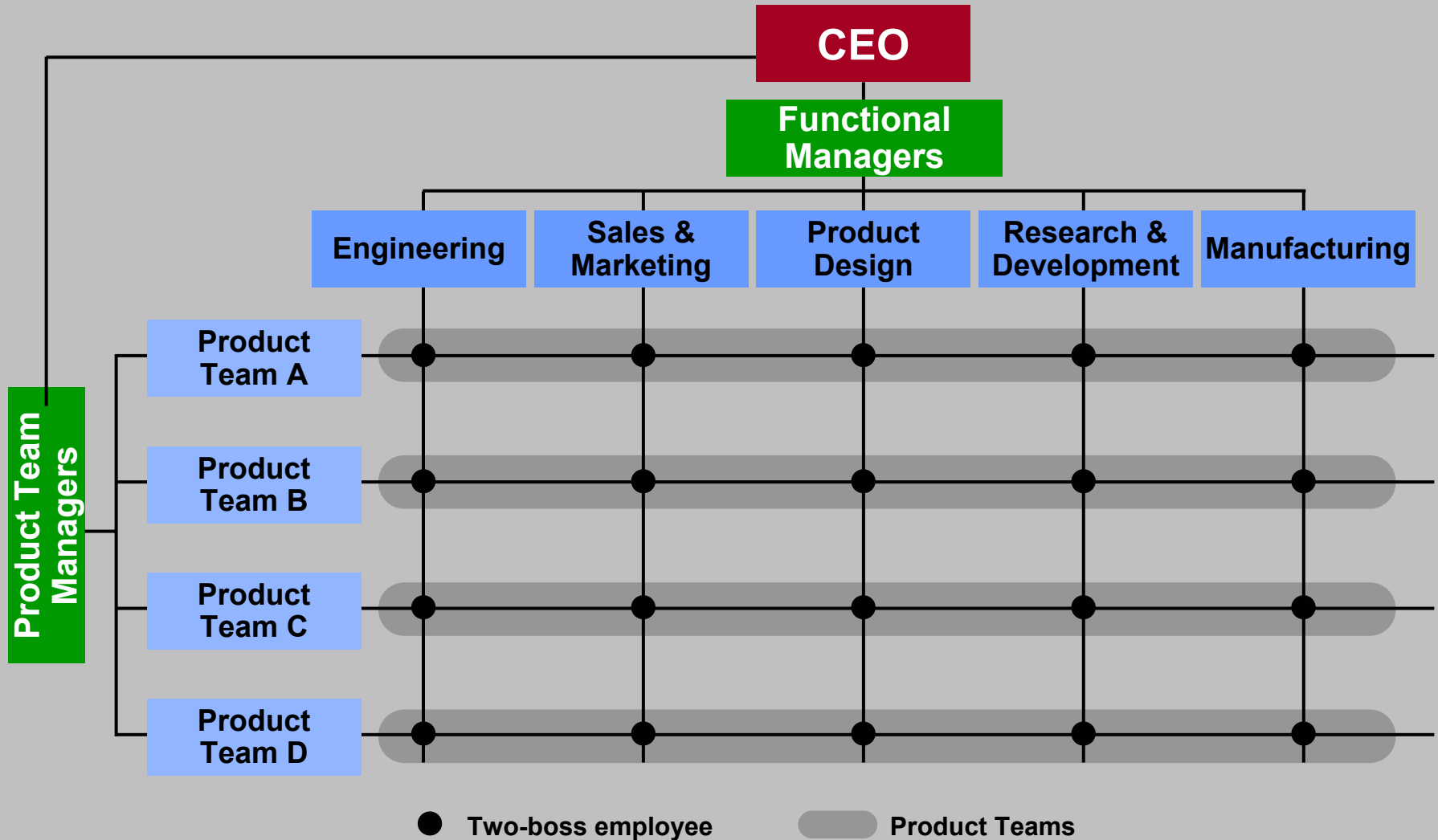
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Product Architecture



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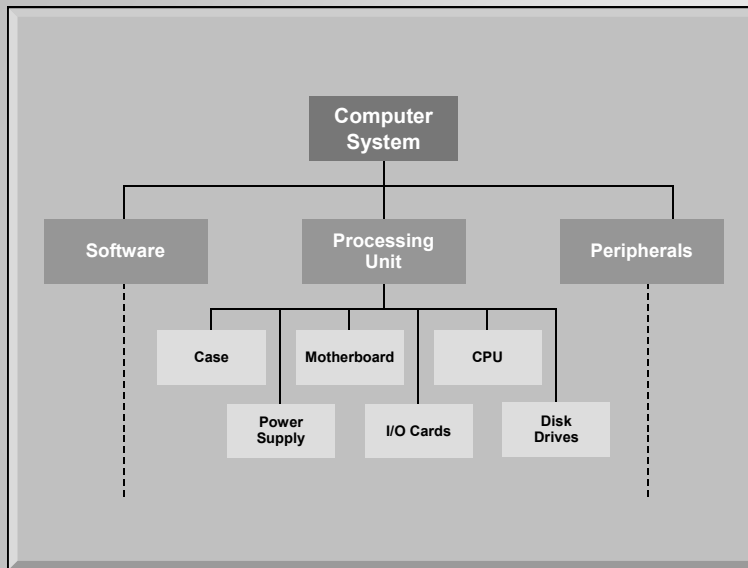
Organizational Architecture



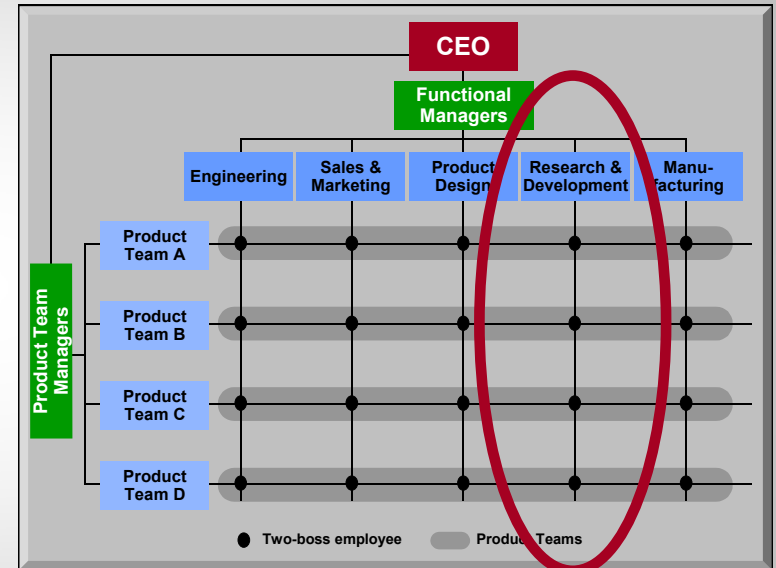
A. Organizational System - Research and Development Approach

Generic Enterprise Architecture

Product Architecture



Organizational Architecture



The Smart Organization, creating value through strategic R&D, by Matheson, David and Matheson, Jim addresses

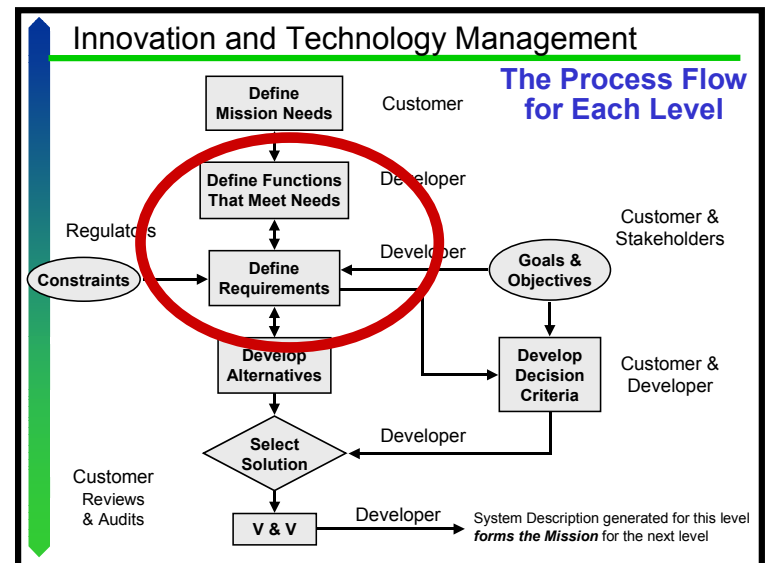
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Organizational System Functions & Reqts

Organizational Principles for R&D

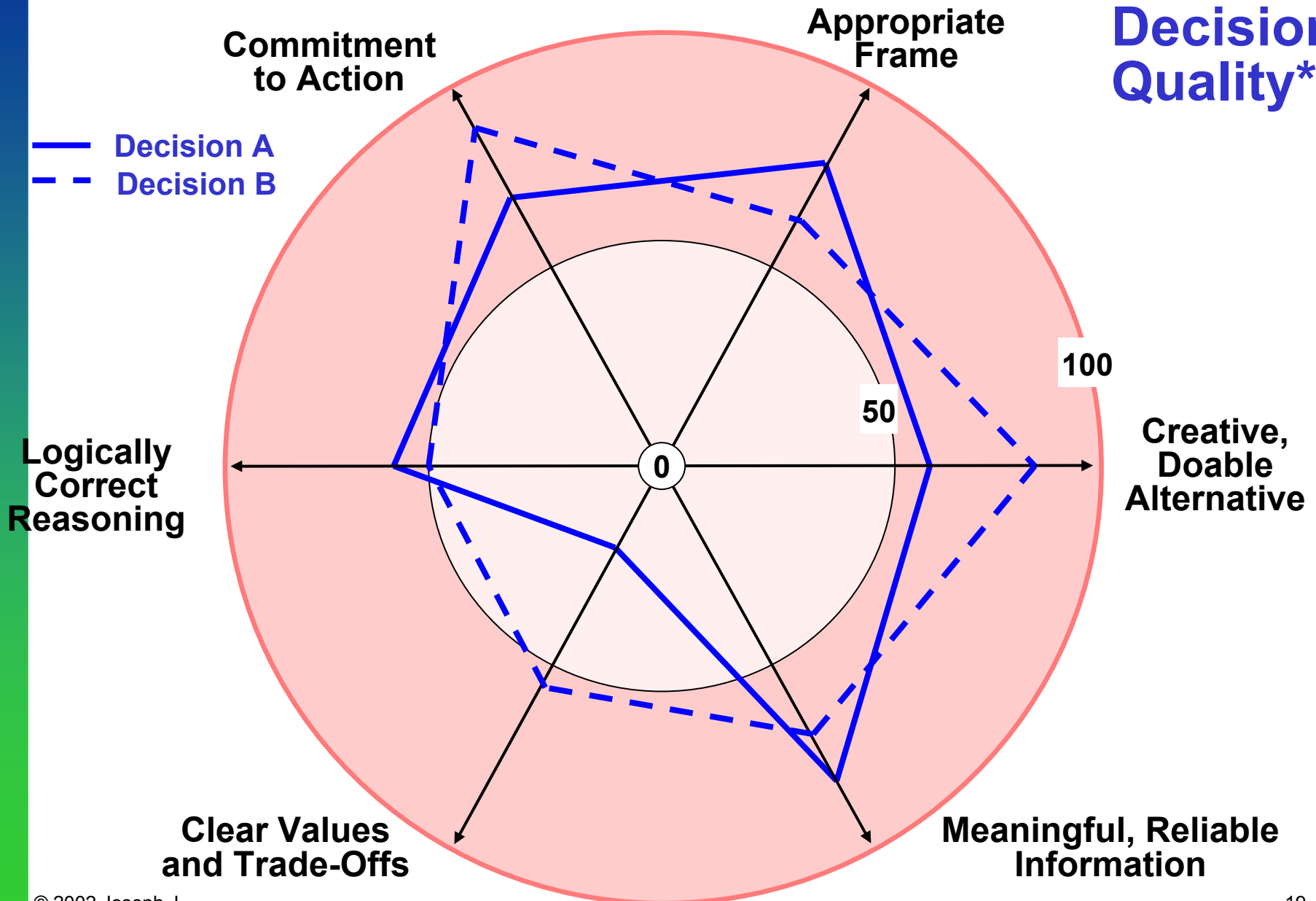
1. Maintain a value creation culture
2. Develop decision alternatives
3. Commitment to continual learning
4. Embrace uncertainty
5. Maintain an outside-in perspective
6. Use systems thinking
7. Ensure open information flow
8. Achieve alignment and empowerment
9. Institute disciplined decision-making

The principles cluster around the functions and requirements areas within the process flow



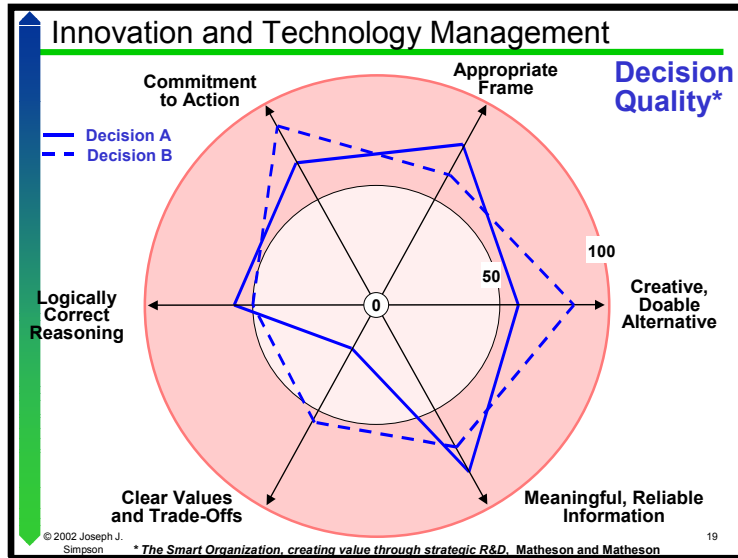
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Decision Quality*



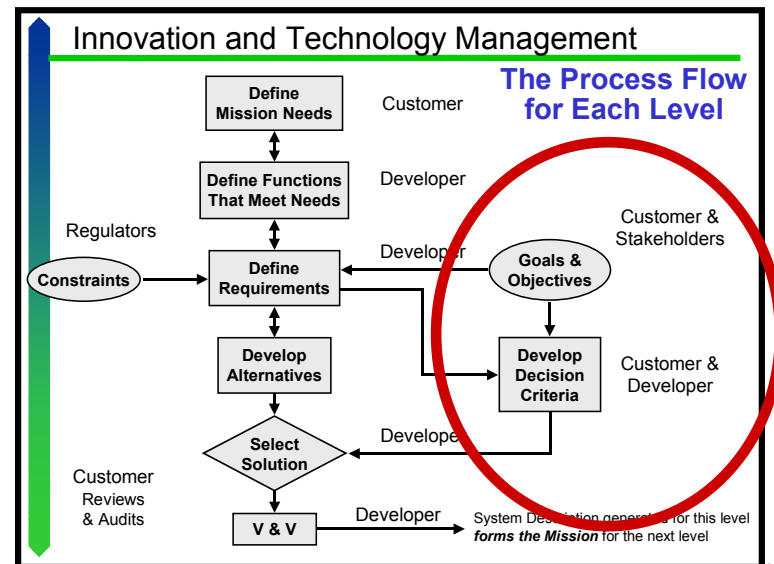
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Organizational Decision Quality



The decisions cluster around the goals, objectives and decision criteria within the process flow

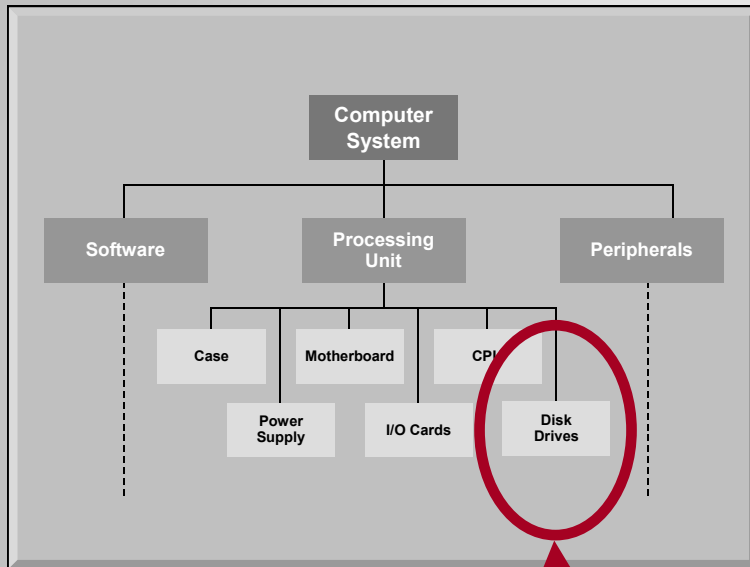
These decision quality metrics are applied primarily to the research and development function of the enterprise



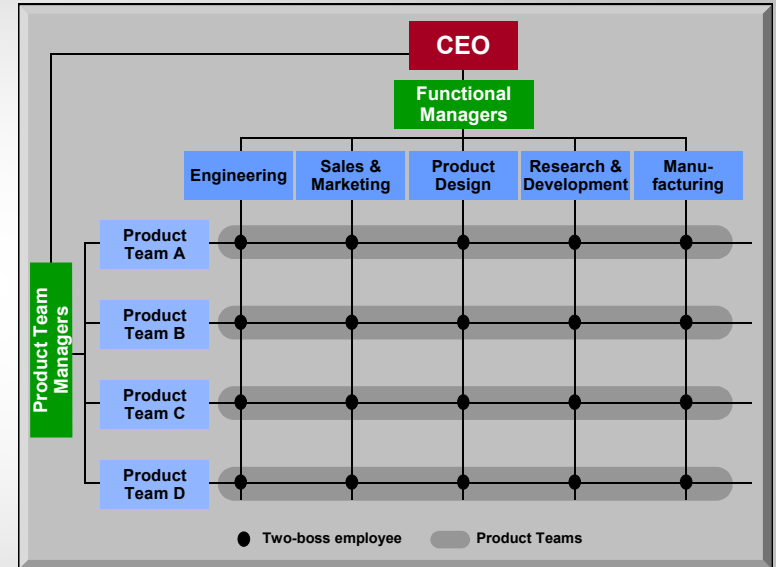
B. Product System Innovation Management

Generic Enterprise Architecture

Product Architecture



Organizational Architecture



The Innovators Dilemma by Clayton M. Christensen addresses

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Two Technology Types: Incremental / Disruptive*

Established companies lead in the incorporation of *incremental technology* into their products, almost 100 percent of the time.

Disruptive technology is not often successfully deployed by market leading firms.

Example Product Systems That Incorporated Both Types

- Steel Milling and Production
- Mechanical Excavator
- Disk Drive
- Motorcycle

Open Source Software is offered as a recent example of a disruptive technology

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Disruptive Technology Characteristics

The innovation enables *less-skilled or less-wealthy customers to do for themselves* things that only the wealthy or skilled intermediaries could previously do

The innovation targets *customers* at the low end of a market *who don't need all of the functionality* of current products; the business model enables the *disruptive innovator to earn attractive returns at discount prices* unattractive to the incumbents

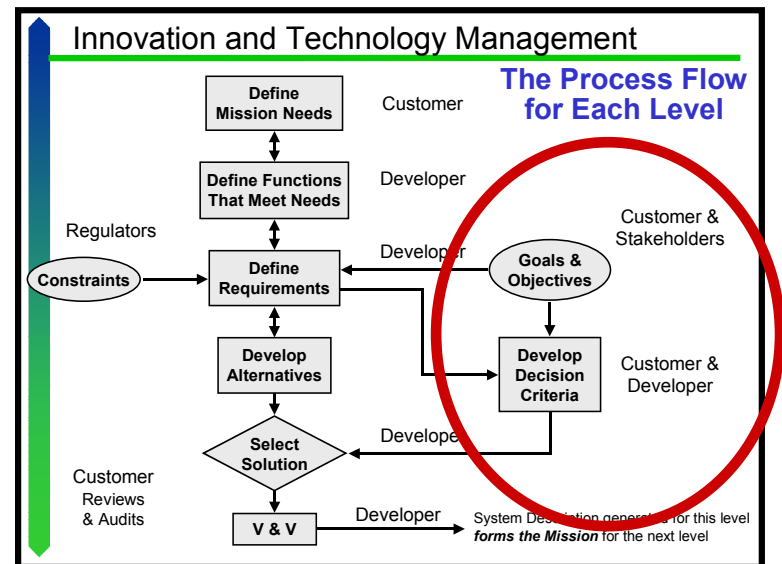
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Product System Values & Distribution Rights

Open Source Disruptors

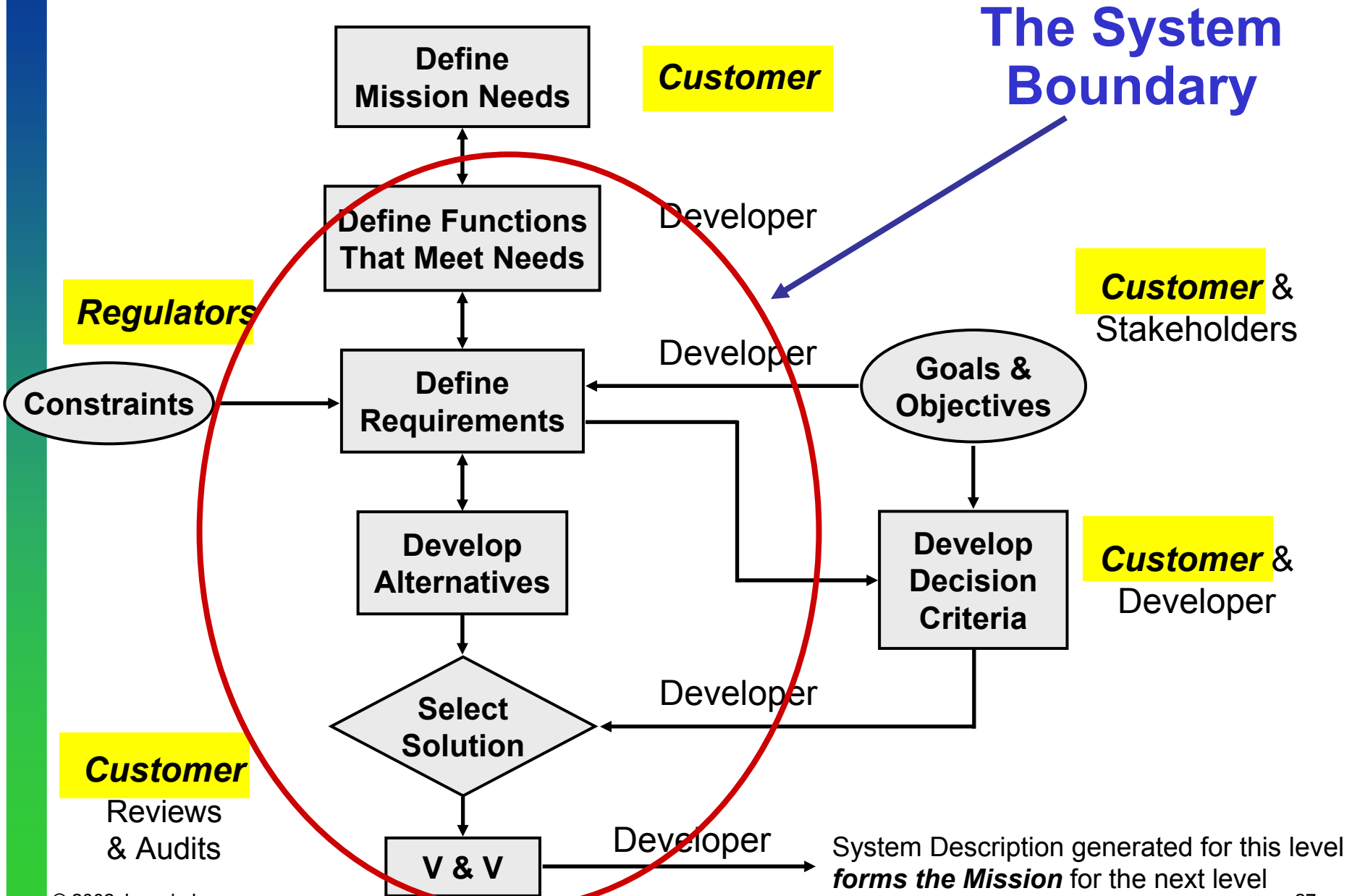
- Free distribution of source code
- Ability to modify code and redistribute
- Ability for anyone to participate
- Product freely available on internet
- Provide basis for new business models
- Encourages rapid code improvement
- Serves the needs of many customers

The disruptors cluster around the goals, objectives, decision values & criteria within the process flow



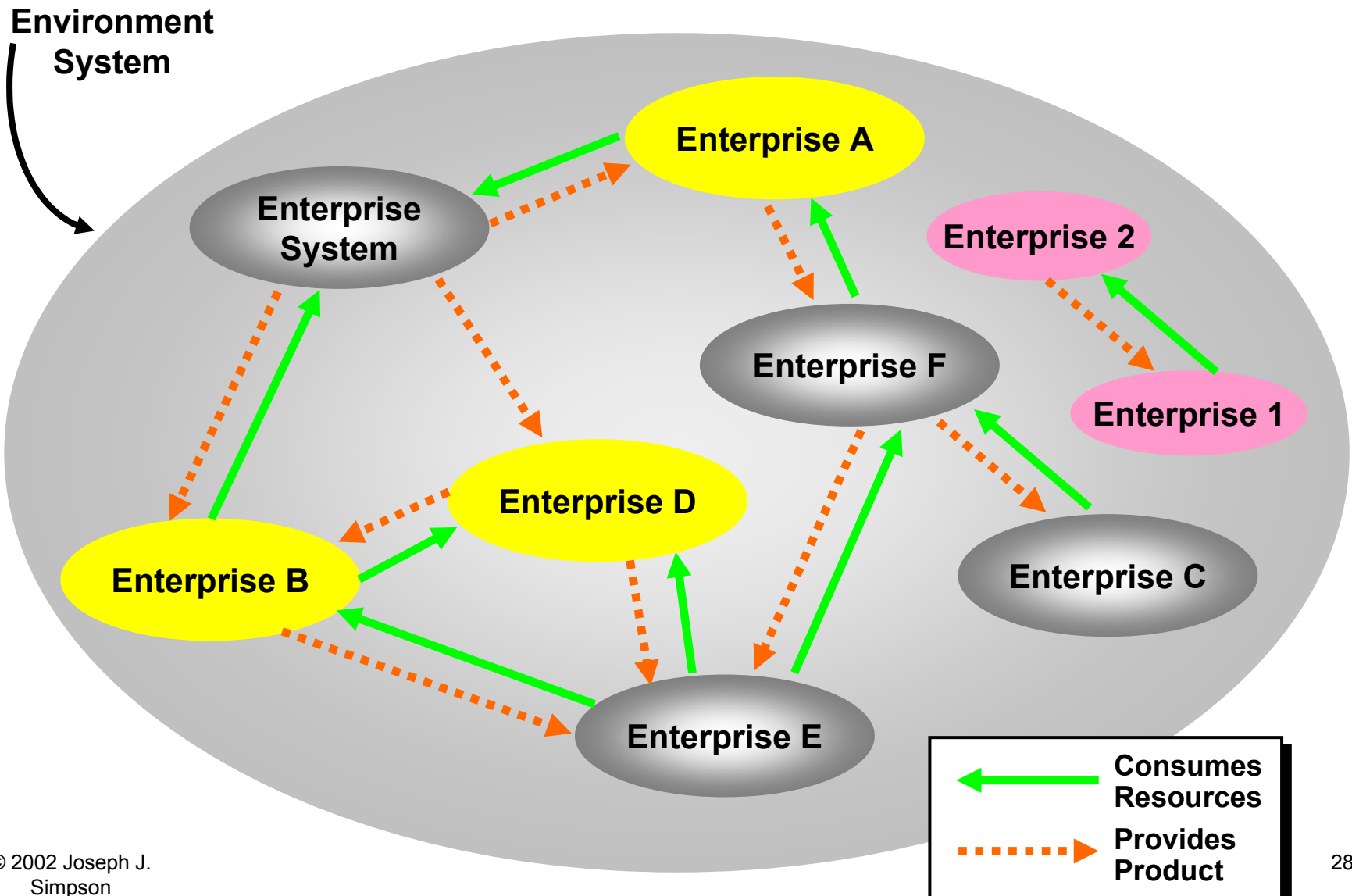
C. Environment System Innovation Management

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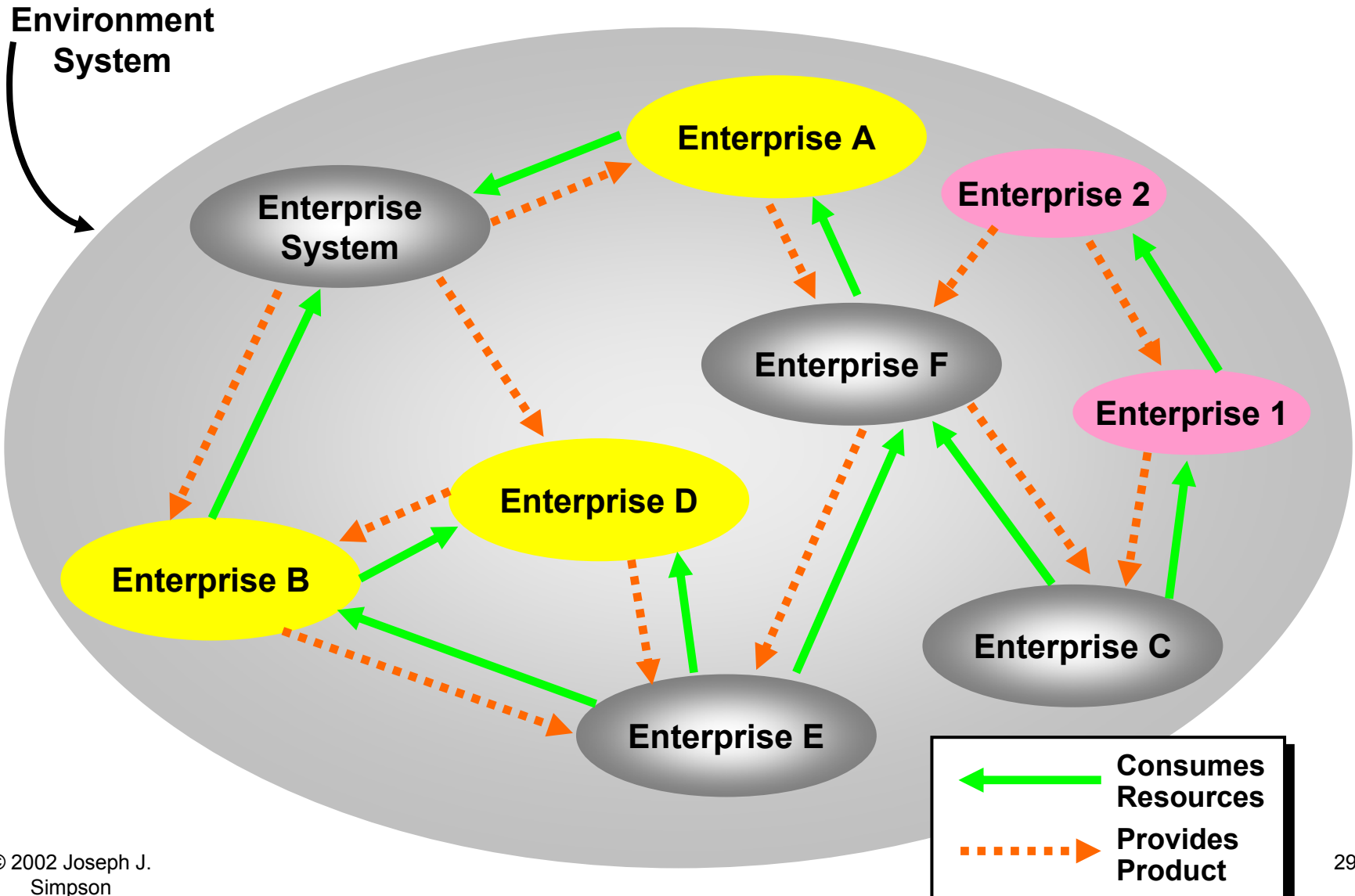
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Disruptive Network: No Common Customers



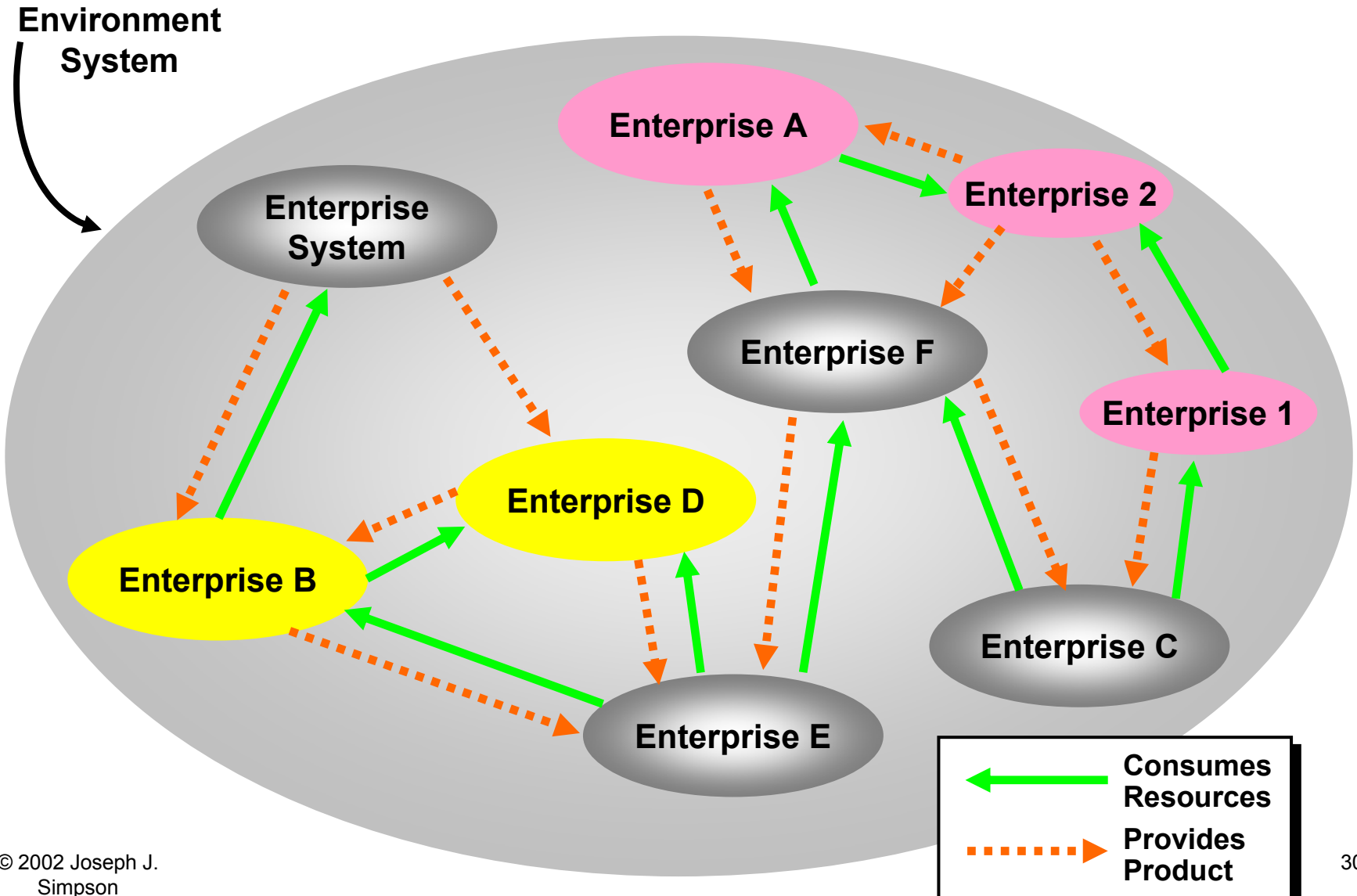
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Disruptive Network: Some Common Customers



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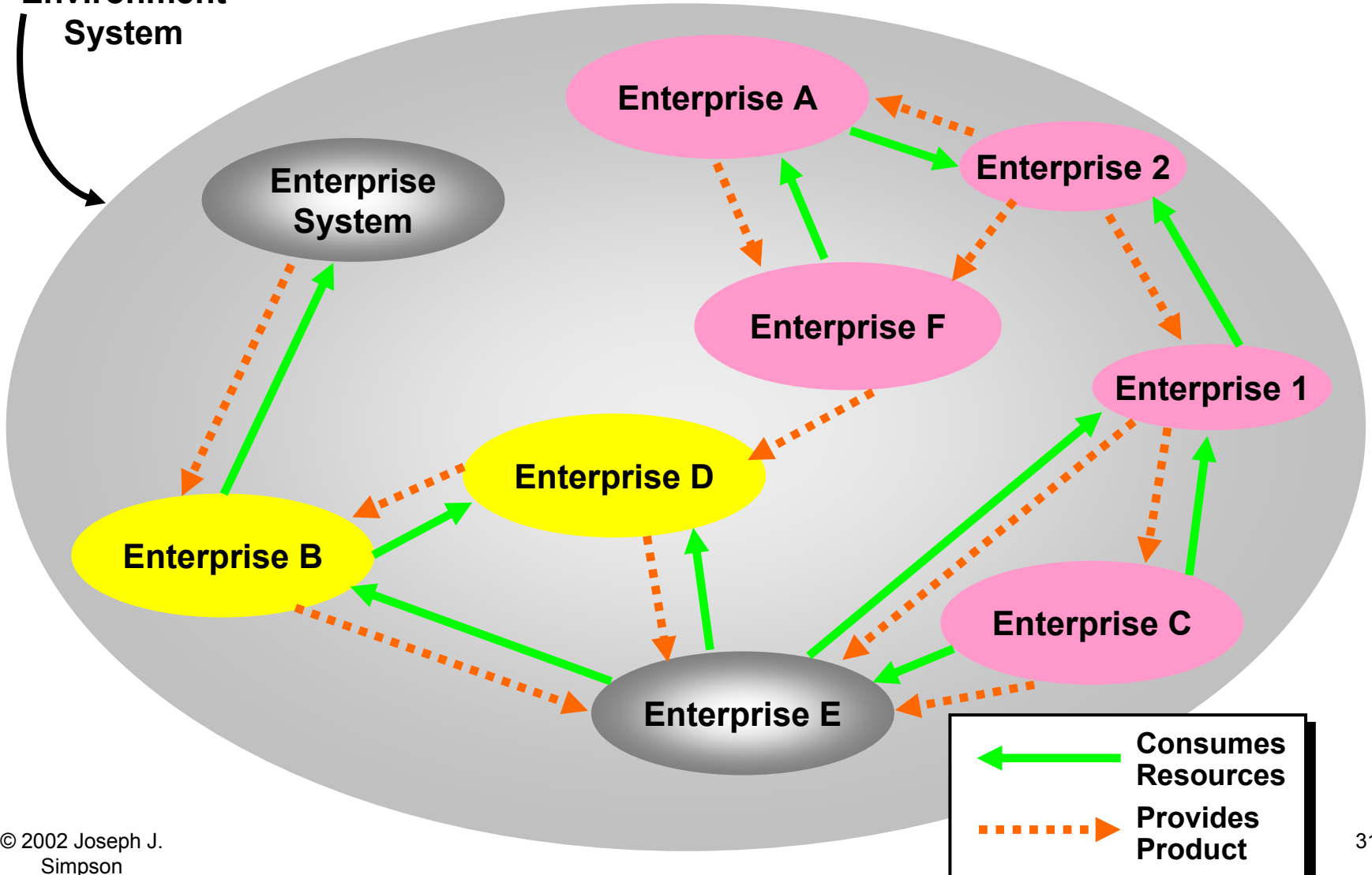
Disruptive Network: Some Common Customers



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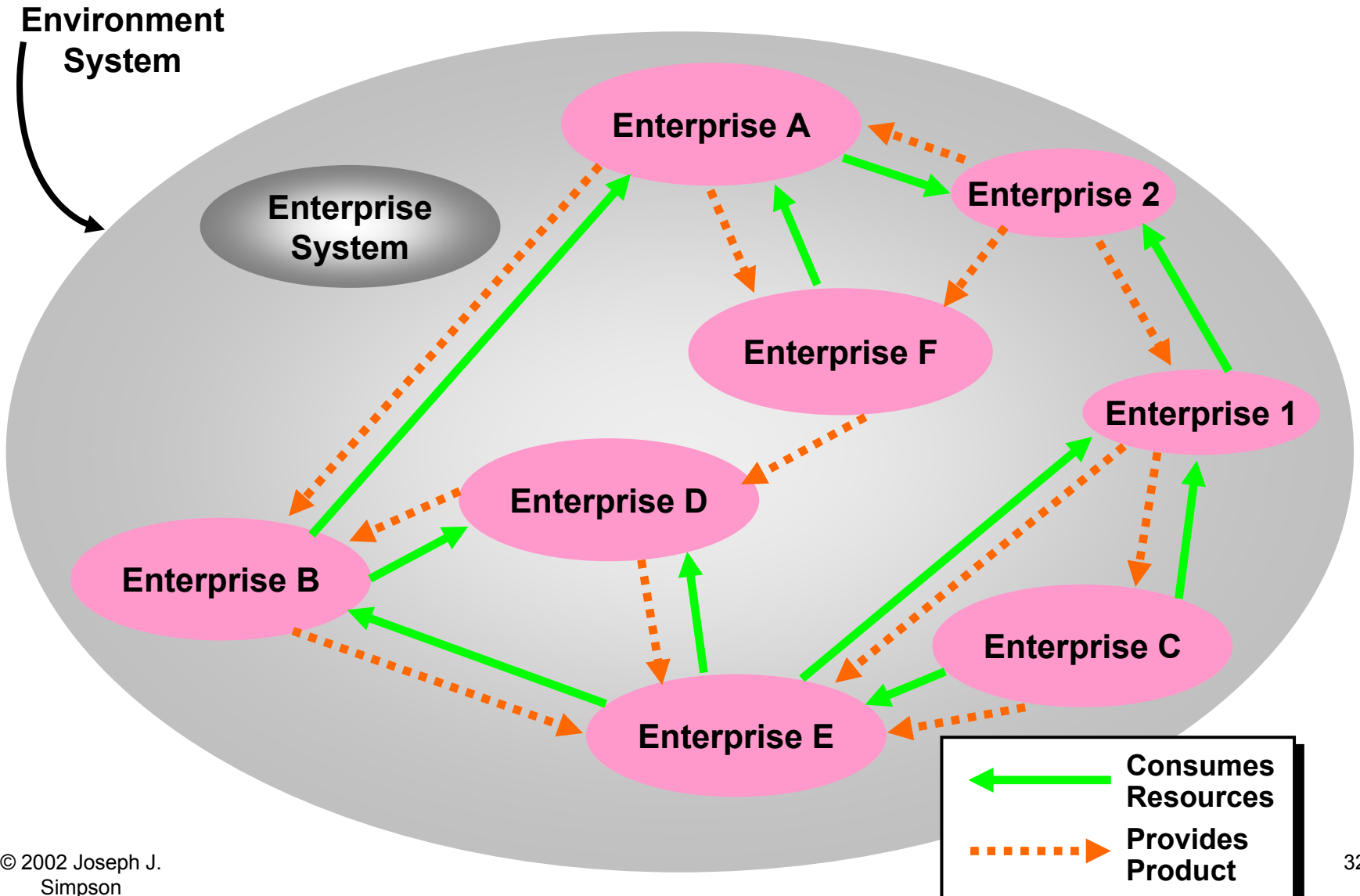
Disruptive Network: Some Common Customers

Environment
System



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Disruptive Network: All Disruptive Customers



New Technology Development and Innovation Management

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Role of New Technology Development in New Product Development

Research by Sampathkumar, Clausing, Schultz and Fricke clearly **separated technology development from product development**

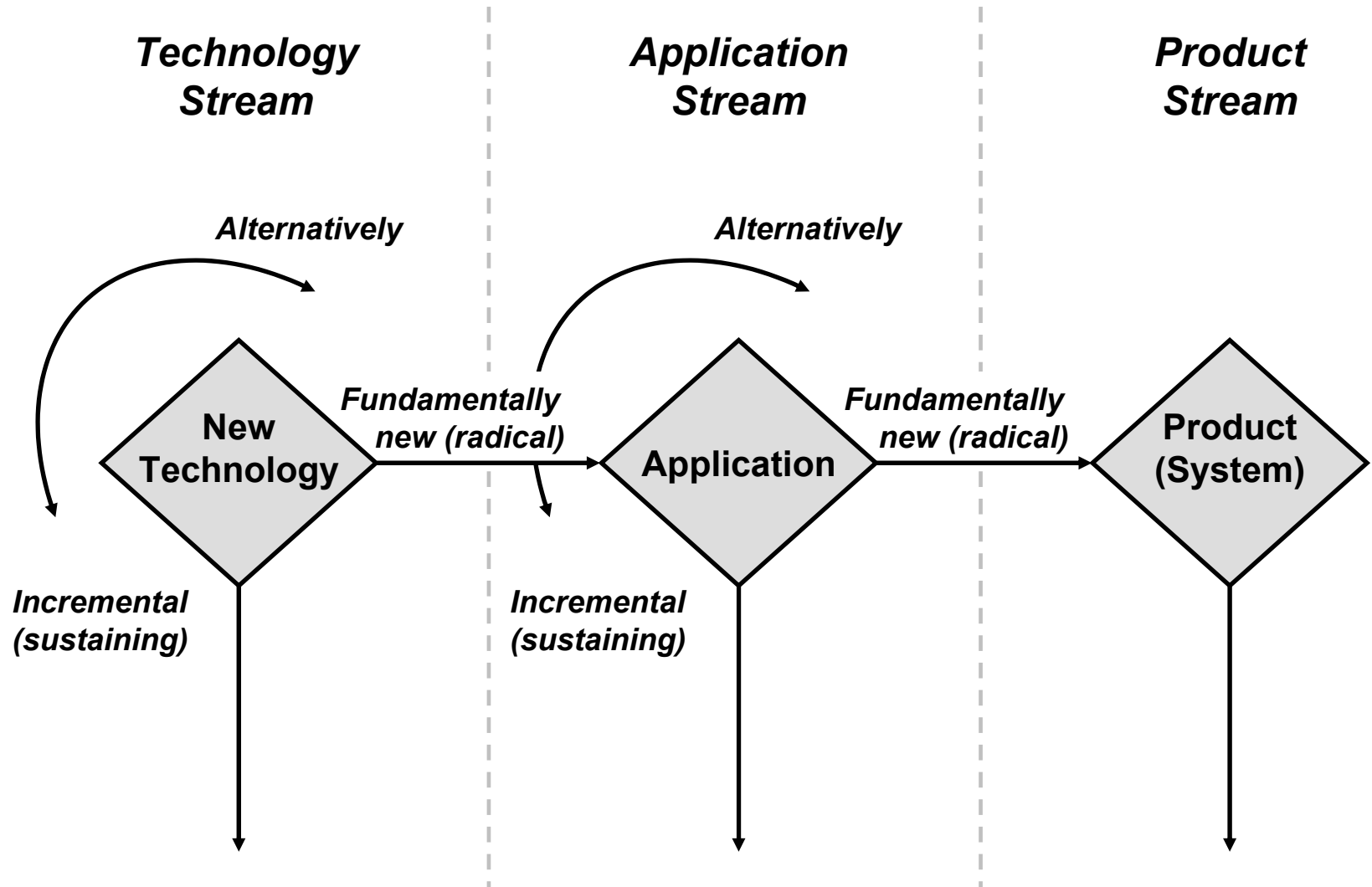
Three **independent concurrent activities** frame innovation

- Incremental development of new **technology**
- Incremental development of new **applications**
- Incremental development of new **products**

Radical technology innovation is introduced in the technology stream and can either be used (1) to continue technology development, or (2) to create a radically new application area. The new application area can generate radically new products.

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The Flow of Innovation*



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“Newness” and Radically New Application

Measures for Technology “Newness”

- Functional structure and logic
- Physics used to implement new function

Measures for Technology Application “Newness”

- Unanticipated benefits
- Required amount of learning

If the main product function uses a new technology, and the performance characteristics are different, then this is deemed a radically new technology application.

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Open Source Software

Open Source Software Technology Evaluation

- Function and logic are the same as closed source technology
- Physics are the same as closed source technology
- Anticipated benefits are great
- Required amount of learning and operational change is small.

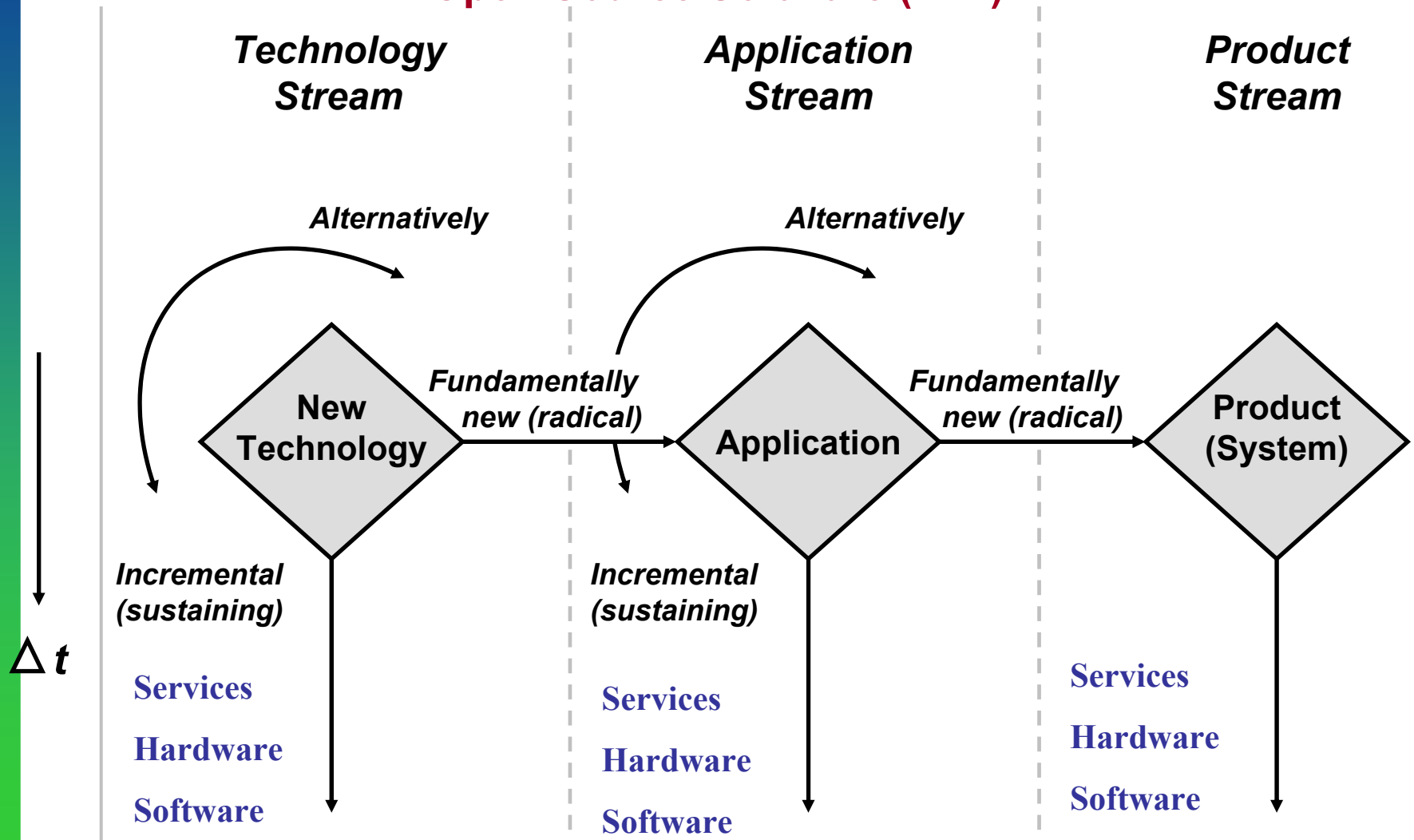
Given this “product evaluation,” open source software may not be a radical new disruptive technology. When the process system that develops the software is evaluated, then the disruptive nature of open source technology can be clearly determined.

Both the product system and the process system innovation activities associated with open source software need to be evaluated to completely understand the disruptive nature of these products

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The Flow of Innovation*

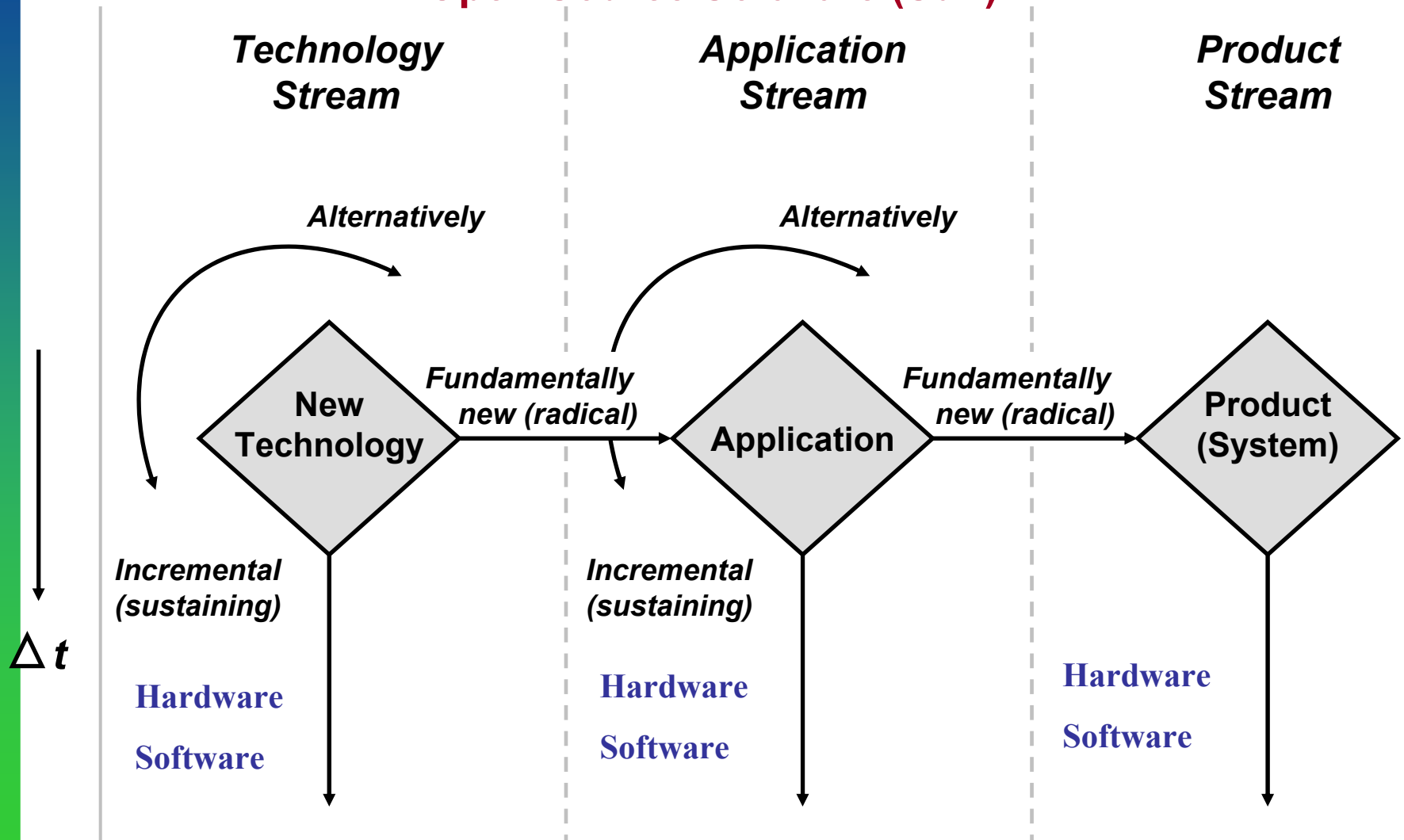
Open Source Software (IBM)



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The Flow of Innovation*

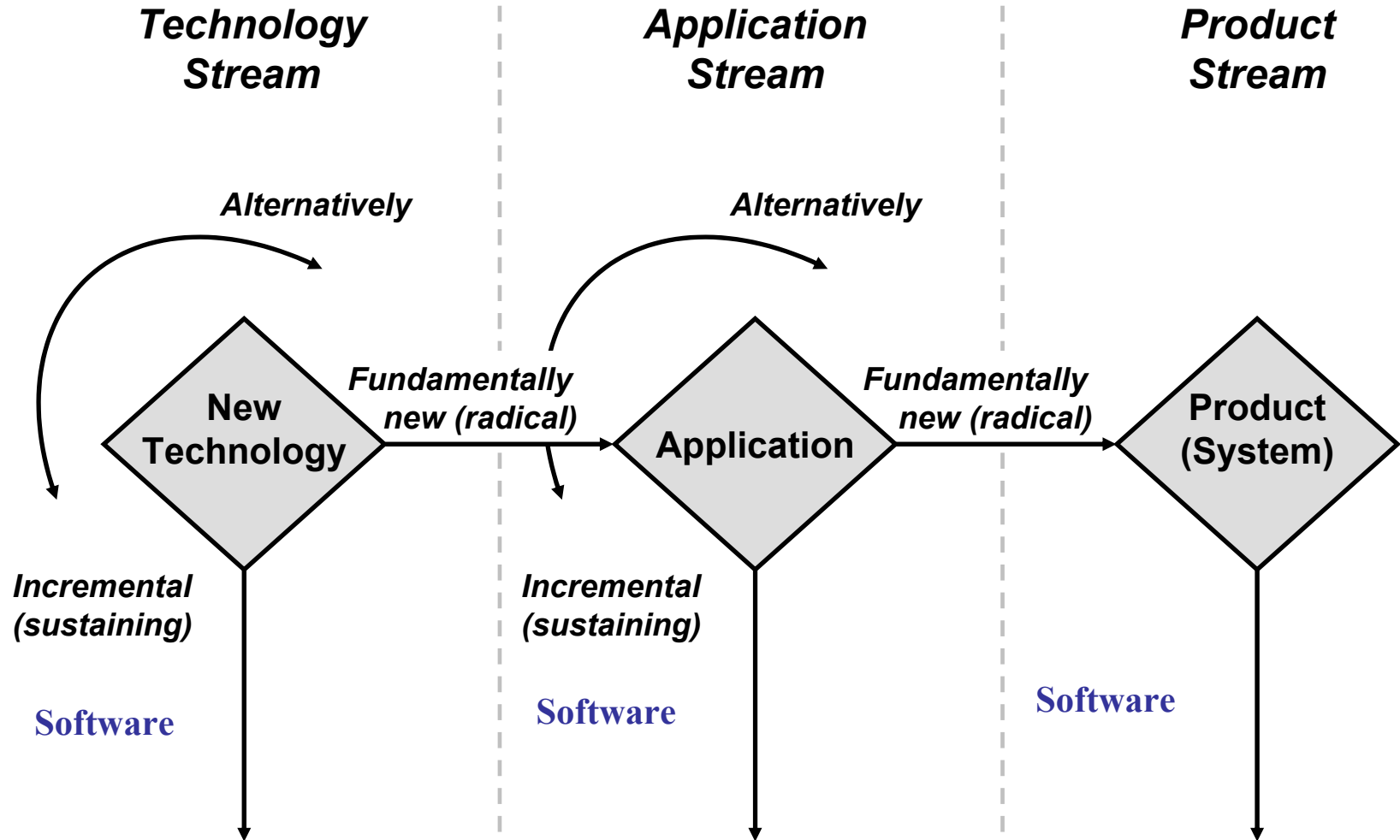
Open Source Software (Sun)



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The Flow of Innovation*

Open Source Software (MS)



Summary and Conclusions

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Summary and Conclusions

Innovation and technology management requires a combined coherent focus on both the product and the process that develops the product.

Systems engineering processes and principles provide a logical framework for evaluation and management of innovation and technology of all types.

The product and the product production process should be combined - from both an innovation and a management perspective. Process innovation is as important as product innovation in the open source software domain.

Disruptive technologies provide great advantages to an enterprise.