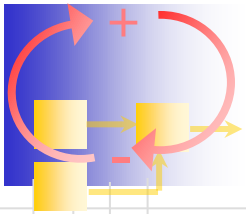
ESD.36 System Project Management

Lecture 1



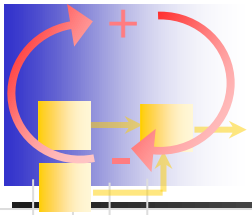
Class Introduction

Instructor(s)

Prof. Olivier de Weck

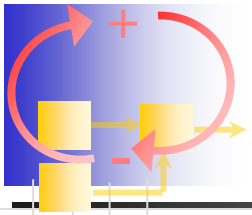
Dr. James Lyneis, Prof. Dan Braha

Massachusetts Institute of Technology



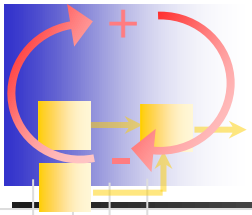
Today's Agenda

- Welcome and Introductions
- Definitions – Initial Discussion
- Course Objectives
- Schedule
- Term Project, Homeworks
- Questions?



Introductions

- Olivier de Weck
  - Dipl. Ing. Industrial Engineering – ETH Zurich ’93
  - 1993-1997 Engineering Program Manager Swiss F/A-18 Project, McDonnell Douglas, St. Louis
  - S.M. ’99 Ph.D. ’01 Aerospace Systems – MIT
  - Associate Professor – dual appointment AA and ESD, Executive Director Production in Innovation Economy (PIE) Study
  - Research:
    - Systems Engineering for Changeability and Commonality
      - http://strategic.mit.edu
    - Space Logistics
      - http://spacelogistics.mit.edu



Introductions

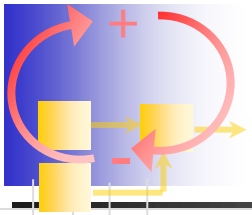
- James Lyneis
  - S.B.s MIT – EE and System Dynamics (’71)
  - PhD – Univ. of Michigan (Mgt. Science; ’74)
  - Sloan Faculty ’74-’78; Senior Lecturer ’98-Present
  - Professor of the Practice, WPI ’02-Present
  - Consultant with Pugh-Roberts Associates, ’78-’02, working on many project models

Introductions

- **Dan Braha**
  - Professor at University of Massachusetts
  - Sabbatical at MIT ESD in AY 2012/13
  - Affiliation with New England Complex Systems Institute (NECSI)
  - Specializes in Complexity research, with application to complex projects and human organizations

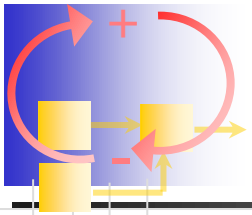
The Structure and Diffusion Dynamics of Large Scale Organizational

Networks Social Network Analysis of ProductDesign and Development Organizational Networks



Introductions

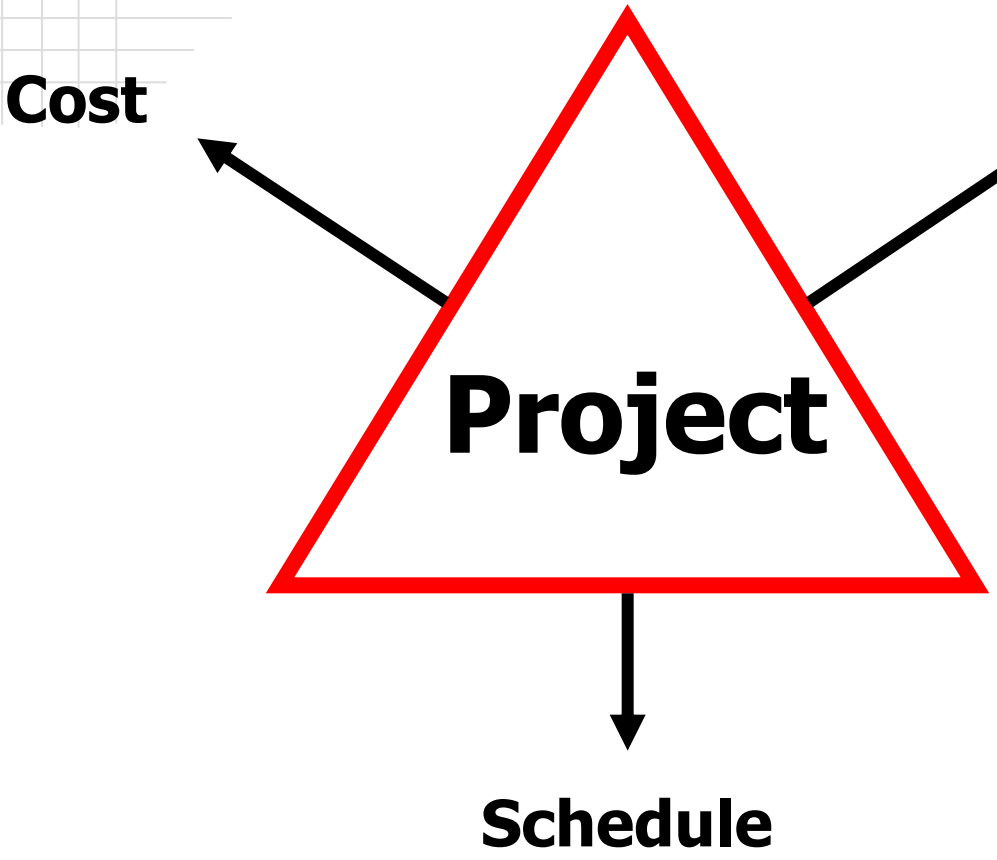
- Let's go around the room & remote sites
  - Name
  - Company and Job (present or past)
  - One observation on project management



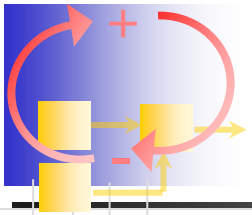
Project Definition

- A **Project** is a set of tasks that
  - Are related to each other
  - Have a specific objective to be completed within certain specifications
  - Have defined start and end dates
  - Have funding limits
  - Consume resources

The "Iron Triangle"

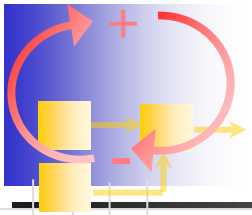


- Why "iron" triangle?
  - Risk if all three are constrained !



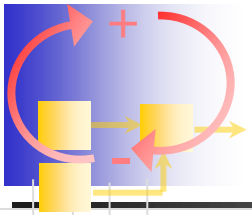
System Definition

- A **System** is a set of physical or virtual objects whose interrelationships enable desired function(s).
  - more than the sum of its parts
  - Undesired (emergent) functions often exist
  - System complexity scales with the number of objects as well as the type and number of interconnections between them
  - Instantaneously available functions, versus "lifecycle" properties (scalability, flexibility, robustness …)
- A Product is a "System" sold for profit



Example System: F/A-18 Aircraft

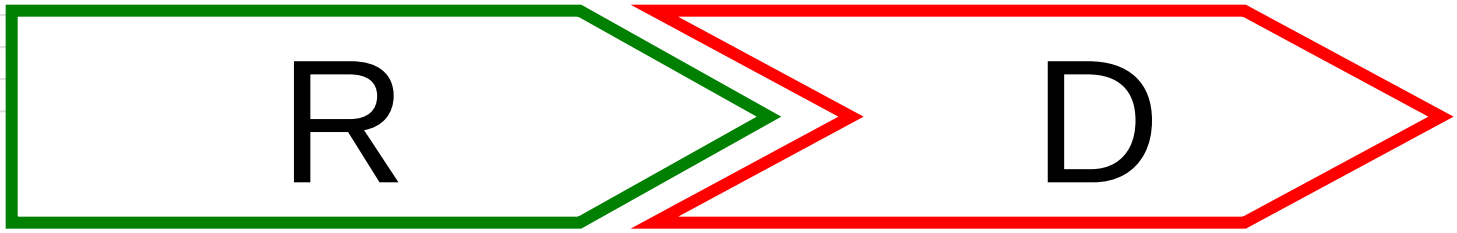
- Clean sheet design ~ 1978 F/A-18 A/B
- Re-designs: C/D (1987), E/F (1999)
- Hardware, Software, Humans …
  - What is inside the system boundary?



Project Management

- **Project Management** comprises a body of methods and tools that facilitate the achievement of project objectives
  - Within time
  - Within cost
  - Within scope
    - At the desired performance/specification level
  - While effectively and efficiently utilizing resources
  - While carefully managing risks and opportunities

Research and Development



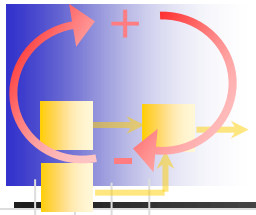
Research, Technology Development

- Unstructured methods
- Difficult to plan
- Unpredictable

Product/System Development

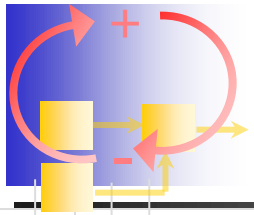
- Structured methods
- Generally planned
- Predictable

Our focus is on downstream development.



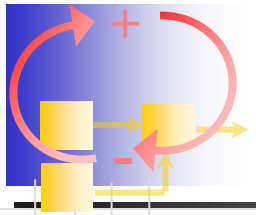
Discussion Point 1: Why is complex (S)PM hard?

- Main obstacles to easy project success:
  - Poorly defined project objectives or shifting system requirements
  - ….. What do you think? …



Concept Question 1 (DEMO)

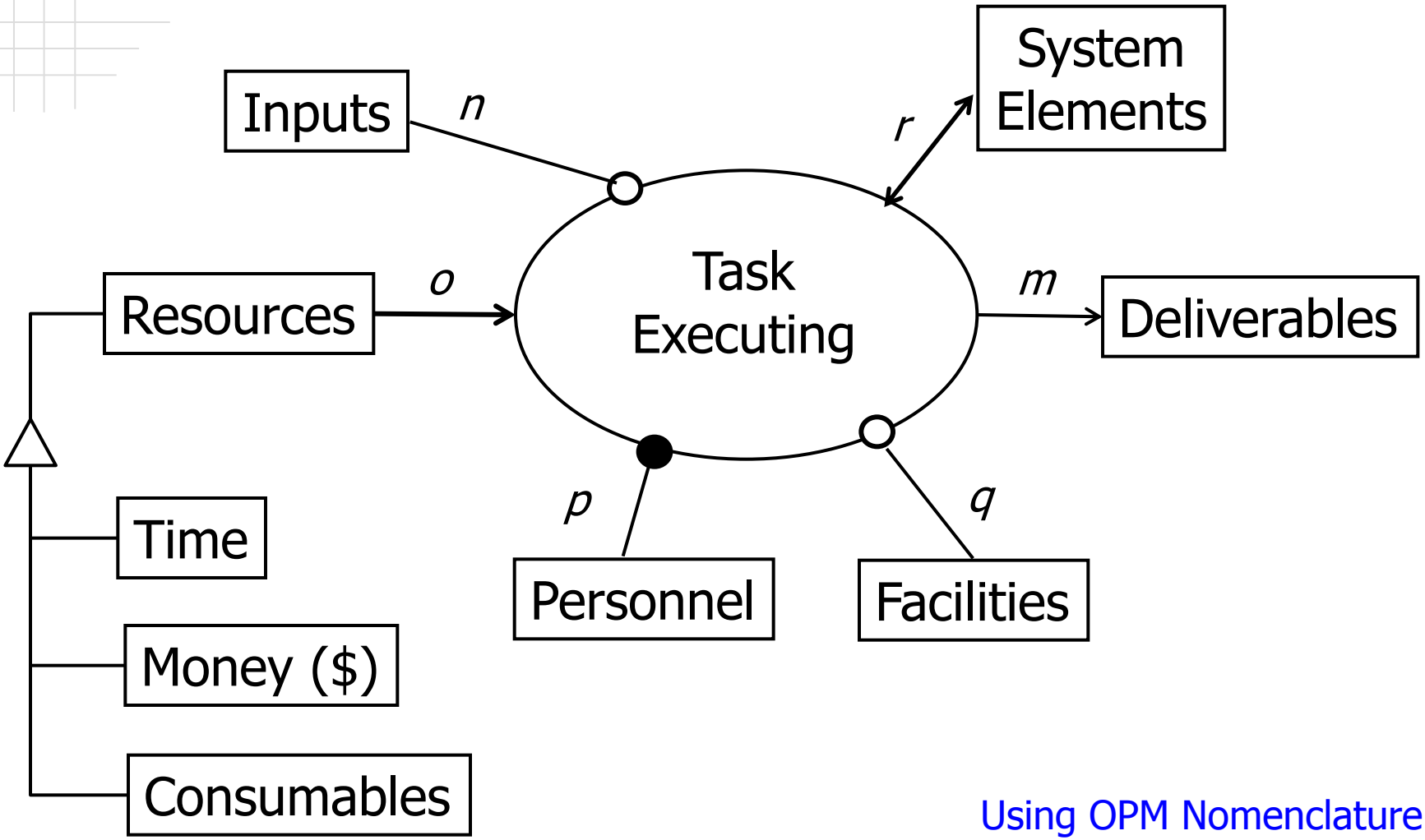
- A project is
  - A - ongoing management of facilities
  - B - a finite undertaking with a specific goal
  - C - task-based design
  - D – doomed to failure from the outset
  - E – all of the above
  - F – none of the above



Relationship w/other SDM core classes

- System Architecture (ESD.34) is about the "DNA" of the ARTIFACTS themselves – atomic unit: object
  - Concept, form, function, decomposition …
- Systems Engineering (ESD.33) is about the PROCESSES to understand and design systems – atomic unit: process
  - QFD, DOE, Requirements Analysis and Verification, …
- Integrating the Lean Enterprise (ESD.61J) is about the PEOPLE and ORGANIZATIONS – atomic unit: person
  - Principles of lean manufacturing, organizational models
- System Project Management (ESD.36) is about how to best utilize resources to implement a set of objectives – atomic unit: task
  - CPM, DSM, System Dynamics

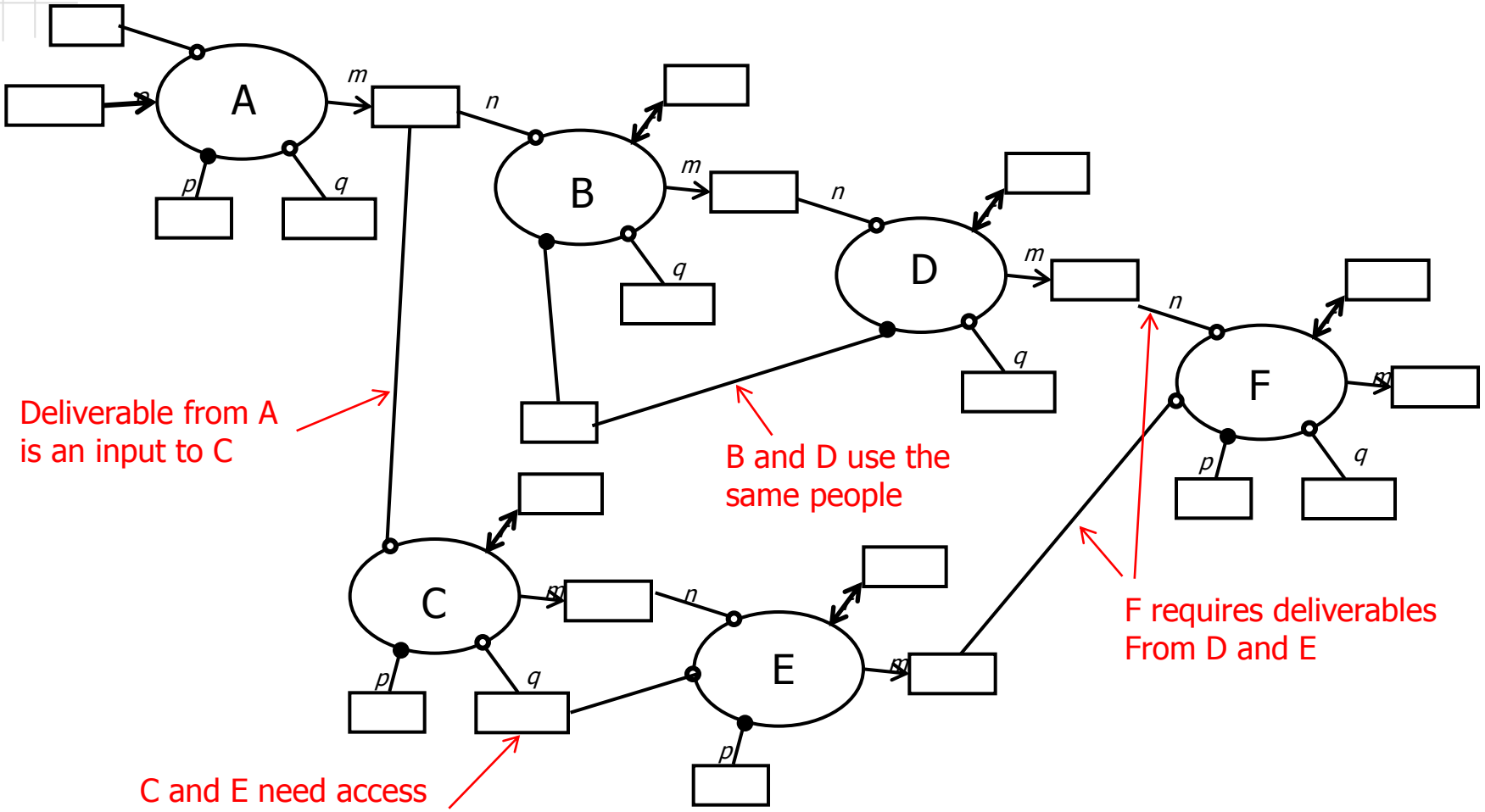
Task as an Object-Process-Diagram



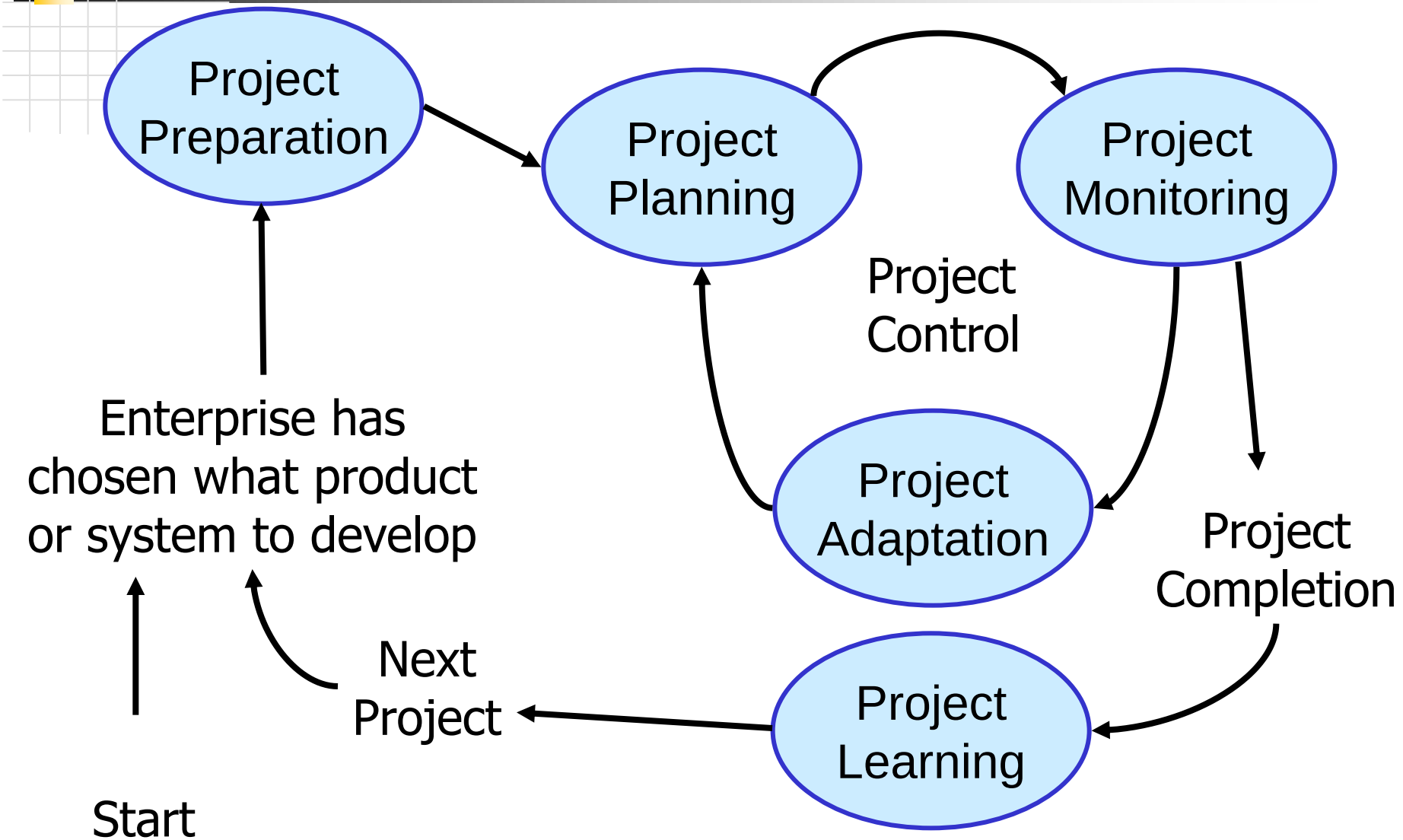
Using OPM Nomenclature

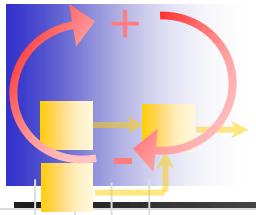
Ref: OPM, D. Dori, 2002

Project = set of related tasks



System Project Management
ESD.36 Framework





Course Objectives

- Introduce advanced methods and tools of Project Management in a development context
  - CPM/PERT, Critical Chain, Design Structure Matrix
  - System Dynamics
  - Earned Value Management
- Understand how methods work (strengths, limitations)
  - Industry Examples
- Gain appreciation for organizational and human aspects
  - Case Studies
  - Managing International Projects, Portfolios of Projects …
- Learn from each other
  - Class Discussions
  - Project Assignments
- → Improve development projects in your career/firm

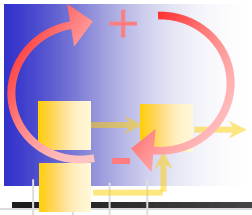
Class Schedule
(next 7 weeks, refer to syllabus)

ESD.36 Class Schedule – Fall Term 2012 (13 Tuesdays, 13 Thursdays)

System Project Management

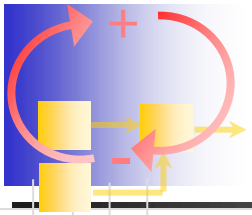
Tuesday		Thursday	
Sep 4 Registration Day		Sep 6 **L1: Class Introduction** *Project Assignment out*	dWo,JL,DB
Sep 11 **L2: Critical Path Method** *HW1 out*	dWo	Sep 13 **L3: Critical Chain Method**	DB
Sep 18 **L4: Design Structure Matrix (DSM)** *Project Proposal due*	dWo	Sep 20 **L5: Managing Iterations with DSM** *HW2 out*	dWo
Sep 25 **L6: Introduction to Project Dynamics** *HW1 due– Project Approvals given*	JL	Sep 27 **L7: The Rework Cycle**	JL
Oct 2 **L8: Project Dynamics Simulation** *HW3 out*	JL	Oct 4 **L9: Probabilistic Scheduling** *HW2 due*	JL
Oct 9 **No Class, Columbus Day Holiday**		Oct 11 **L10: Budgeting and Cost Control** *HW4 out*	dWo
Oct 16 **L11: Risk Management** *HW3 due*	dWo	Oct 18 **L12: Project Strategic Issues**	JL
Oct 23 *Business Trip Week* **Case 1: Construction Project**	G	Oct 25 *Business Trip Week* **Case 2: Aerospace Project** *Project Update due*	G

Business Trip



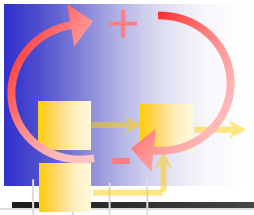
Readings

- Required Readings
  - NO Paper Class Reader Packet
  - Read ahead of lecture ~ 1-2 papers/chapters per session
    - Check reading assignments in the syllabus
  - Next:
    - MIT Press Book Chapter: Introduction to PM
    - ABCs of the Critical Path Method (1963)
- Optional Readings
  - Textbooks
  - Available at MIT Library (Dewey)
  - Purchase only if you think useful beyond class
    - (e.g. MIT COOP, amazon.com etc ….)



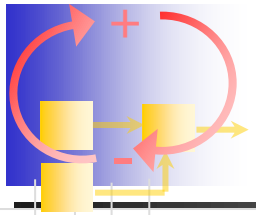
Draft Textbook

- "Successfully Designing and Managing Complex Projects"
  - de Weck, Lyneis
  - MIT Press, draft in development
  - textbook to support SDM core class ESD.36
  - current draft ~ 300 pages



Case Studies

- Case 1: Civil Engineering Project
  - BAE Systems: DIA Baggage Handling System
    - HBS-9-396-311
  - or "live case" BP Wind Farm Development
- Case 2: Aerospace Project
  - Raise and Fall of Iridium (or Mission to Mars HBS-9-603-083)
    - HBS-9-601-040
  - Presented by Prof. Joel Schindall
- Case 3: Software Project
  - Microsoft .Net (and/or Microsoft Office 2000)
    - HBS-9-602-086
  - Presented by Prof. Paulo Gomes
- Case 4: Voted by Students



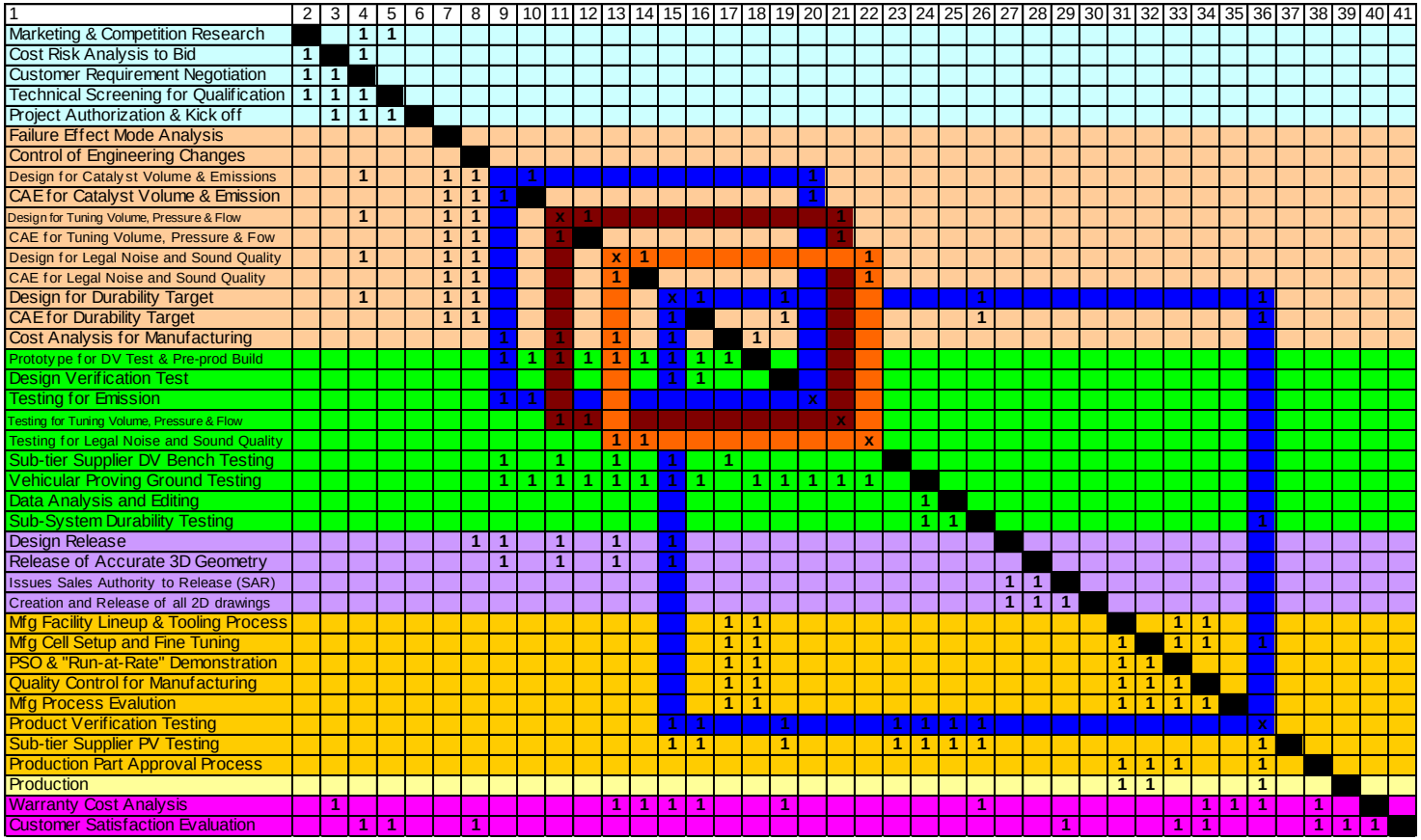
Project Assignment

- Apply Design Structure Matrix (DSM) method, generally at your sponsor company site
- System Dynamics Project (incl. simulation)
- Survey of Methods & Tools in company
- Analyze Success or Failure of a significant Past Product/System Development Project
  - Work in teams of 4 (nominally)
  - 1-page project proposals due on 9/18
  - Get approval by 9/25
  - Project Update due on: 10/25
  - Final presentation in class on December 4 or 6

Previous Project Examples

DSM Project

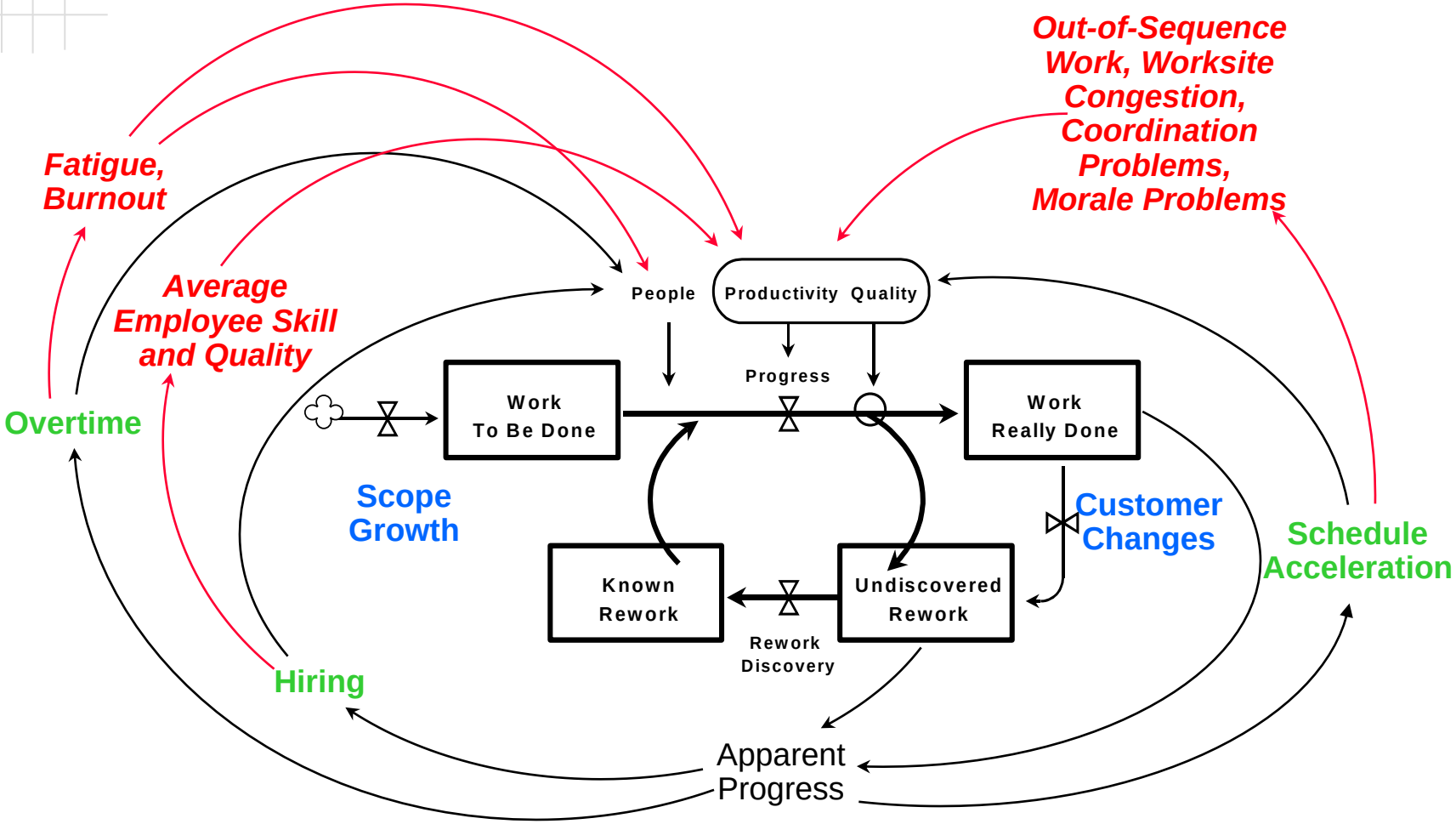
Exhaust System Design



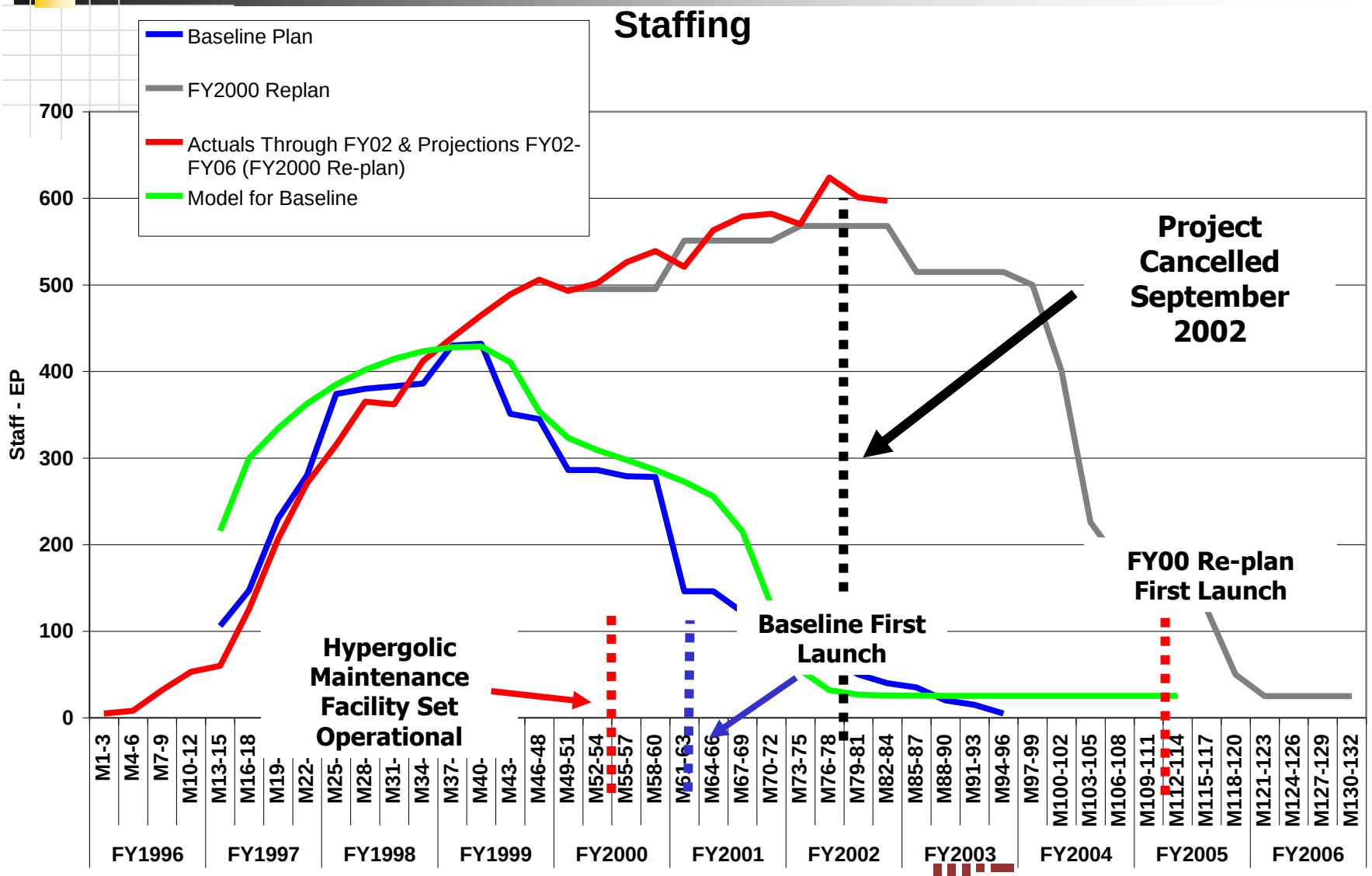
- Understand Iterations
- Reduce Expected Project Duration

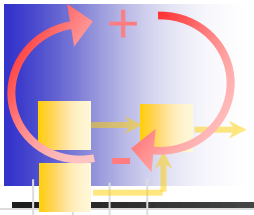
Understanding the sources of change --

External factors; management responses; side effects



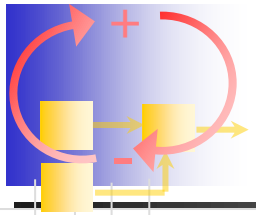
Understand the dynamics of a cancelled project at NASA





Discussion Point 2: Failure?

- What can lead to projects failing ?
  - What is success/failure?
  - Project Manager is unqualified and overwhelmed.
  - What else…

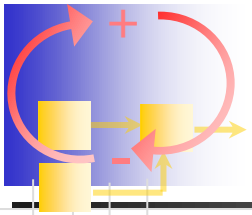


Homework Assignments

- 6 Individual assignments, but can cooperate (**acknowledge !**)
- Don't spend more than ~10-15 hours per HW !

Electrical CityCar Design Project

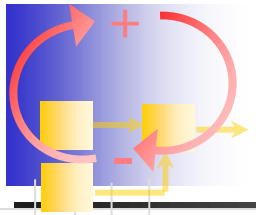
HW1: Critical Path and Network of Tasks
HW2: Design Structure Matrix and Iterations
HW3: System Dynamics – Initial Model
HW4: Budgeting and Earned Value
HW5: System Dynamics – Brook's Law
HW6: Project Organizational Design



Grading

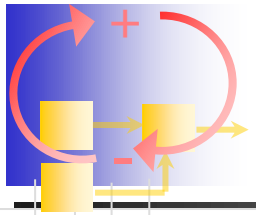
- Homeworks 60%
- Project Assignment 25%
- Active Participation 15%
  - Total 100%

  - Each HW counts 10%
  - All project team members receive same project grade, work together
  - People in this class do get A,B,C …even F … you want a good grade? … you have to earn it !



The Course Site
Getting Started

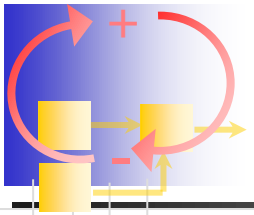
- SDM students should add themselves to the class list (if not already there)
- Non-SDM students get permission from instructors
  - Contact TA via email to be added
- Course number is ESD.36
  - Make sure you go to the Fall 2012 version



The Course Site

Main features

- Syllabus (under > Materials > General)
- Calendar
  - Schedule
- Handouts
  - Go to "Materials" (store all shared files)
  - will be posted before each lecture
- Homework
  - Submit assignments through the course site
  - Receive comments and grades
- FAQ / Forums
  - Forum will be used for various topics



Remember

- **Read the syllabus**!
  - Answers many of your questions
- Take a look at what's already uploaded
  - Reading for next class
- Sign up on the course site if needed
- Non-SDM students need permission of instructor to enroll.
- Use your name cards every class.
- PLEASE … okay, pay attention
  - Laptops needed to answer concept questions
  - IM TA's during lecture from remote sites if problems surface

ESD.36 System Project Management

Fall 2012