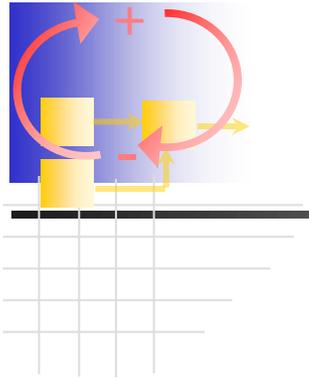


# ESD.36 System Project Management

## L20: Class Summary

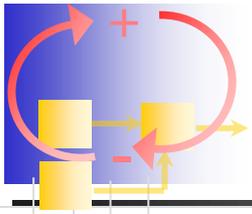


Instructor(s)

Prof. Olivier de Weck

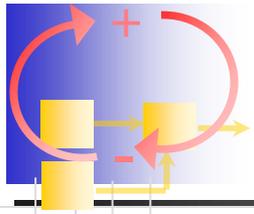
Dr. Jim Lyneis

Prof. Dan Braha



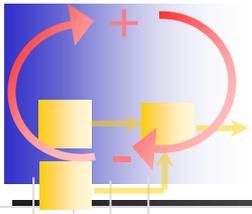
# Outline

- Class Summary
  - Learning Objectives revisited
  - SPM Framework: Preparation, Planning, Monitoring, Adaptation
  - 9 Key Takeaways
  - 14 Success Factors
- Last 30 minutes reserved for evaluation
  - Faculty will leave room - done at 4:00p.m.



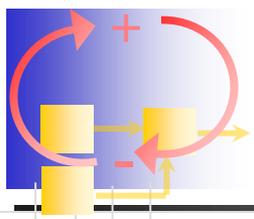
# Learning Objectives

- Introduce advanced methods and tools of Project Management in a product/system development context
  - Probabilistic CPM/PERT, Critical Chain
  - Design Structure Matrix
  - System Dynamics
  - Earned Value Management
- Understand how methods work (strengths, limitations)
  - Industry Examples
  - Case Studies, Risk Management, Real Options
- Learn from each other
  - Class Discussions
  - Project Assignments
- → Improve development projects at your workplace

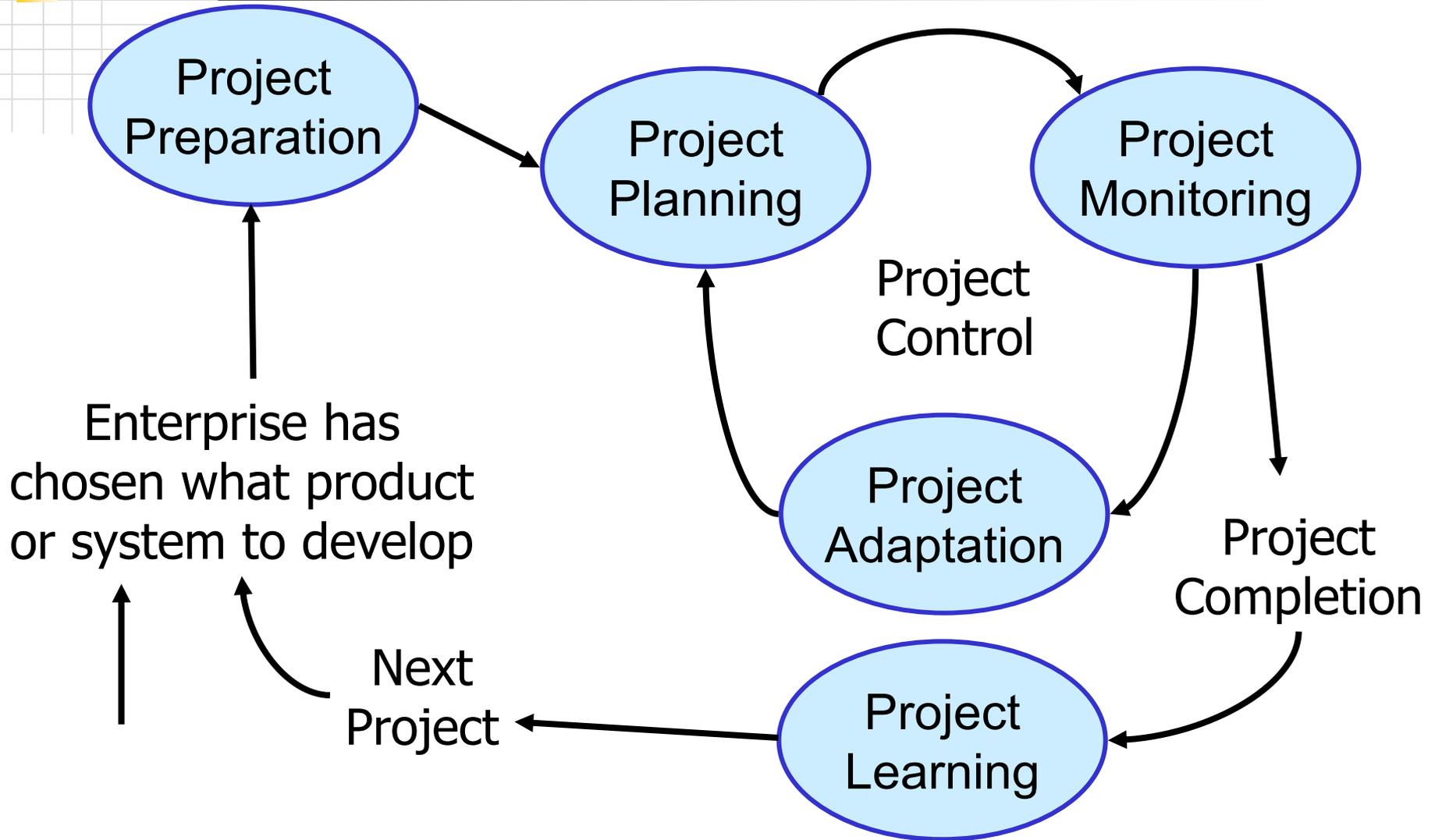


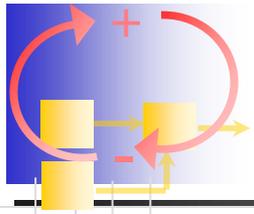
# Relationship with other SDM core courses (simple view)

- 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, 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

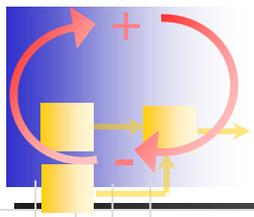


# System Project Management ESD.36 Framework





# 9 Key Takeaways



# Takeaway 1: Doing the right thing, not just doing things right



- Mid-America Airport, outside St. Louis
- Example: Turn large military airport (Scott AFB) into profitable commercial airport
- Built terminal building, baggage claim, processing facilities, etc. - \$1.2 billion investment
- Opened for commercial flights until 2000

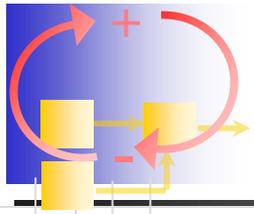


Image Source: <http://www.swi-news.com/SWI-MidAmerica.htm>

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## ■ Lesson Learned:

- Negotiate initial set of requirements with true stakeholders
- A good technical solution does not guarantee success



# Takeaway 2: The “Iron Triangle” is real

**Cost**

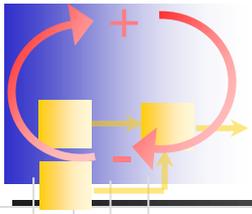
**Scope**

**Project**

**Schedule**

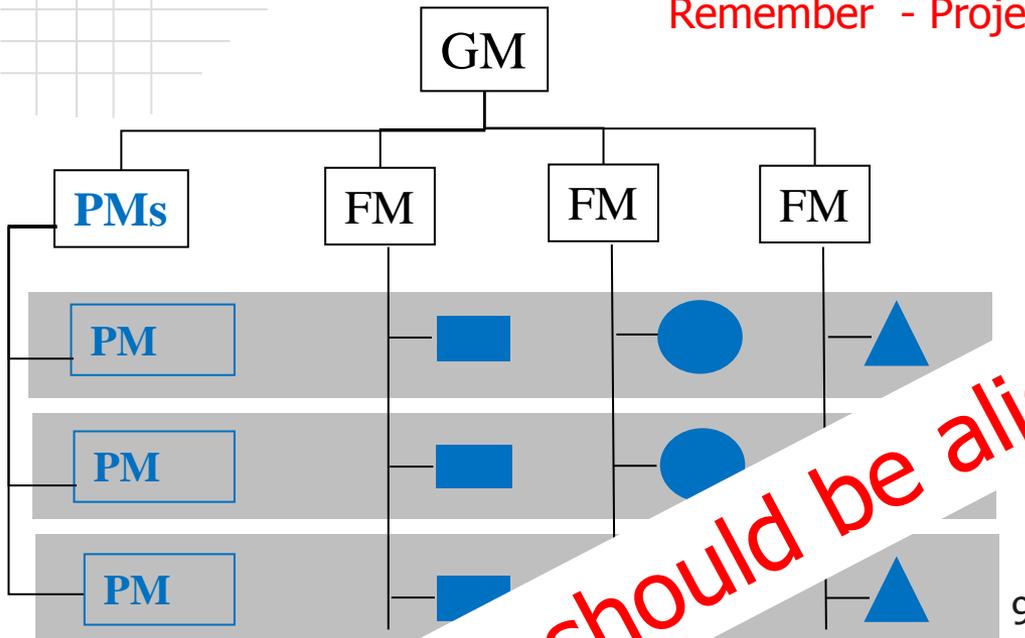
*Is the mission feasible to begin with?  
Are there multiple initial feasible plans?*

- Why “iron” triangle?
  - Risk if all three are over-constrained !
  - Can have all three but must be consistent



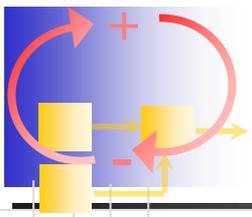
# Takeaway 3: Importance of Project Organization and Individuals

Remember - Project Organization and Complexity Structures

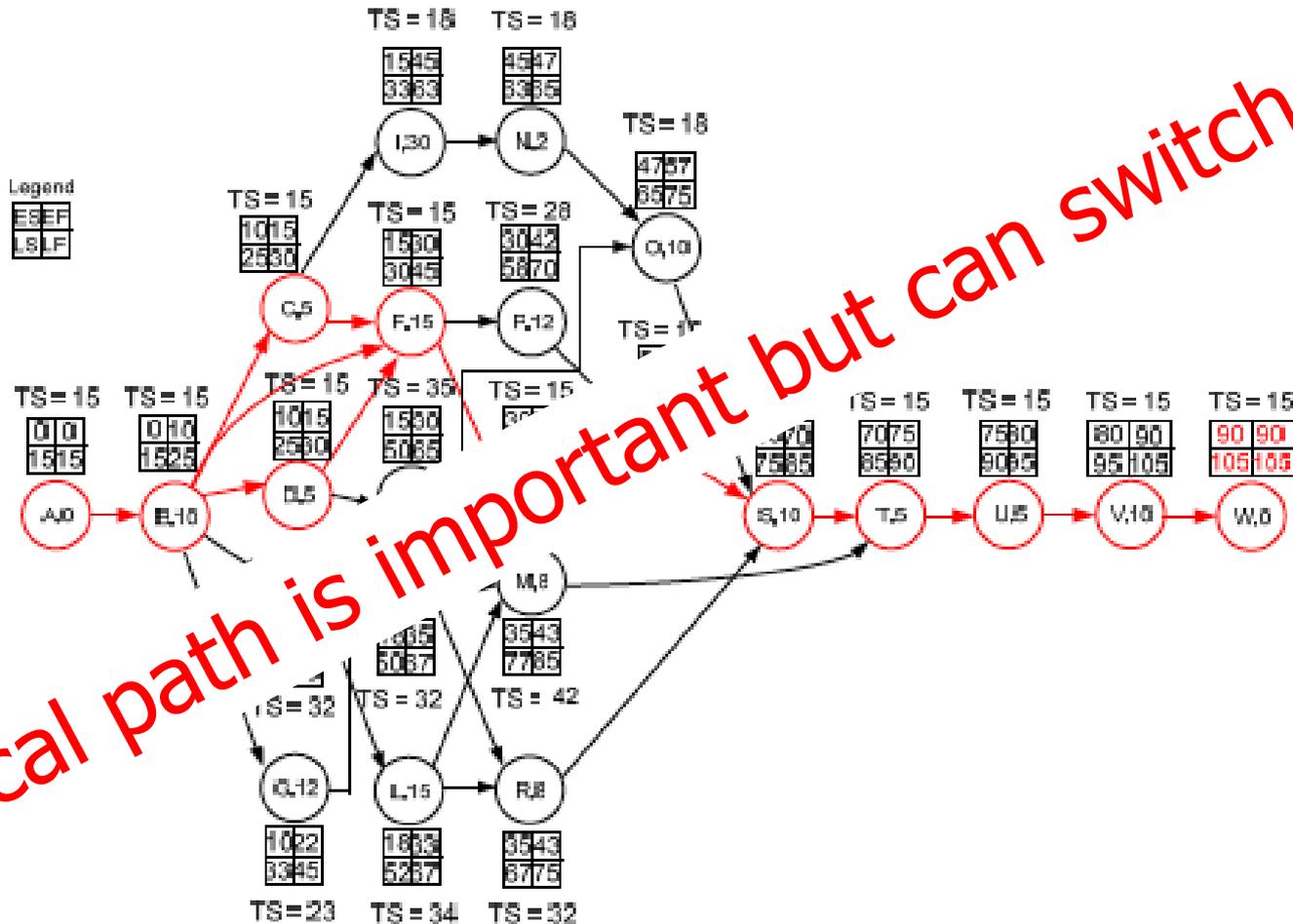


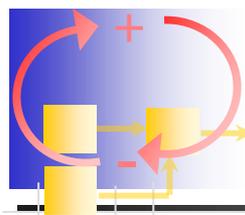
Organization should be aligned with project

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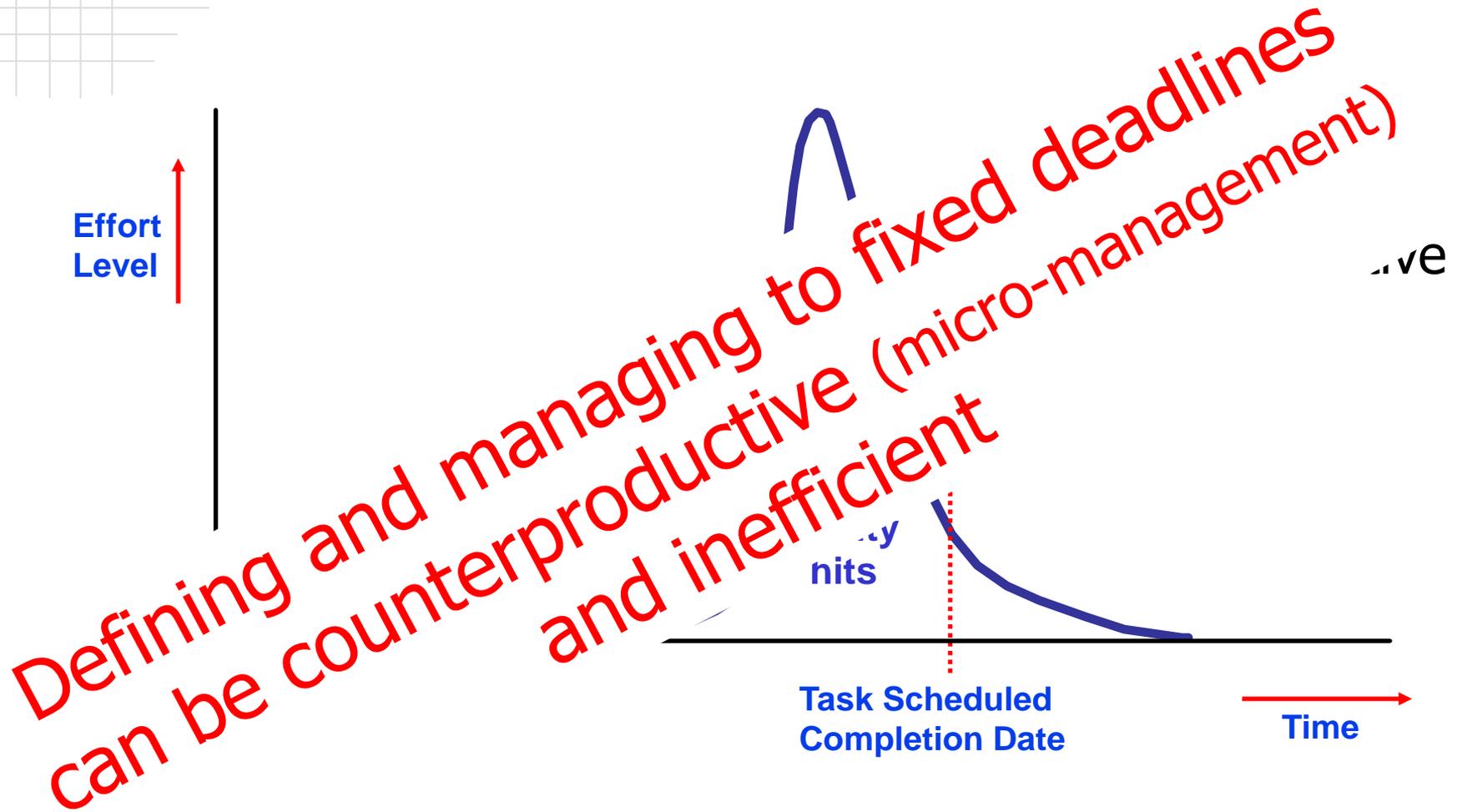


# Takeaway 4: Managing only the critical path can be dangerous

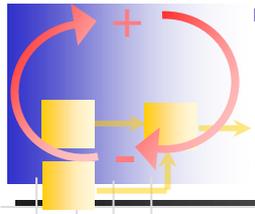




# Takeaway 5: Padded schedules become a self-fulfilling prophecy

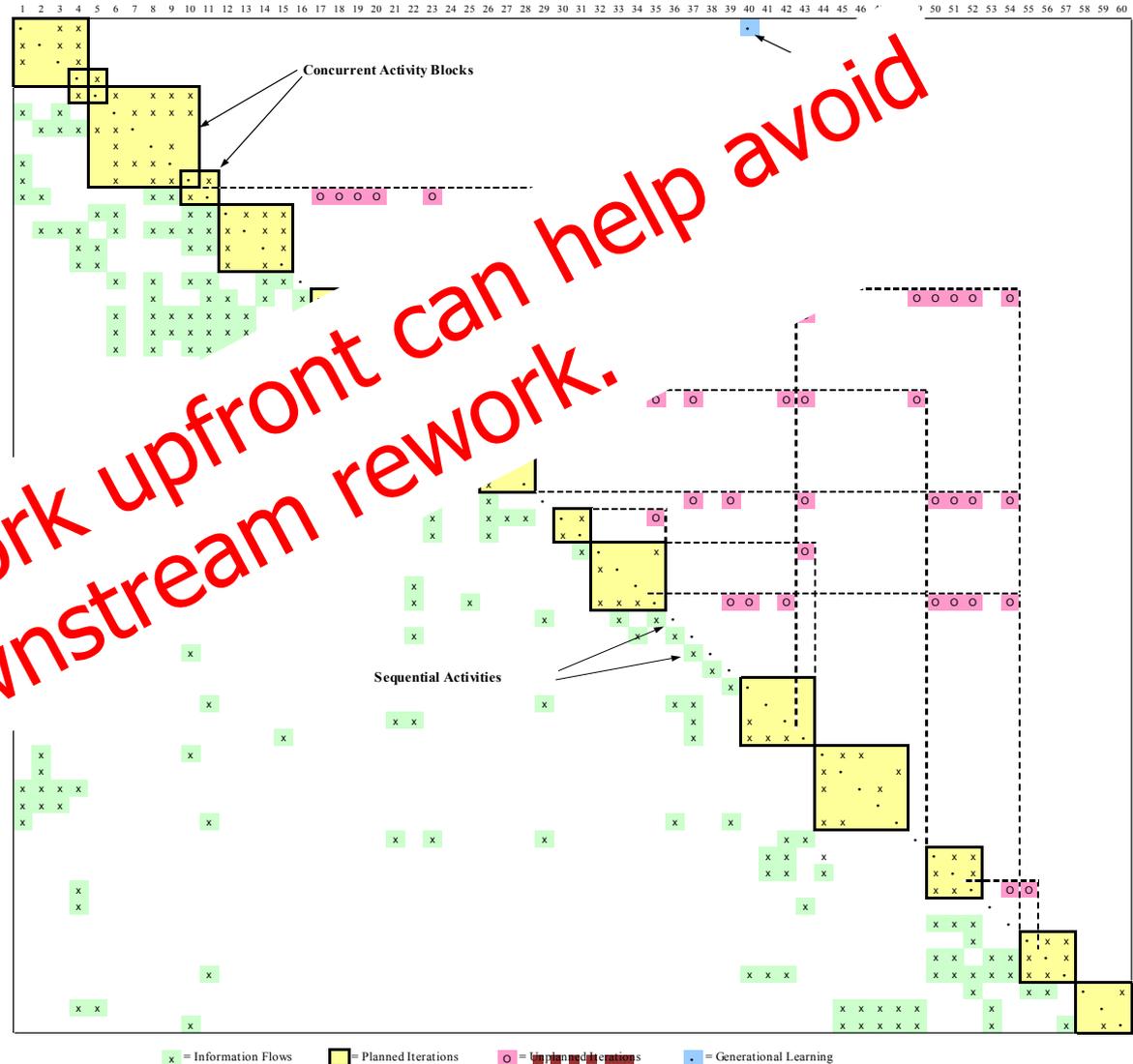


Source: Avraham Y. Goldratt Institute



# Takeaway 6: Planned Iterations can accelerate a project

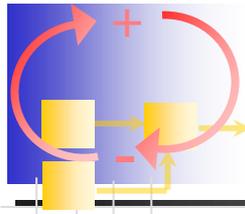
- 1 Set customer target
- 2 Estimate sales volumes
- 3 Establish pricing direction
- 4 Schedule project timeline
- 5 Development methods
- 6 Macro targets/constraints
- 7 Financial analysis
- 8 Develop program map
- 9 Create initial QFD matrix
- 10 Set technical requirements
- 11 Write customer specification
- 12 High-level modeling
- 13 Write target specification
- 14 Develop test plan
- 15 Develop validation plan
- 16 Build base prototype
- 17 Functional modeling
- 18 Develop product modules
- 19 Lay out integration
- 20 Integration modeling
- 21 Random testing
- 22 Develop test parameters
- 23 Finalize schematics
- 24 Validation simulation
- 25 Reliability modeling
- 26 Complete product layout
- 27 Continuity verification
- 28 Design rule check
- 29 Design package
- 30 Generate masks
- 31 Verify ma<sup>3</sup>
- 32 Run
- 3<sup>3</sup>



Doing more work upfront can help avoid downstream rework.

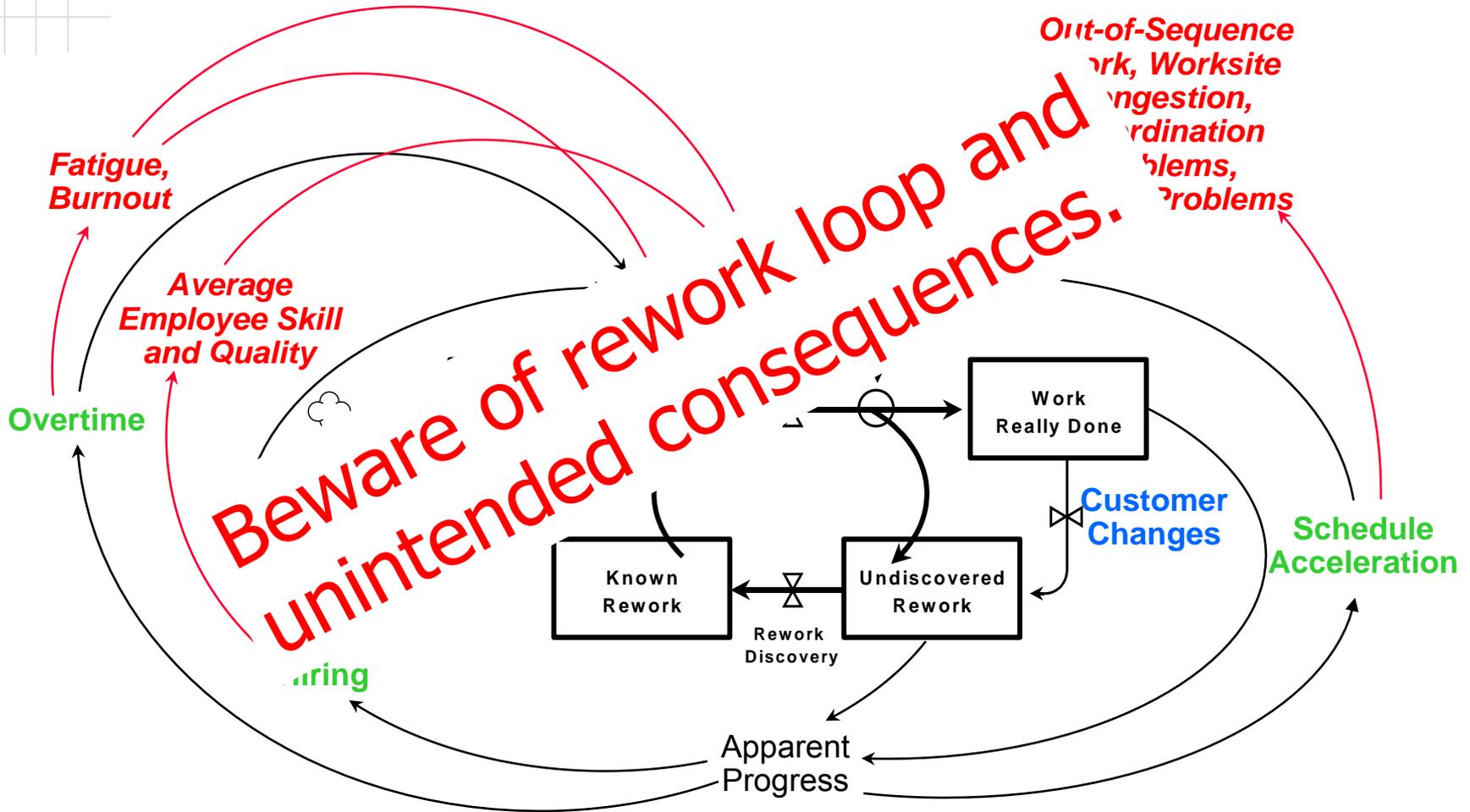
Courtesy of Steve D. Eppinger.  
Used with permission.

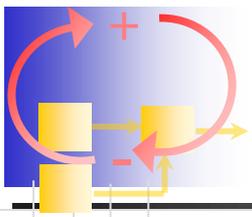




# Takeaway 7: Unplanned Iterations generate rework

External factors; management responses; side effects



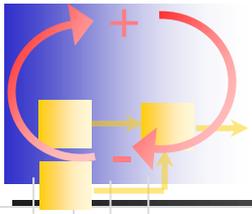


# Takeaway 8: Adding new personnel to a late project...

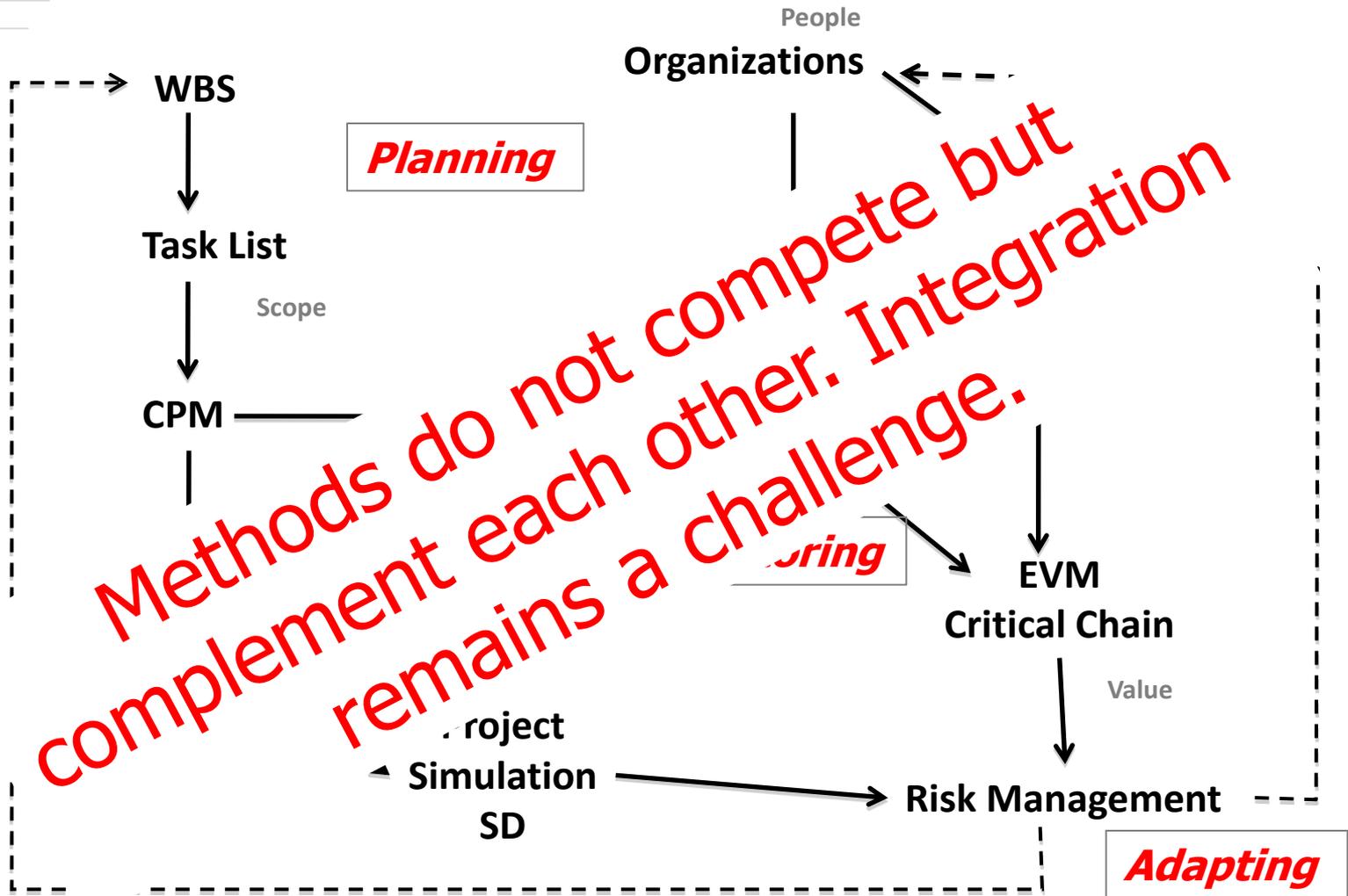
- ...can delay it even further
- Brooks' Law holds when
  - ... the experience dilution impact of adding staff is significant (10-20% of existing staff), or when experience dilution is more moderate (50% of experience of existing staff) but the time to add the help is long compared to the remaining duration of the project

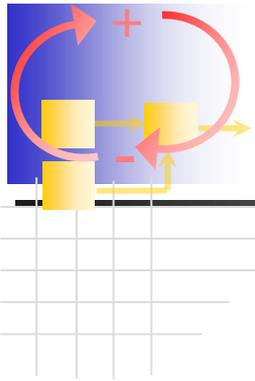
*Sometimes the "help" will delay you further*



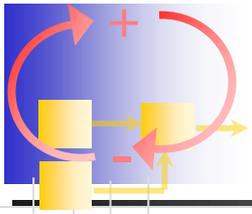


# Takeaway 9: Project Management Framework



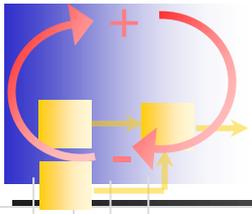


# Project Success Factors



# Why projects fail ...

- Selected the wrong product (system) concept to develop
  - Market Risk, Technological Risk
- Human Dimension
  - Wrong person as project manager
  - Reward and Incentive systems not aligned
  - Dysfunctional Team Structure/Organization
- Upper management is non-supportive
- Inadequately defined tasks, goals ...(ambiguity is never removed)
  
- “Impossible” mission
  - Over-scoped, under-funded, not enough time
- Wrong corrective measures
  - kicks off vicious circles (SD)... burnout, fatigue...
- Project “end game” is not planned, no post-project learning



# What is a successful project?

- What are the assessment criteria?
- What does the comparison refer to (original objectives, changed ones, similar past projects)?
- Who assesses?
- When is the assessment/comparison made?

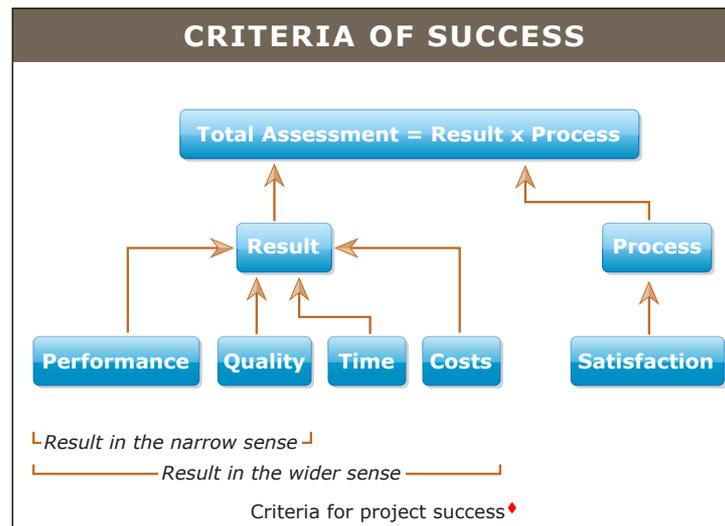
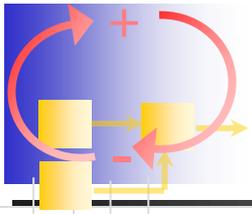
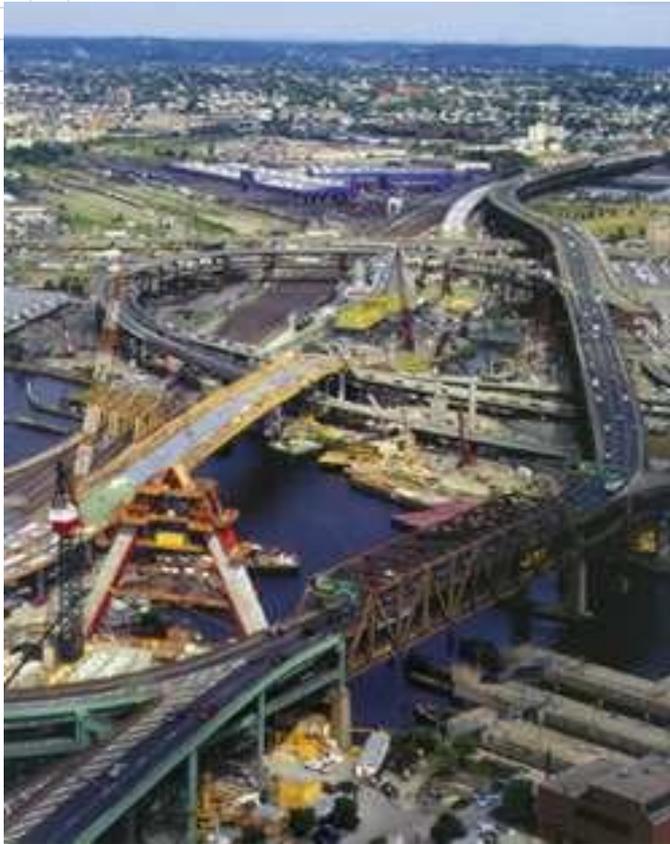


Image by MIT OpenCourseWare.



# Were/are the following projects a success?



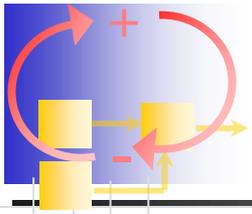
Source: Public domain.

## Boston's Big Dig?

## Boeing 787 Dreamliner?

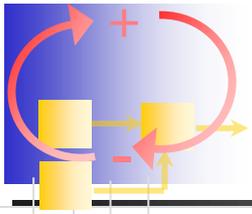
Image of Boeing 787 Dreamliner removed due to copyright restrictions.

An Image of Microsoft Windows 8 has been removed due to copyright restrictions.



# 14 Factors for Project Success

1. (Top) Management is supportive of project
2. Good external connections, especially with customers
3. Clearly defined (and stable) project objectives
4. Carefully execute the project startup-phase, especially for international projects
5. Sufficient project planning
6. Appropriate project control
7. Open and direct communications
8. Appropriate use of formal methods (CPM, DSM, SD...)
9. Suitable un-bureaucratic organization of the project
10. Project Manager (PM) needs to have sufficient power and control
11. Qualification, authority and experience of the PM
12. Management style of the PM should be adapted to the situation
13. Composition of project team
14. Motivation



# PM Skill Balance

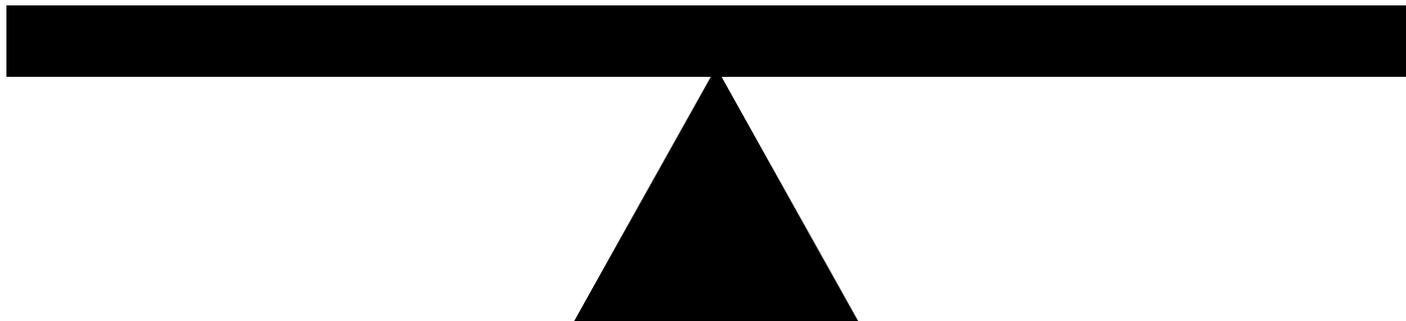
## Analytical Skills

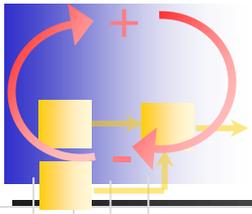
Planning / Forecasting  
Technical Engineering  
Cost/EVM Analysis  
Risk Analysis

## Soft Skills

Visioning  
Intuition  
Risk Identification  
Motivation  
Negotiation  
Persistence

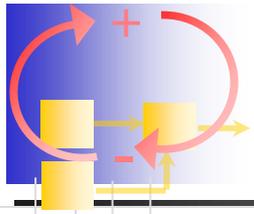
**Project Leadership**





# Final Touches

- Please fill in online official MIT class evaluation
  - Looking for 100% response rate
- Term project evaluations will be posted by the TAs
  - project score is average of referee scores
  - some (brief) feedback provided
- Final class grade -- a week after the semester ends.



# Thank you!

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## Happy Holidays !

From All TA' s

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ESD.36 System Project Management  
Fall 2012

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