Introduction
Simulation-based dynamic project management

401.661 Advanced Construction Technology

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In 1960’s in Greece...
They found a clue but...

How to reduce air pollution caused by emitting vehicles?

- Regulating car driving on an odd and even number basis
- Buying one more car
- Increasing registration fee for new cars
- Buying a used car
Lecture Outline

- Chronic Problems in Project Management
- Dynamic Management Approach
- Dynamic Management Concepts
- Course Administration
Have you experienced ...

- Schedule and budget overruns?
- Projects seemingly stuck at “90%” complete?
- New products with flaws discovered after release?
- Late realization of additional time or resource needs?
- Difficulty comparing the performance of different, “unique” projects?
You are not alone ...

The majority of all development projects fail to meet their time and cost targets, with the overrun typically between 40 and 200 percent.

Sources:

Construction is not an exception. The UK construction industry reports that only 70% of projects delivered within 5% of the tender cost and 38% delivered within 5% of the tender program.

Sources:
- Latham, “Constructing the Team”, HMSO, 1994
Why?

- Unrealistic Goals
- Late Changes
- Poor Program Planning and Management
- Resource Shortages
- Lack of Participants’ Understanding on Requirements
- Lack of Commitment
- Uncertainties
- And so on...
Chronic Problems in PM

Chronic problems in project management persist in spite of advances in planning and management tools.

- Problems encountered during project management are fundamentally dynamic. However, they have been treated statically with a partial view on a project.

As a result, schedule tends to be continuously updated during the project duration without value-adding.
Chronic Problems in PM

- Learning has rarely accumulated across projects.
  - Partly due to the structural problems of projects.
    - R&D Projects: unique each time
    - Construction: process-based work that is performed on an unfixed place by a temporary alliance among multiple organizations [Slaughter, 1999].
  - Also, attributed to the lack of learning mechanism in the traditional network-based planning tools such as CPM, PERT, and PDM.
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건설경영에 대한 새로운 접근

**Observed Problem**
공기지연

**Traditional Approach**
공사자원을 증가시킴

**System Approach**
공기지연을 유발시킨 시스템구조에 기초한 해결 모색
Their Ability to Influence...

External Factors → Events → Patterns of Behavior → System Structure

Ability to Influence:
- Low
- Medium
- High
Dynamic Management Approach Helps...

- Understanding the structure of projects, and how that structure creates behavior
- Designing robust project plans under uncertainty
- Learning across projects
Lecture Outline

✓ Chronic Problems in Project Management
✓ Dynamic Management Approach
  ▪ Dynamic Management Concepts
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Dynamic Management Concepts

- Focus on Dynamic Behavior
- System Structure as Cause of that Behavior
- Emphasis on Internal Dynamics
Examples of Behavior Modes

Growth
- population, project progress, accumulated project costs, etc.

Stability
- unemployment rate, oil price, inventory level, etc.

Decay
- popularity of a movie star, project staffing, change orders during construction, etc.
The basic element of system structure is the feedback loop.

This one is called a “positive,” or “reinforcing” feedback loop.
Exodus....
Loop effects interact with one another, making traditional diagnosis quite difficult.

Such as with this “negative,” or “balancing”, feedback loop, which may slow or reverse growth.
An example: taxi calling system

Use of Taxi Call System

Just-In-Time Service

Average Waiting Time on the Road

+ +
An example: taxi calling system

Use of Taxi Call System

Number of Taxi Refusing People on the Road, Waiting for Calls

Average Response Time to Customers

Just-In-Time Service

Average Waiting Time on the Road

+  +
-  -

+  +
This also happens in PM...

The “dominant” loop on a project may be a controlling loop.
Reinforcing loops complicate that control...
An Example on a Project

Staffing usually experiences a second staffing peak and/or an extended tail.

Why?
An extended tail caused by rework

Staffing Allocation

- Original Work
- Rework

Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7
800. | 600. | 400. | 200. | 0. | 0. | 0.
A second staffing peak caused by rework
Main Elements within Feedback Loops

Cause-Effect Relationships
Experience → Productivity

Time Delayed Action
New Staff → Productivity

Non-linear responses
Productivity → Years of experience
“...Interacting positive and negative feedback loops of cause-effect relationships, with delays and non-linearities are capable of generating all observed modes of behavior...”
Simulating observed behaviors

Program Staff (Original plan, Simulated vs. Actual Data)

- Simulated
- Original Plan
- Data

A Second Staffing Peak Cause by Rework
Emphasis on Internal Dynamics

- System-as-Cause Thinking
  - What can we do to improve our performance and accomplish our objectives.
  - Proactive and offensive

- System-as-Effect Thinking
  - Others did it to us
  - Predictive, reactive, defensive
Potential Benefits of Dynamic Approach

Systems thinking and dynamic modeling provide a new approach

As a World View ...
- Focus on understanding behaviour over time
- Internal feedback and stock-flow structure creates that behaviour
- Integrative, high-level view of projects, business, competition, markets.
- Provides understanding of how the business dynamics work, and critical success factors

As a Process and Tools ...
- Engages management team in strategy dialogue
- Structured approach to analyzing and managing complex issues
- Facilitates communication of strategies, consensus-building, and commitment
- Basis for strategy management and organizational learning
Project Management Context

- Project Planning
  - Mgt. Plan
  - Schedule Plan
  - Contract Mgt. Plan
  - WBS
  - Estimating, planning & risk assess.

- Project Organization
  - Org Structure
  - Work Responsibility
  - Information interfaces
  - How changes affect project, implementation

- Project Monitoring
  - Cost/schedule
  - Technical Performance
  - Technical Risk
  - Programmatic risk
  - Determining factors to monitor, benchmark

- Project Control
  - Cost/schedule Mgt.
  - Baseline Mgt.
  - Configuration Mgt.
  - Problem Resolution
  - Determining responses; risk mgt.; change mgt.

- Process Improvement
  - Analysis of metric data
  - Project-to-project learning
Already applied in many industries..

- **Aerospace/Electronics**
  - Missiles
  - Radars
  - Aircraft
  - Fire Control Systems
  - Guidance Systems
  - Satellites

- **Shipbuilding**
  - Destroyers
  - Carriers
  - Submarines
  - Frigates
  - Commercial
  - Assault Ships

- **Major Construction**
  - Cross-Channel Tunnel
  - Nuclear Power Plants

- **Large Developments**
  - Air Defense / C³ I
  - Telephone
  - Switching Systems
  - Shipboard Control Systems
  - Vehicles
  - Power Trains
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Reading


Grading

Continuous Assessment: 100% (NO Exam)

- Assignments: 20% (4 x 5%)
- Term Project: 70% (only final presentation to be assessed)
- Quizzes, attendance etc: 10%
Others

- Lecture materials will be posted in e-Class of IT4U SNU portal (http://portal.snu.ac.kr).

- Assignments (A1 to A4) and one term project (TP1 to TP3) will be done and assessed in a group of 2-3 students.

- Hard & soft copies (thru e-Class) of the assignments are to be submitted before lecture (* 50% deduction on marks will be applied to late submission).

- Modelling software, Vensim PLE is available at www.vensim.com
Lecturer

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Yehiel Rosenfeld, “Project Management”, MIT 1.401J Course Material, 2000

Sarah Slaughter, “Innovation in construction”, MIT 1.420 Course Material, 1999

Gray and Hughes, “Building Design Management”,


Gray, Hughes and Bennett, “The Successful Management of Design”, Reading, 1994