

Introduction

Simulation-based dynamic project management

401.661 Advanced Construction Technology

Sep. 1st, 2006

Moonseo Park

Assistant Professor, PhD

39동 433

Phone 880-5848, Fax 871-5518

E-mail: mspark@snu.ac.kr

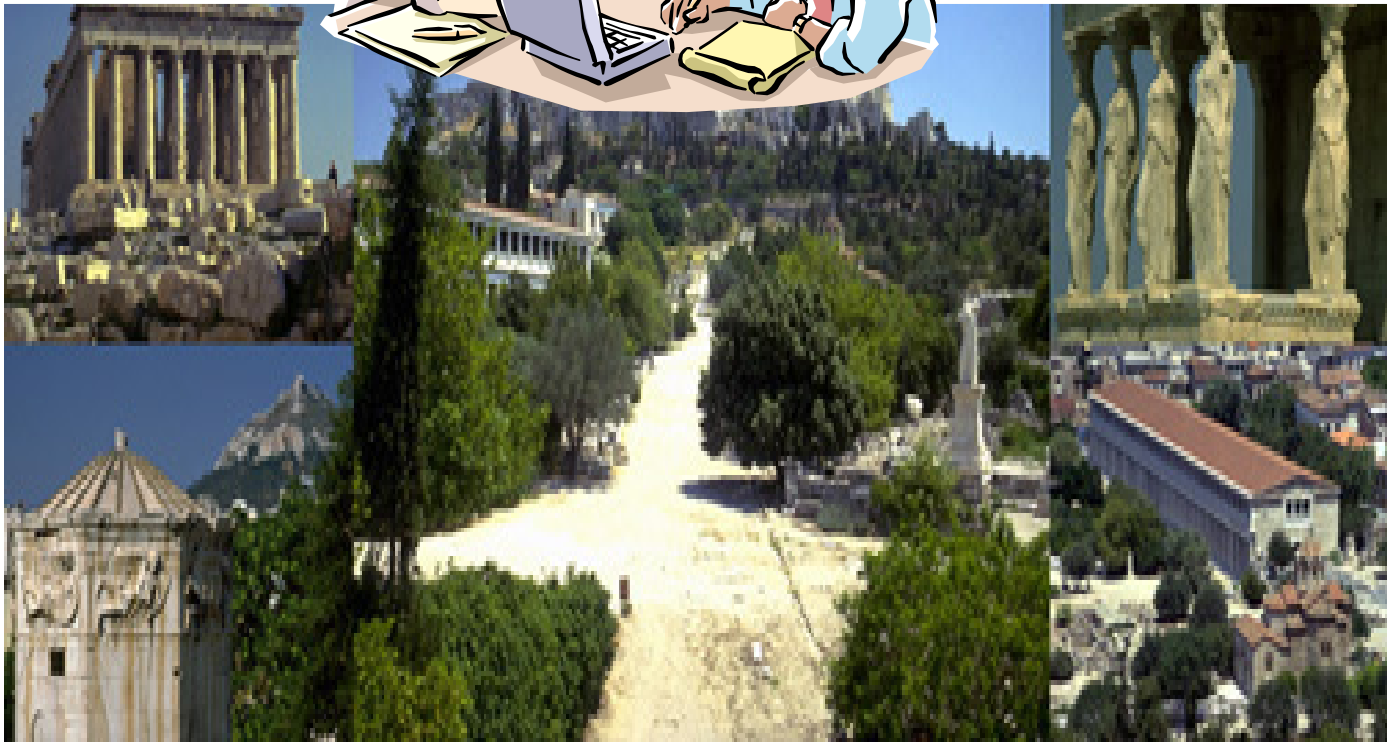
Department of Architecture
College of Engineering
Seoul National University



서울대학교

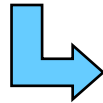
건설기술연구실

In 1960's in Greece...

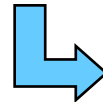


They found a clue but...

Regulating car driving
on an odd and even
number basis



Buying one more
car



Increasing
registration fee
for new cars



Buying a used car

How to reduce air pollution
caused by emitting vehicles?



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:

- Peter Morris and George Hough, *The Anatomy of Major Projects*, Wiley, 1987.
- Dr. Edward B. Roberts, *Strategic Management of Technology: Global Benchmarking*, December 10, 1992 [Results of a survey sponsored by the Massachusetts Institute of Technology, Cambridge, Mass and PA Consulting Group, London, England].

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.



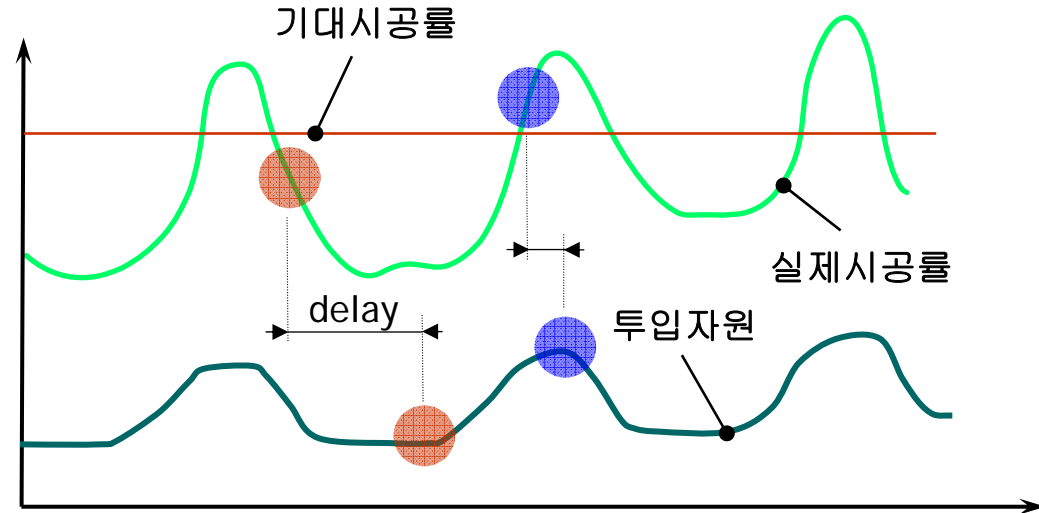
Lecture Outline

- ✓ Chronic Problems in Project Management
 - Dynamic Management Approach
 - Dynamic Management Concepts
 - Course Administration

건설경영에 대한 새로운 접근

Observed Problem

공기지연

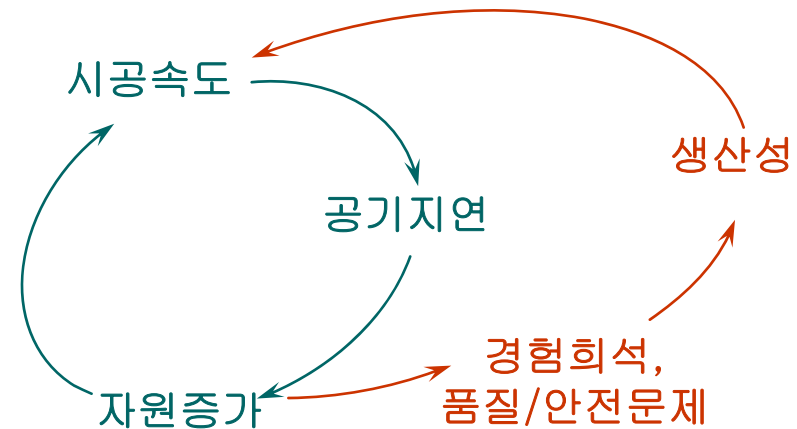


Traditional Approach

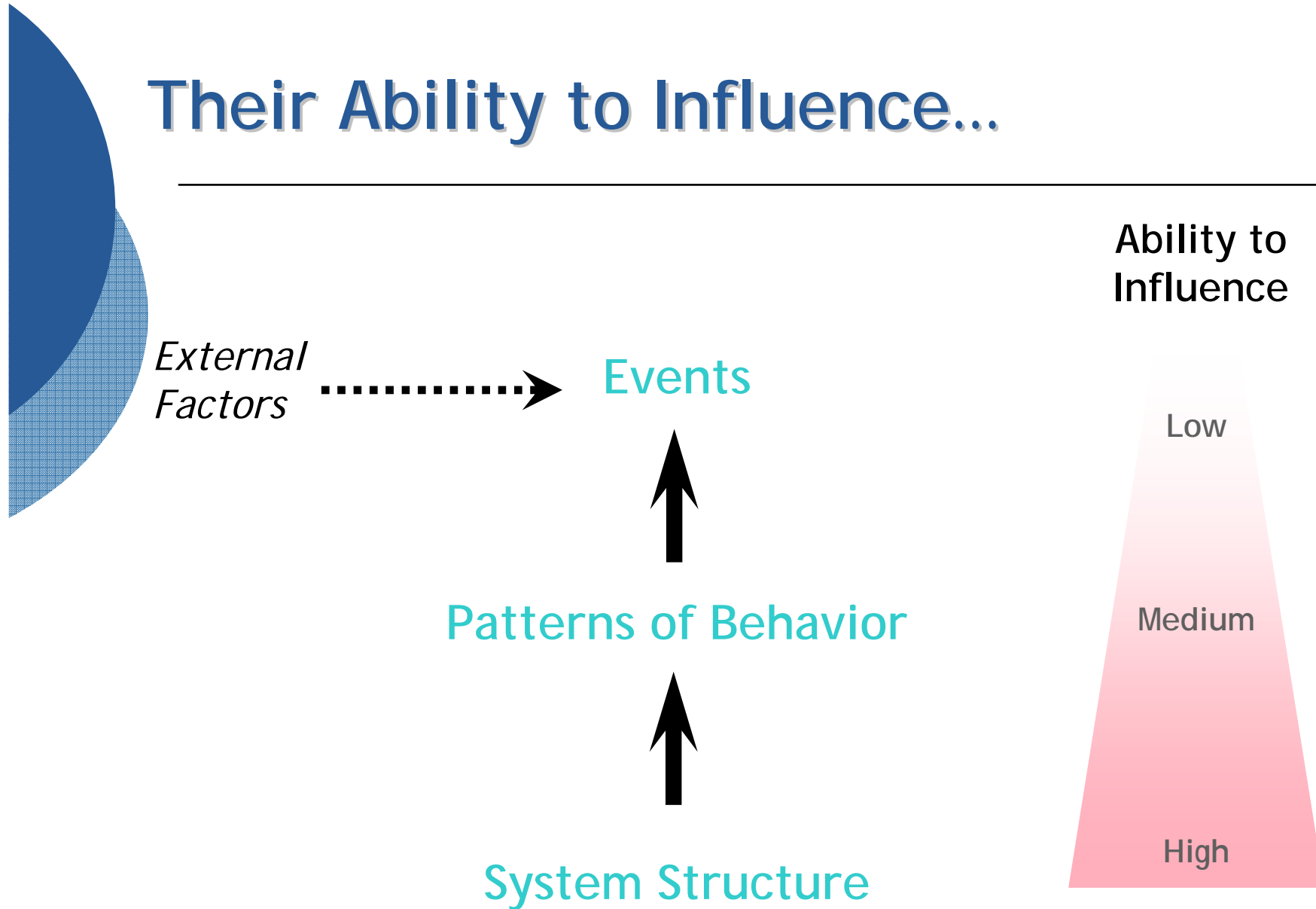
공사자원을 증가시킴

System Approach

공기지연을 유발시킨
시스템구조에 기초한
해결 모색



Their Ability to Influence...





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
 - Course Administration

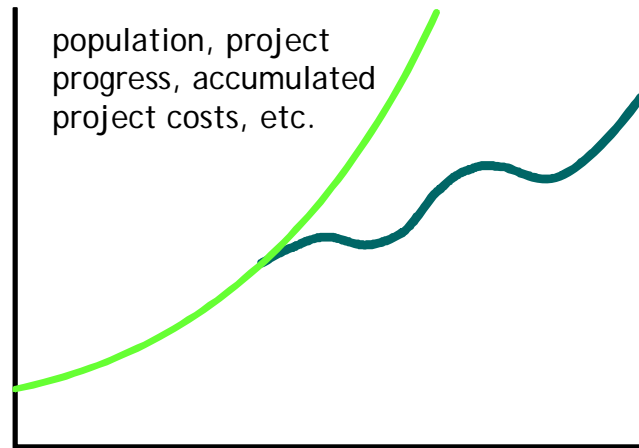


Dynamic Management Concepts

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

Examples of Behavior Modes

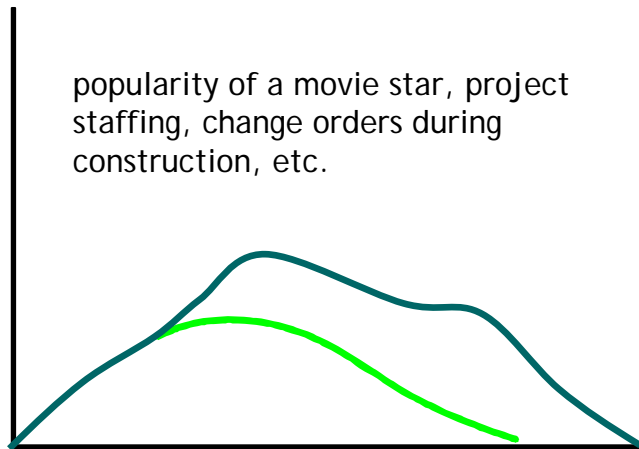
Growth



Stability

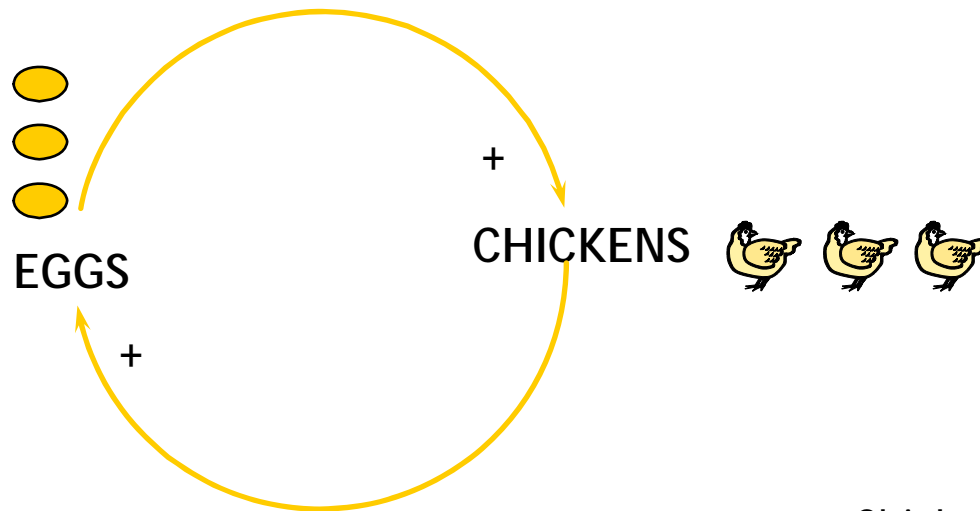


Decay

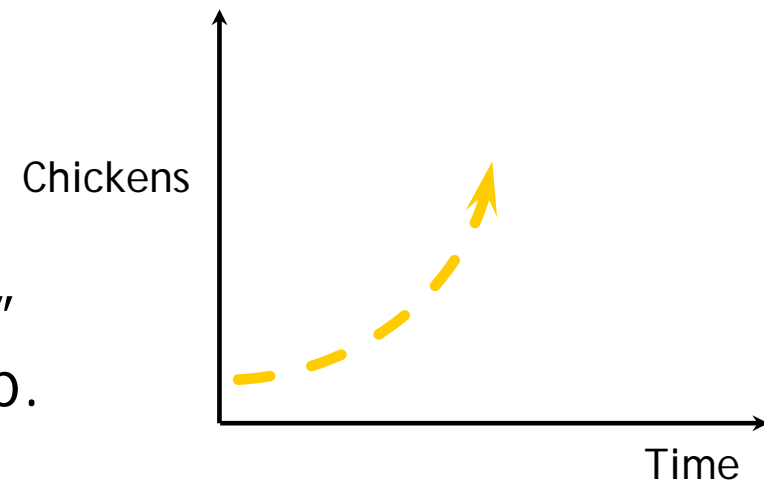


System Structure as Cause of Behaviors

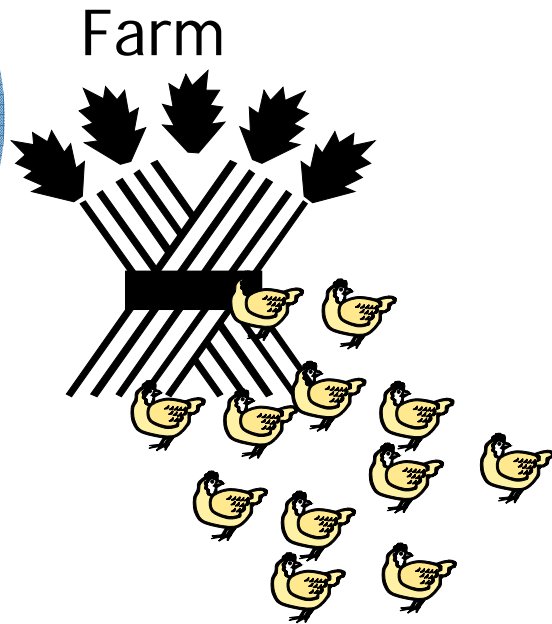
The basic element of system structure is the feedback loop.



This one is called a “positive,” or “reinforcing” feedback loop.

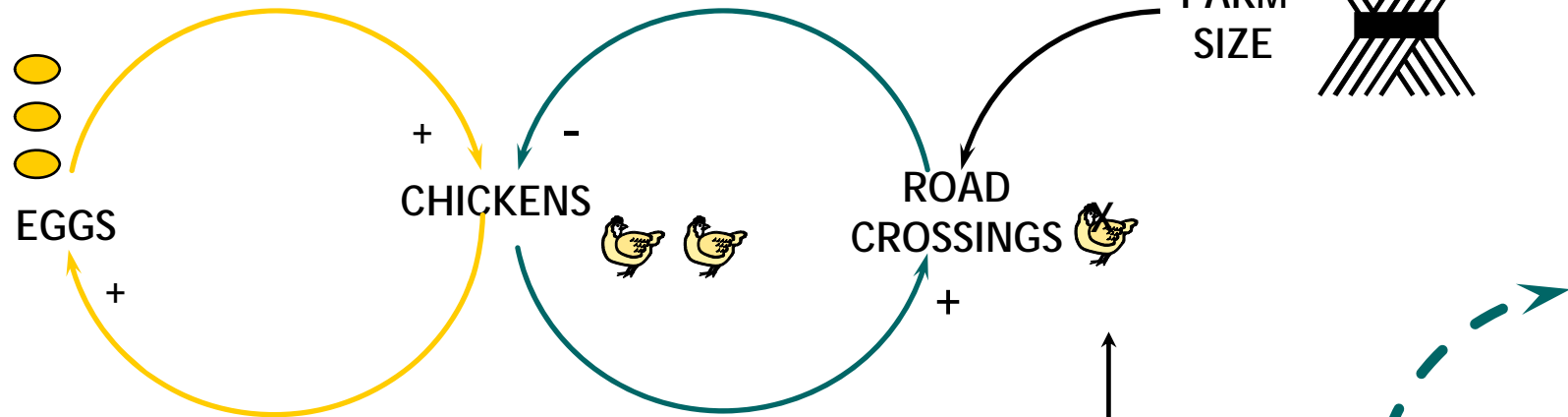


Exodus...

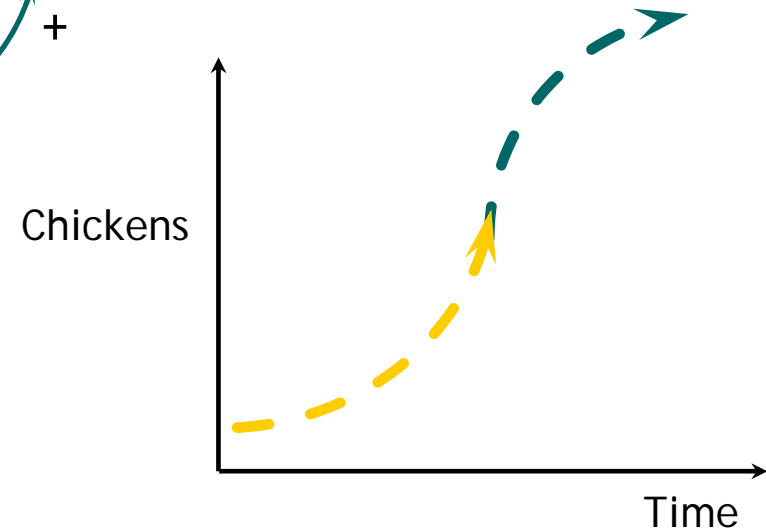


When interacting with one another...

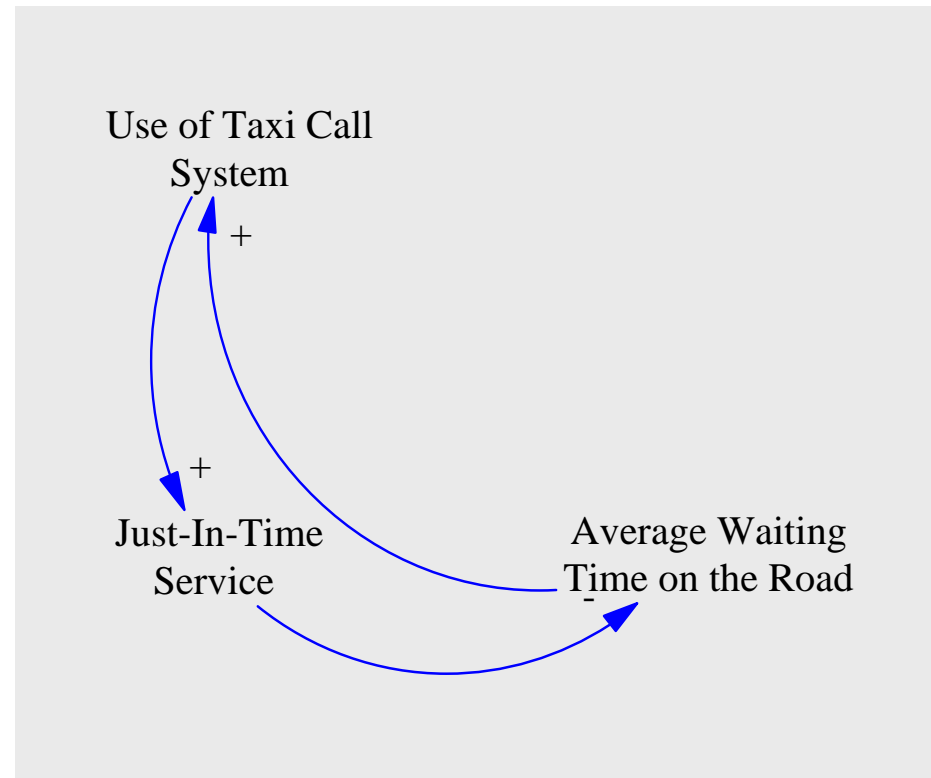
Loop effects interact with one another, **making traditional diagnosis quite difficult.**



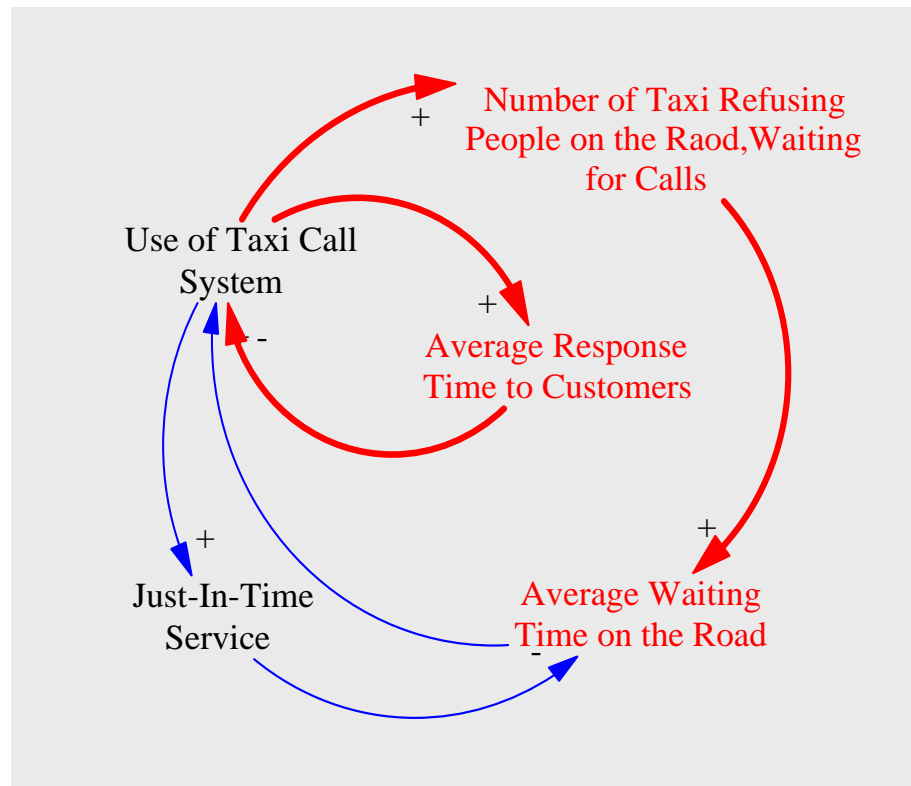
Such as with this
“**negative,**” or “**balancing**”,
feedback loop, which may
slow or reverse growth.



An example: taxi calling system

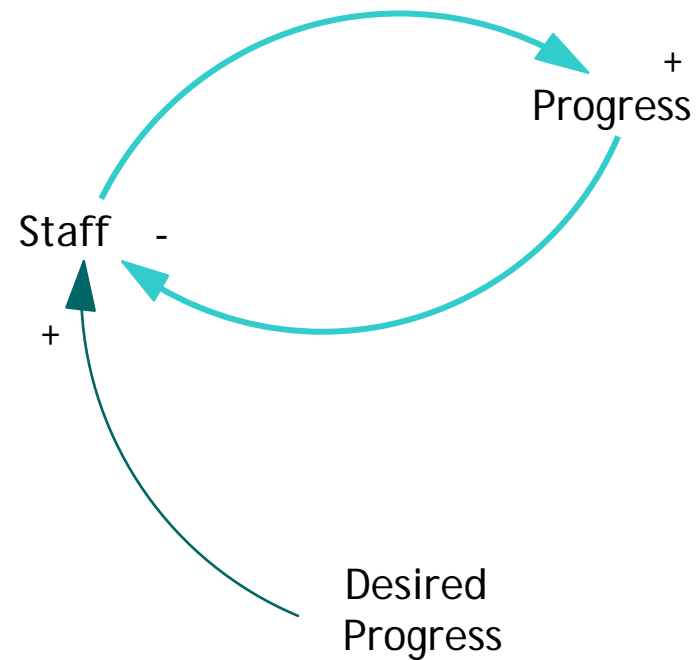


An example: taxi calling system

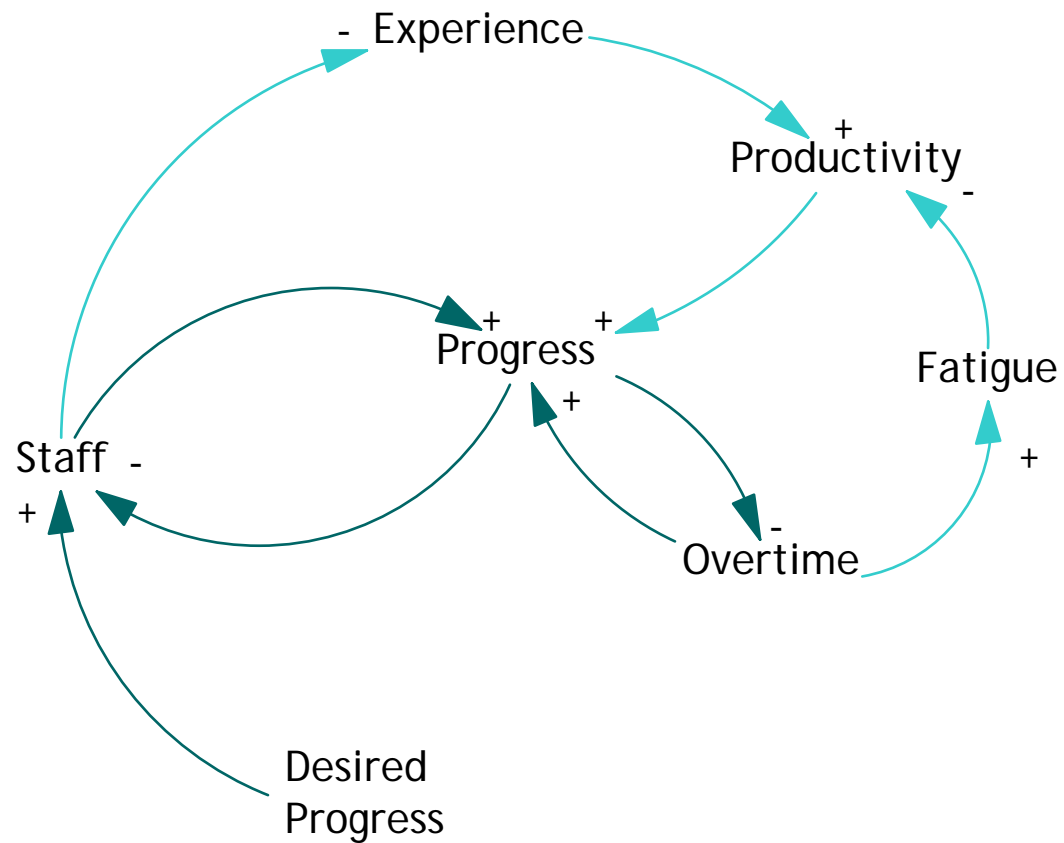


This also happens in PM...

The “dominant” loop on a project may be a **controlling loop**.

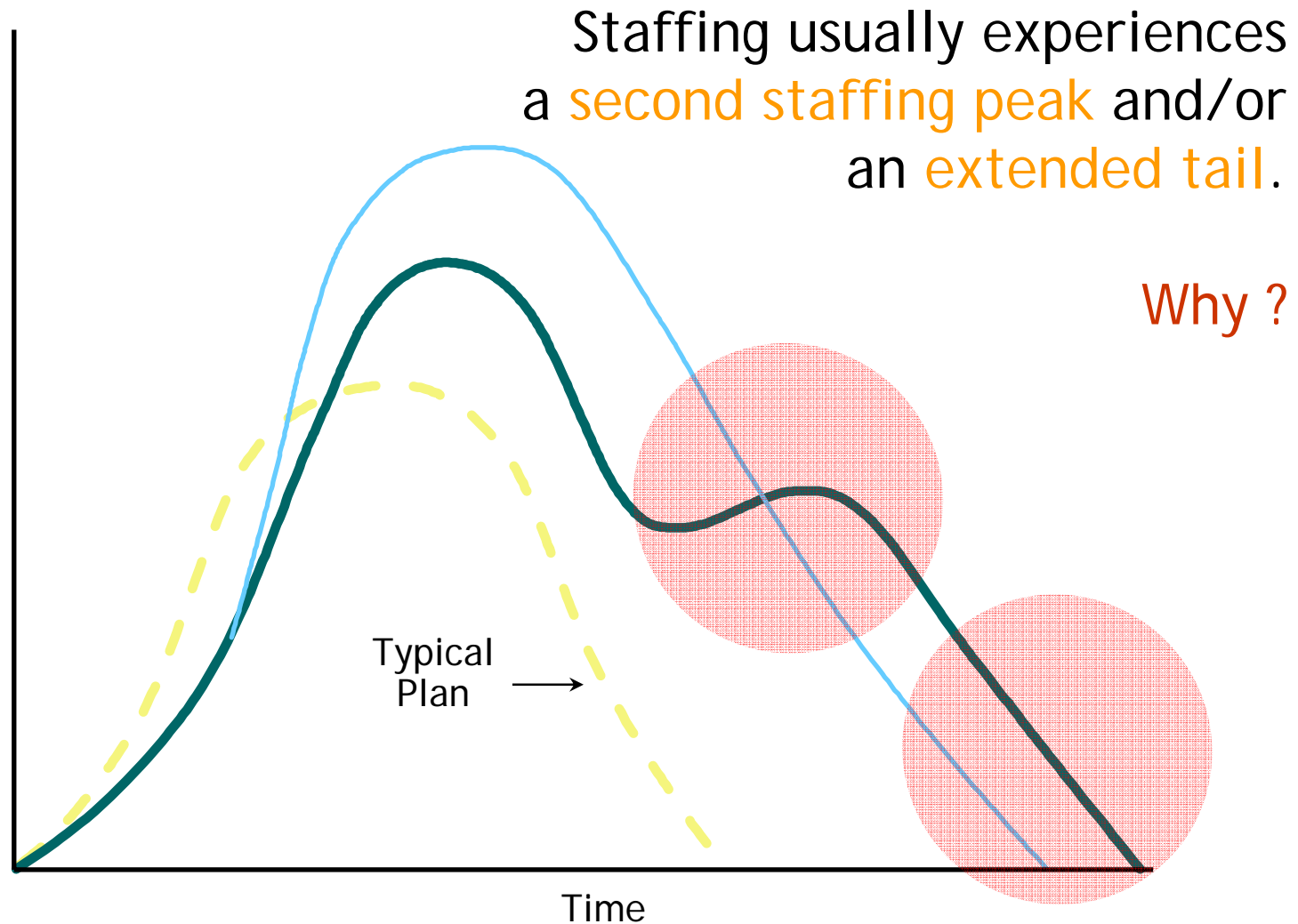


Reinforcing loops complicate that control...

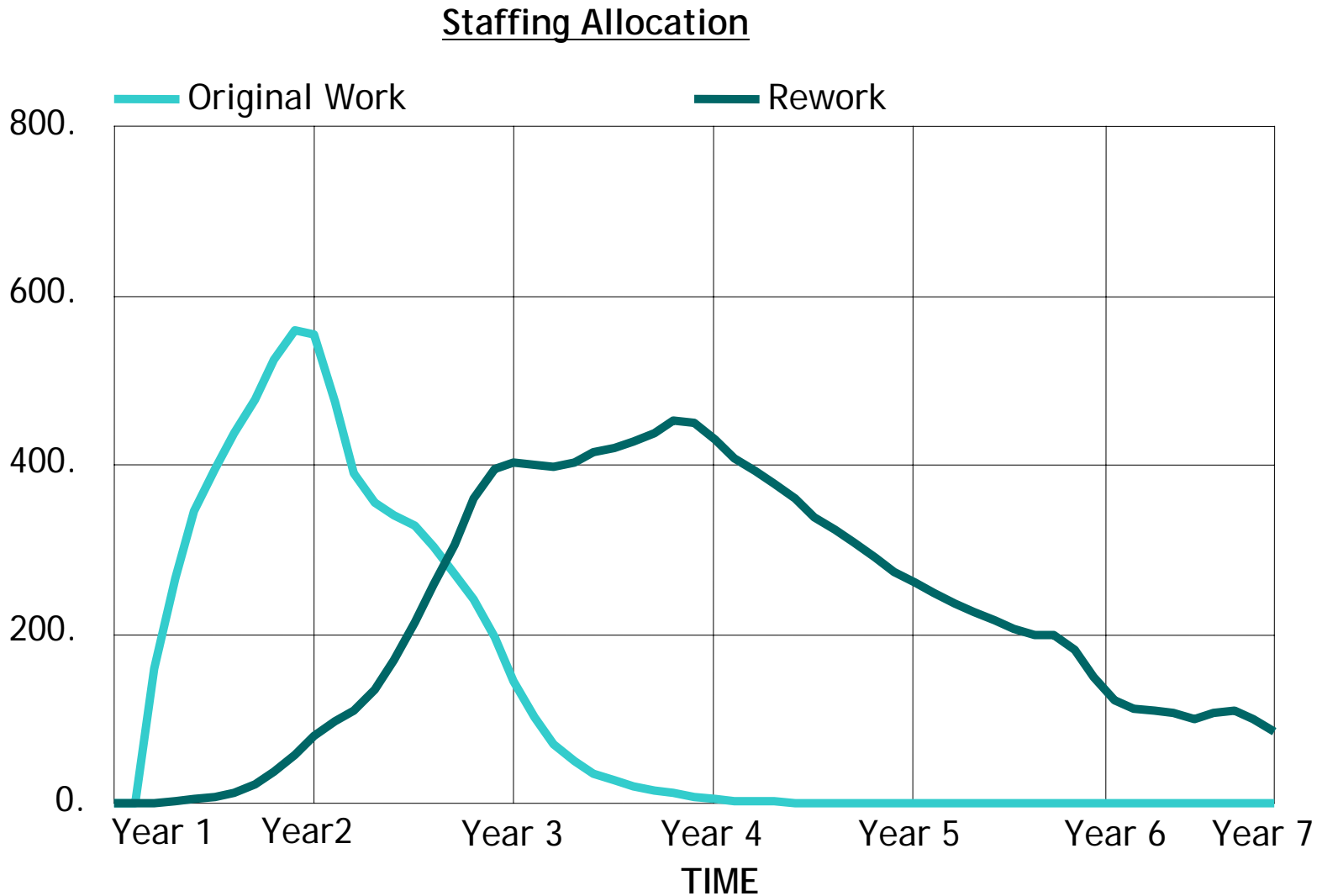


An Example on a Project

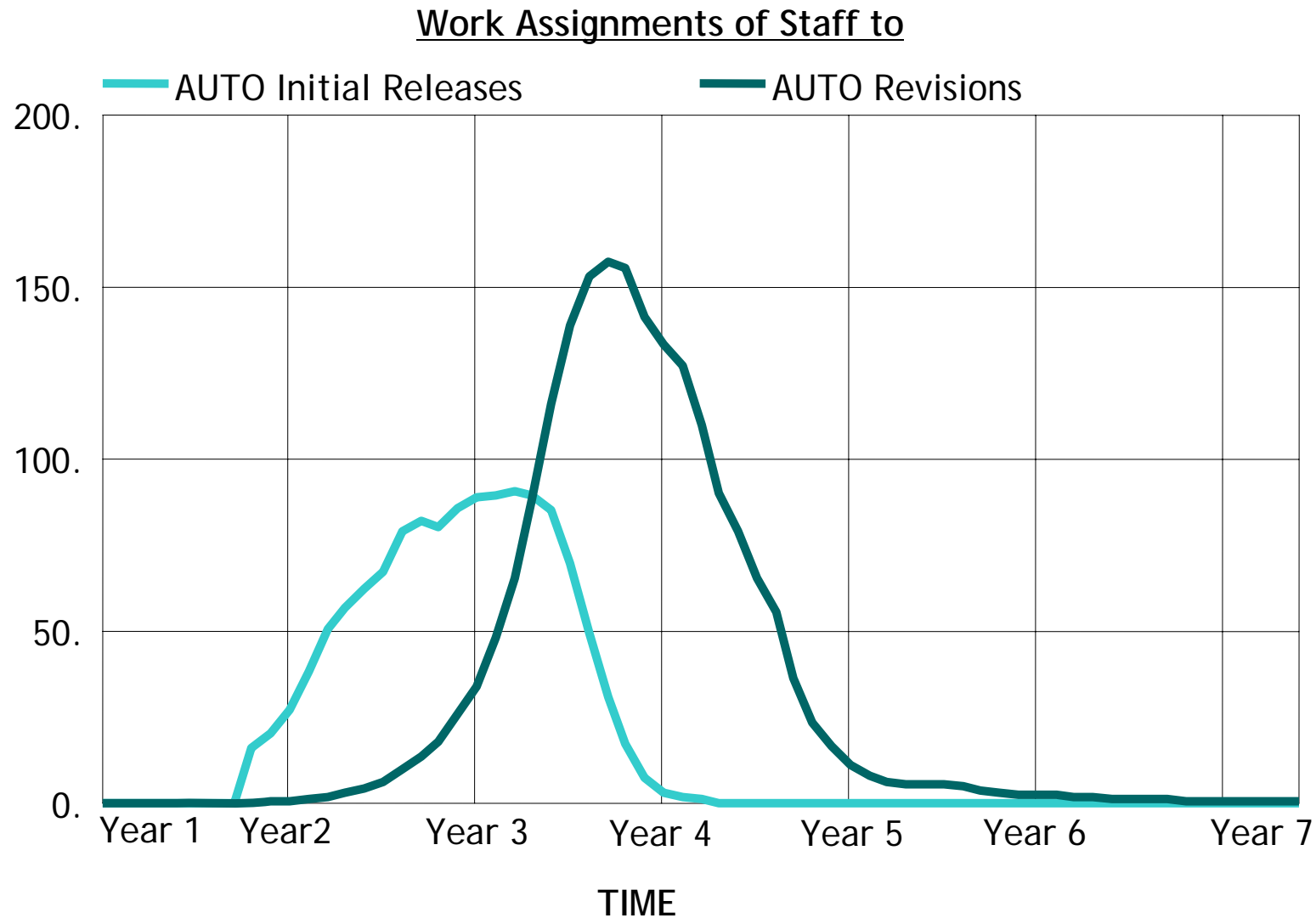
Project Staffing



An extended tail caused by rework



A second staffing peak caused by rework

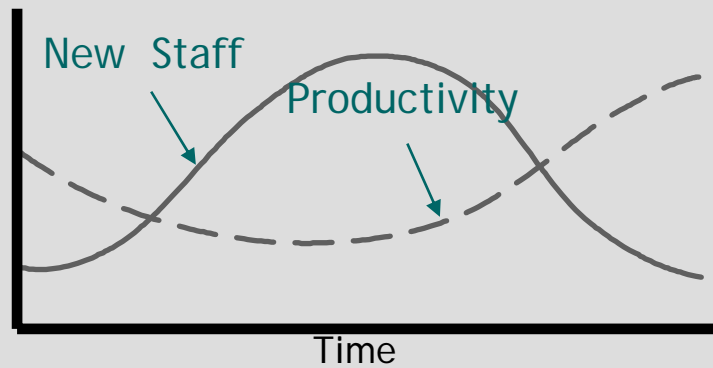


Main Elements within Feedback Loops

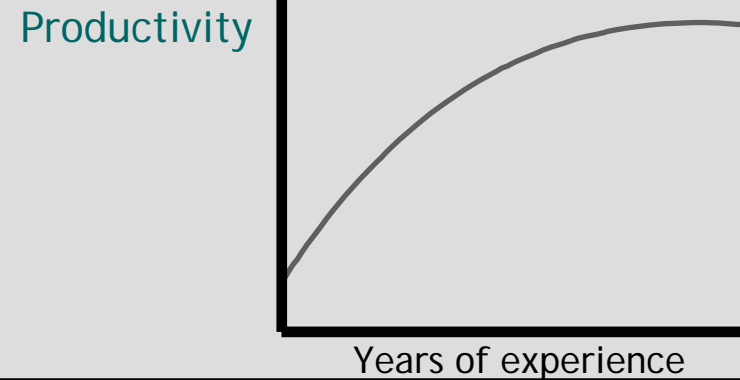
Cause-Effect Relationships

Experience  Productivity

Time Delayed Action



Non-linear responses



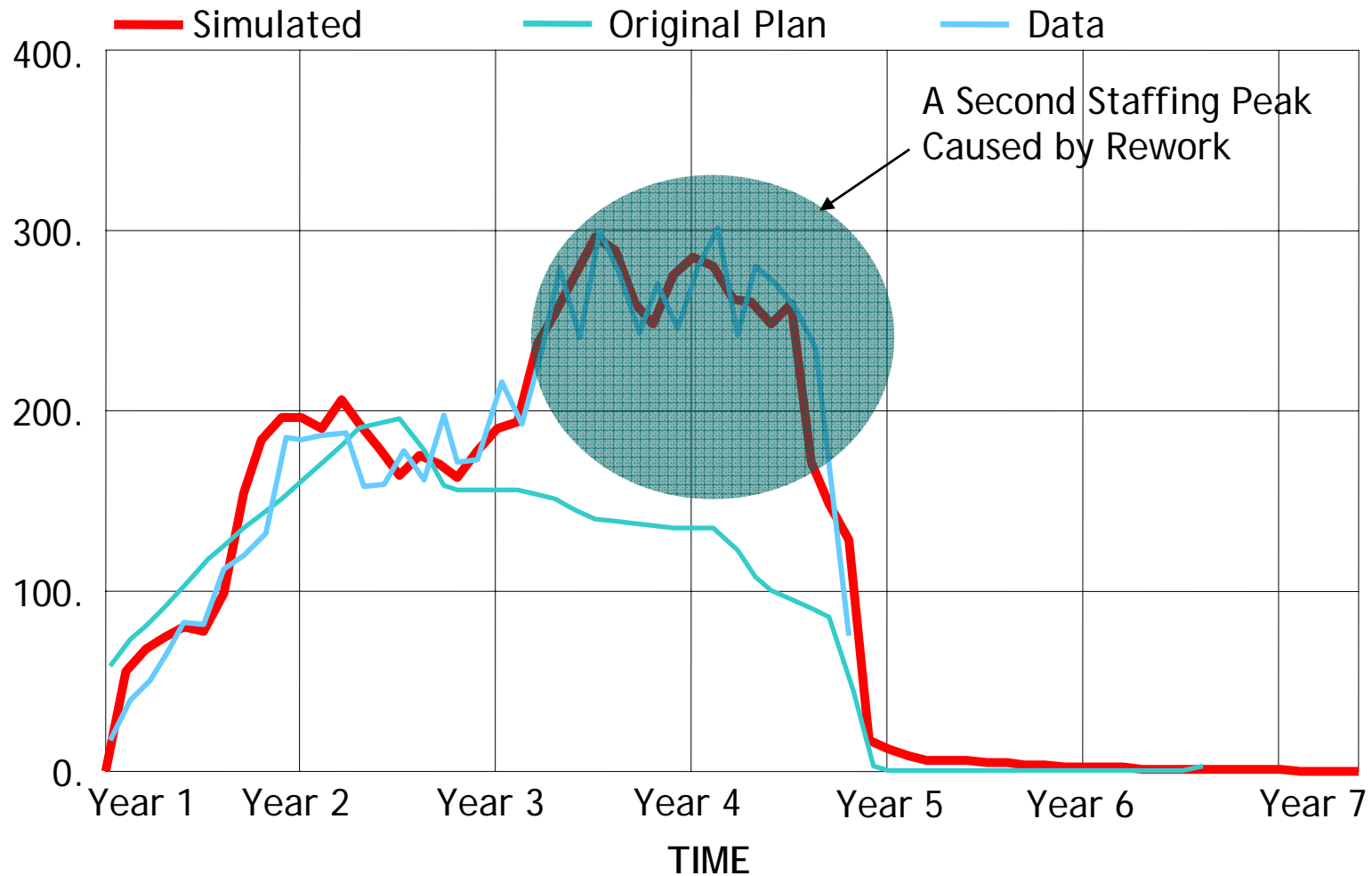


Generating observed modes of behaviors

“...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)





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

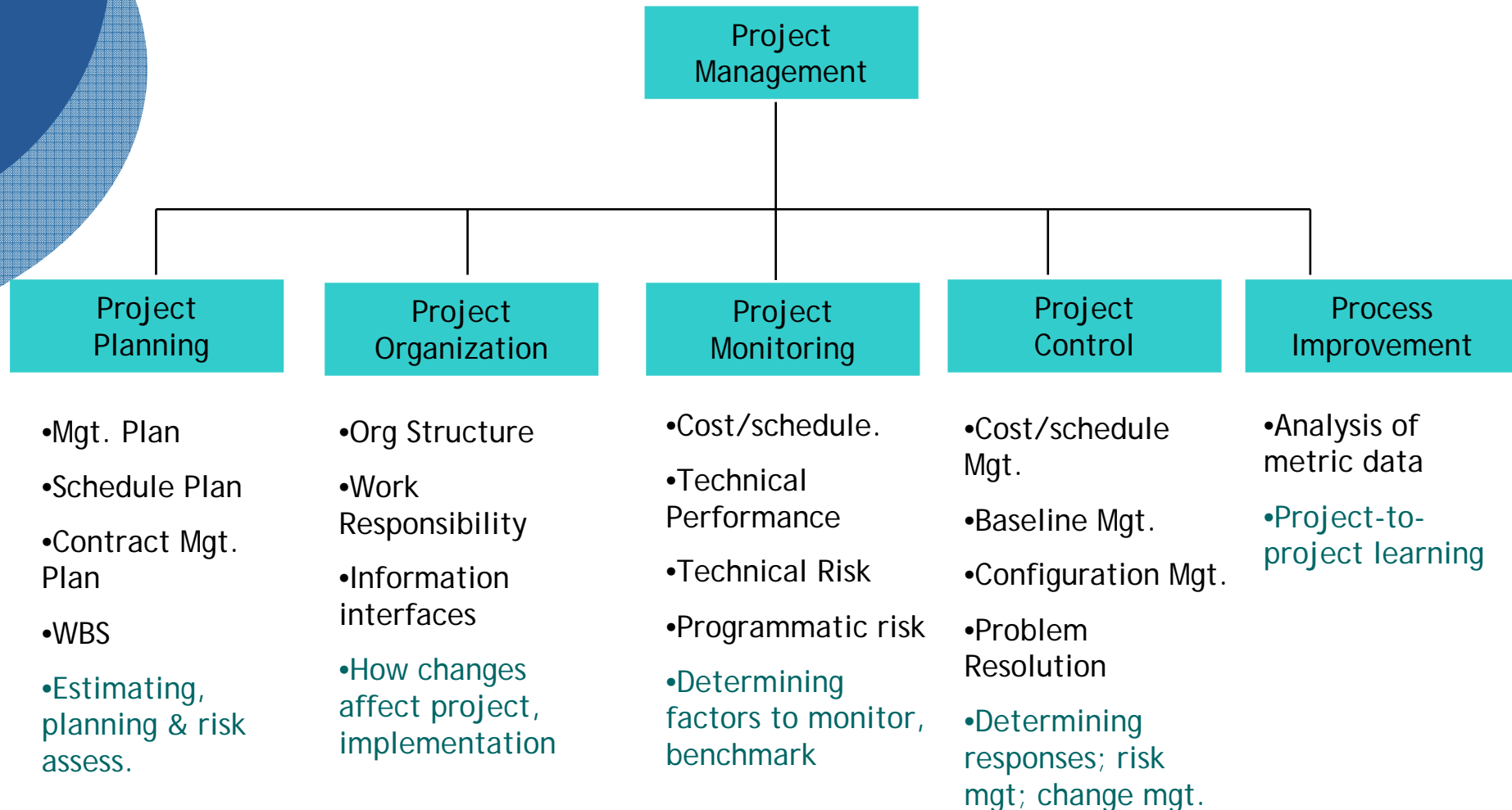
As a World View ...

- 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

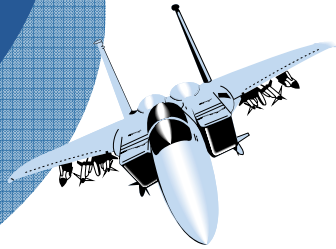
As a Process and Tools ...

- 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

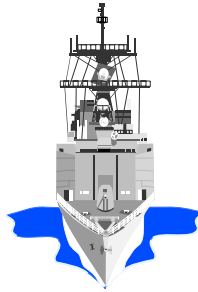


Already applied in many industries..



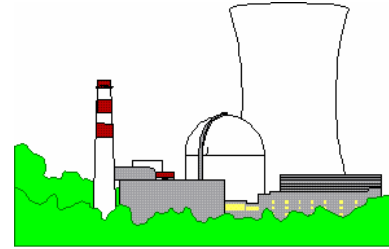
Aerospace/ Electronics

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 / C³I
Telephone
Switching Systems
Shipboard Control
Systems
Vehicles
Power Trains



Lecture Outline

- ✓ Chronic Problems in Project Management
- ✓ Dynamic Management Approach
- ✓ Dynamic Management Concepts
- Course Administration



Reading

- R1: John D. Sterman, "System Dynamics Modelling for Project Management", MIT online publication at <http://web.mit.edu/jsterman/www/SDG/project.html>, 1992
- R2: Terry Williams et. Al, "The Effects of Design Changes and Delays on Project Costs", Journal of the Operational Research Society, Vol 46, pp 809-818, 1995
- R3: James M. Lyneis *, Kenneth G. Cooper, Sharon A. Els, "Strategic management of complex projects: a case study using system dynamics", System Dynamics Review, Vol. 17, No. 3, 2001
- R4: Pena-Mora, Feniosky; Park, Moonseo, " Dynamic Planning for Fast-Tracking Building Construction Projects", Journal of Construction Engineering and Management, Vol 127, Issue 6, 2001
- R5: Park, Moonseo, Yashada, "Model-based Construction Policymaking: Singapore Government's Policy to Diffuse Prefabrication to the Private Sector", Journal of Construction Engineering and Management, Submitted 2004 (to be distributed)
- R6: Park, Moonseo, "Model-based Dynamic Resource Management for Construction Projects", Automation in Construction, 2005 vol 5
- **Main Textbook: "Business Dynamics", John D. Sterman, 2000, McGraw-Hill**



Grading

Continuous Assessment: 100% (NO Exam)

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

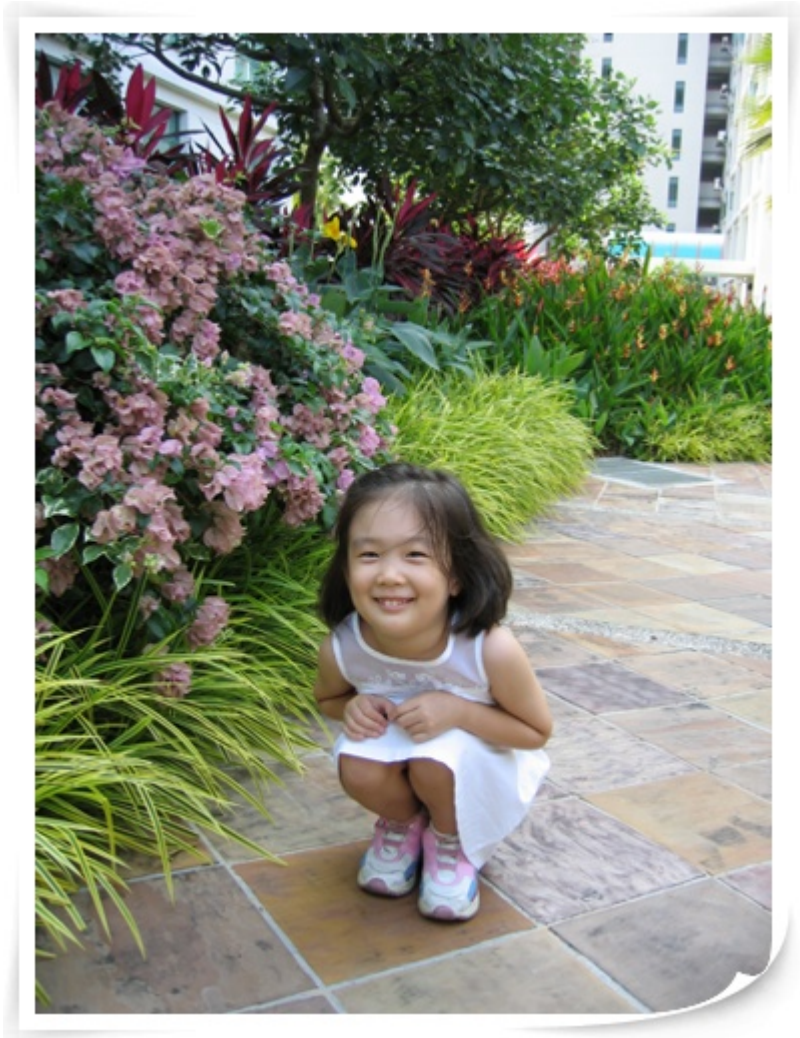


Others

- 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

180 cm, 80kg
Assistant Prof.,
PhD from MIT
E-mail: mspark@snu.ac.kr



References

- Avraham Shtub, Jonathan F. Bard, Shlomo Globerson, "Project management : engineering, technology, and implementation", Englewood Cliffs, NJ, Prentice Hall, 1994
- Frederick E. Gould, Nancy Joyce, Chapter 8, "Construction project management", Upper Saddle River, NJ, Prentice Hall, 1999
- James M. Lyneis *, Kenneth G. Cooper, Sharon A. Els, "Strategic management of complex projects: a case study using system dynamics", System Dynamics Review, Vol. 17, No. 3, 2001
- Christopher M. Gordon, "Choosing appropriate construction contracting method", J. of Construction Engineering & Management, Vol. 120, No. 1, 1994
- Feniosky Pena-Mora, Jim Lyneis, "Project control and management", MIT 1.432J Lecture Material, 1998
- Barrie, D.S., and Paulson, B.C., "Professional Construction Management", McGraw Hill, 1992
- Halpin, D.W., "Financial and Cost concepts for construction management", John Wiley & Sons, 1995
- 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", .
- Murdoch and Hughes, "Construction Contracts: Law and Management", E&FN SPON, 1996
- Gray, Hughes and Bennett, "The Successful Management of Design", Reading, 1994