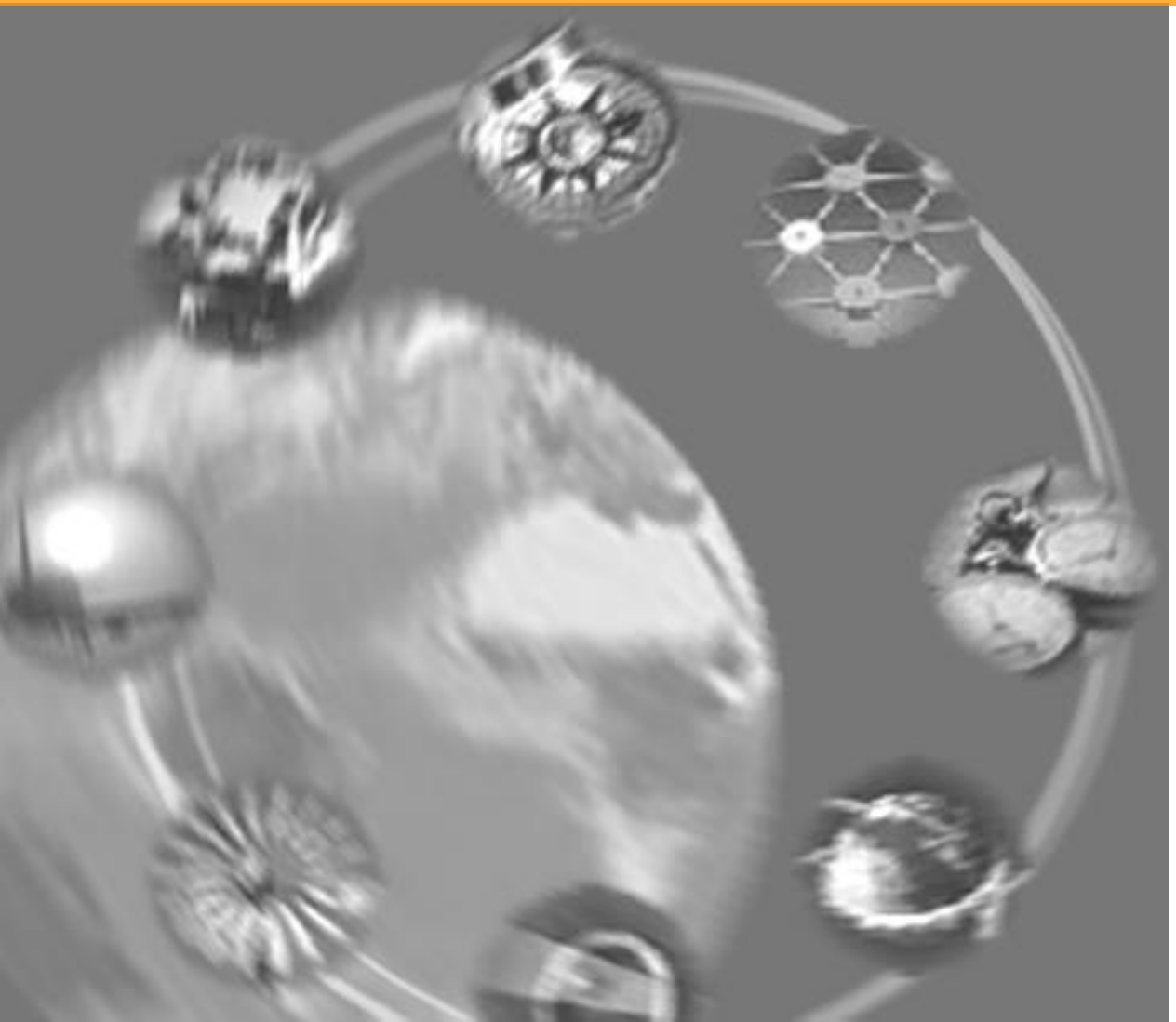
Introduction

Simulation-based dynamic project management

401.661 Advanced Construction Technology



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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.

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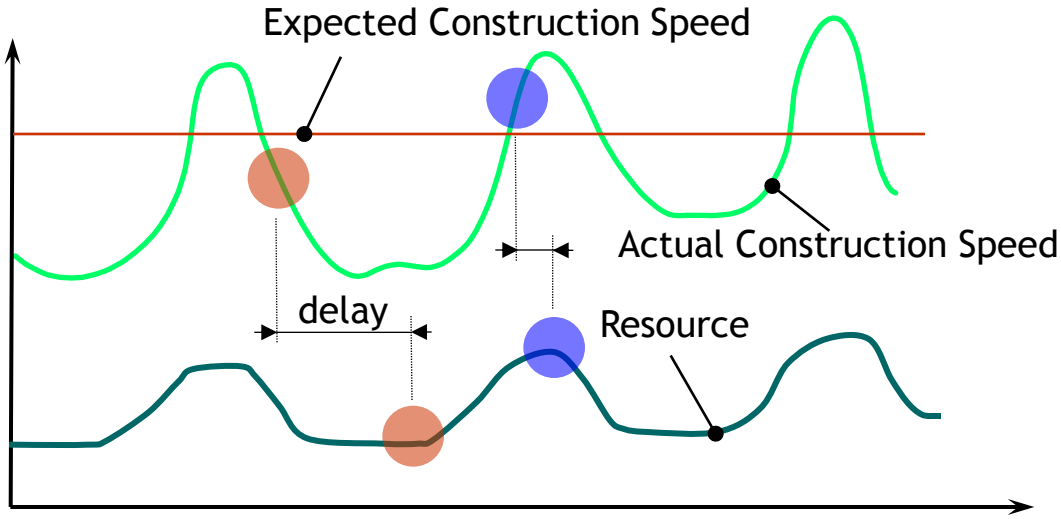
New Approach to PM

Observed Problem

Schedule delay

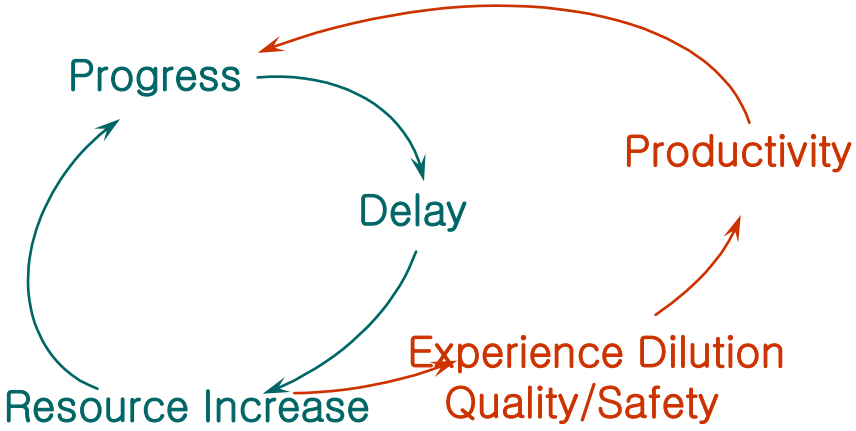


Traditional Approach

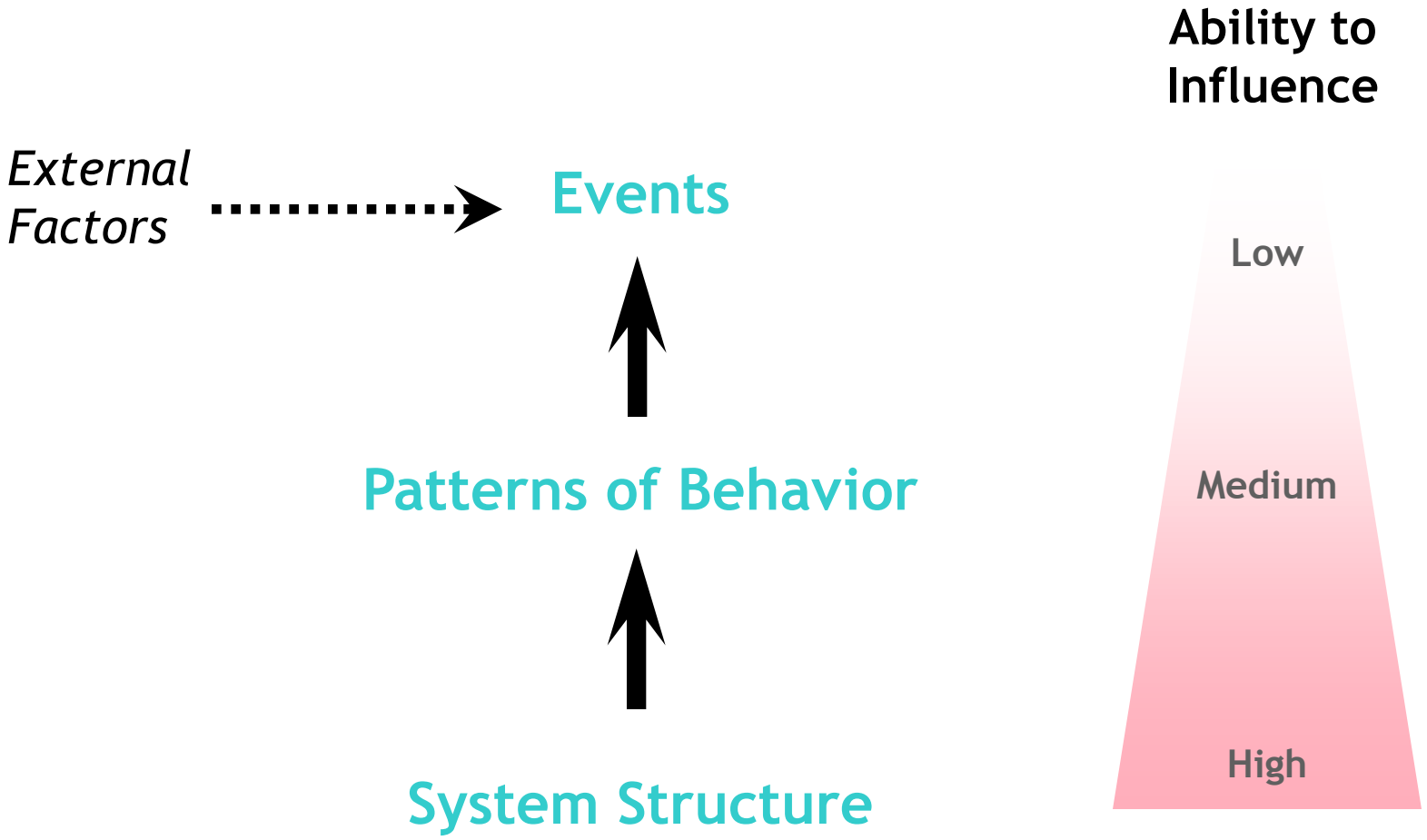
Increasing resources

System Approach

Focusing on the system context in which the problem occurred



Their Ability to Influence…



Dynamic Management Approach Helps…

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

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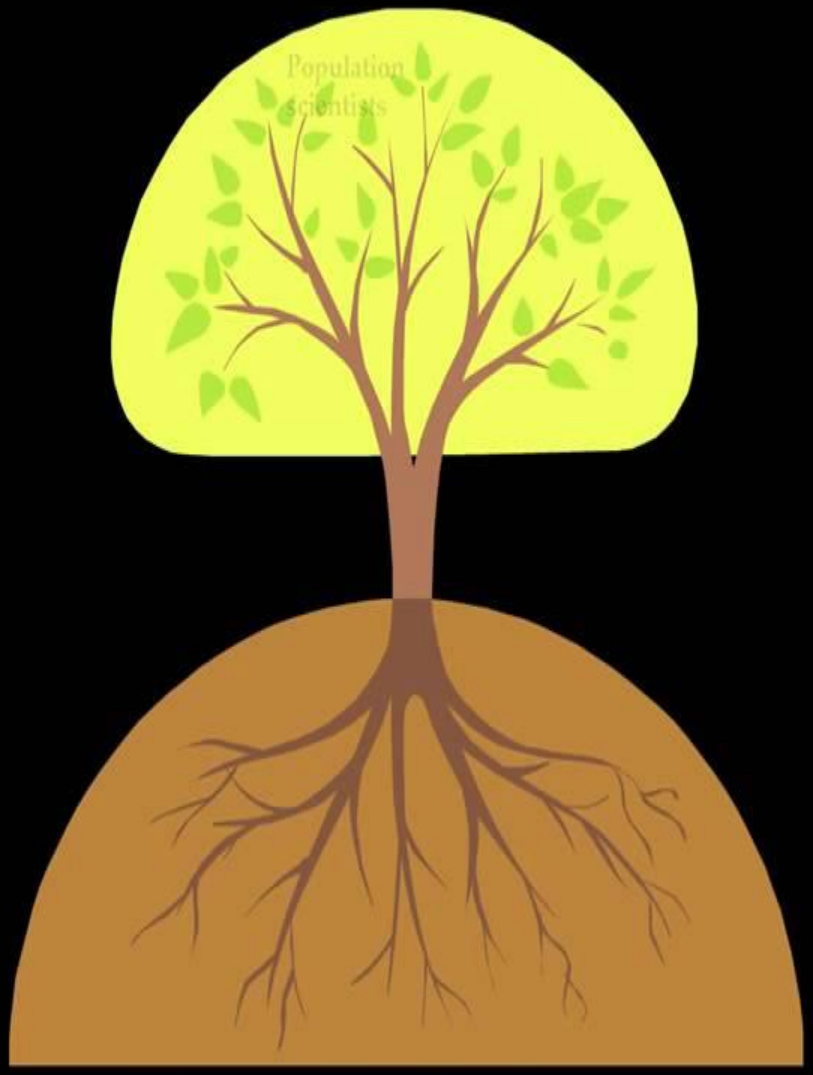
The premise

The structure of the system (시스템구조) generates its *behavior* (*행태*), which is observed as a phenomenon (현상).



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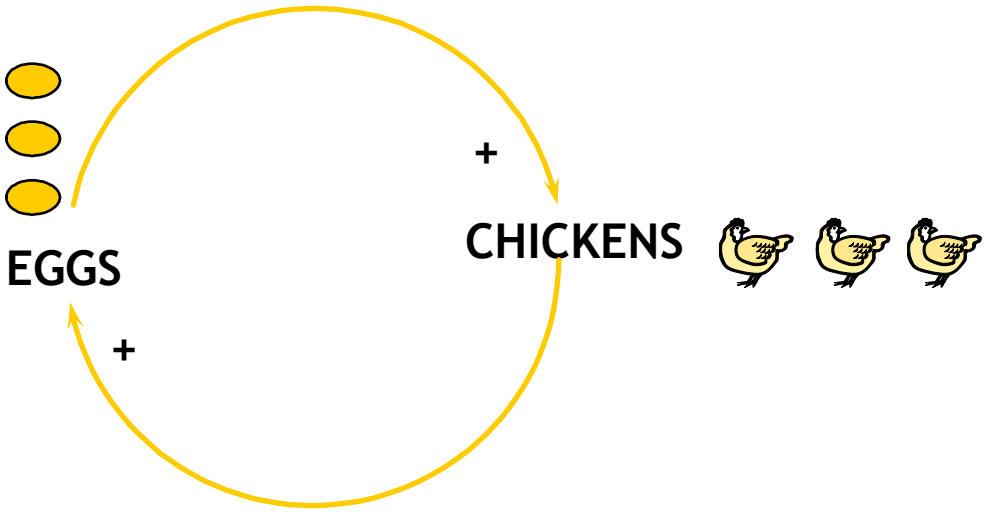
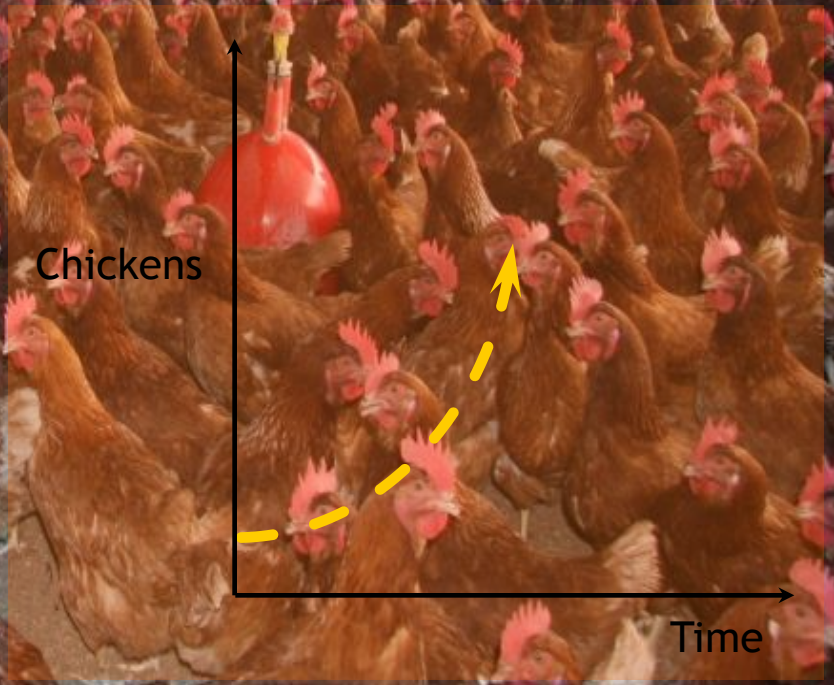
System Structure as Cause of Behaviors

The basic element of system structure is the feedback loop.

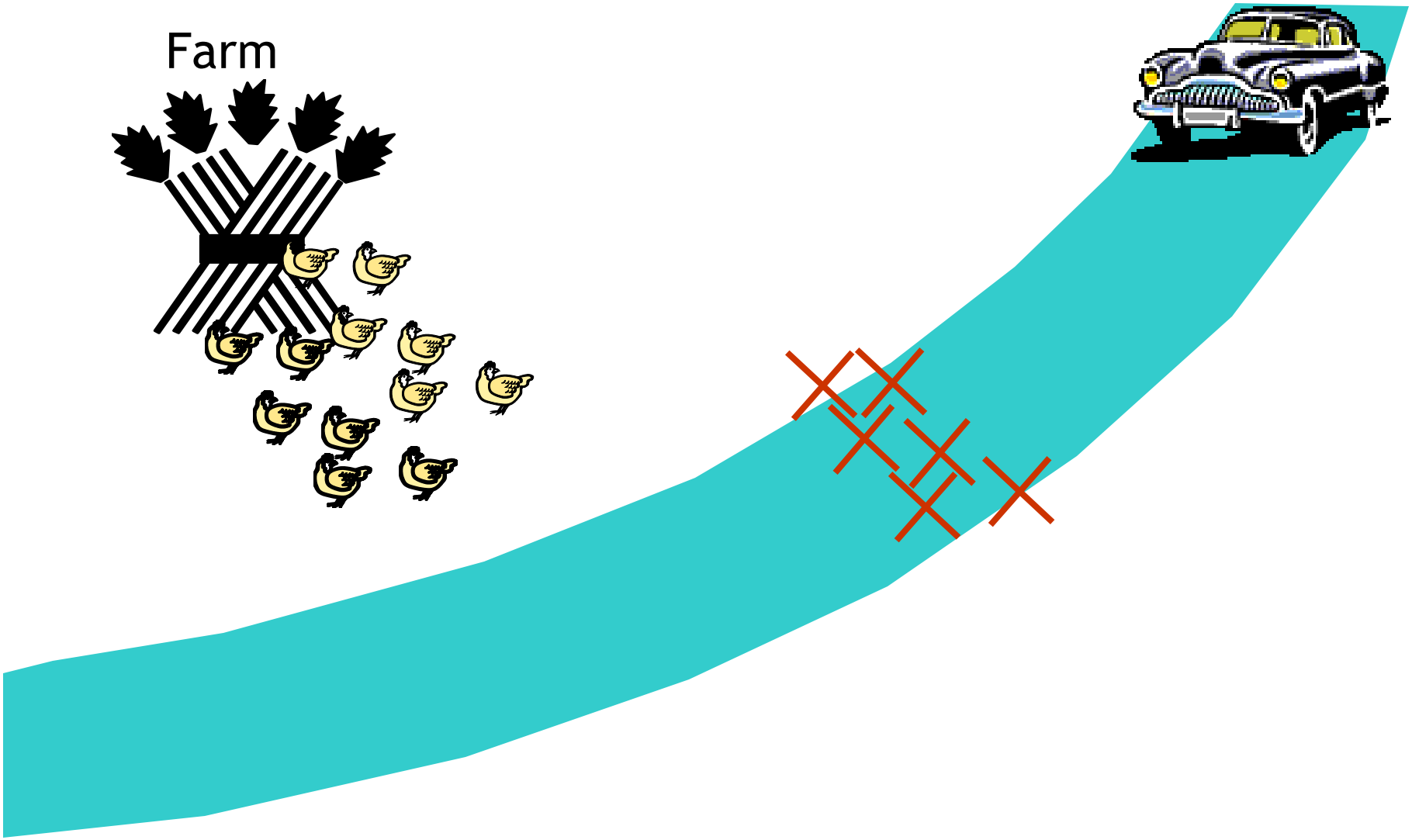


This one is called a "positive," or "reinforcing" feedback loop.

As a result….

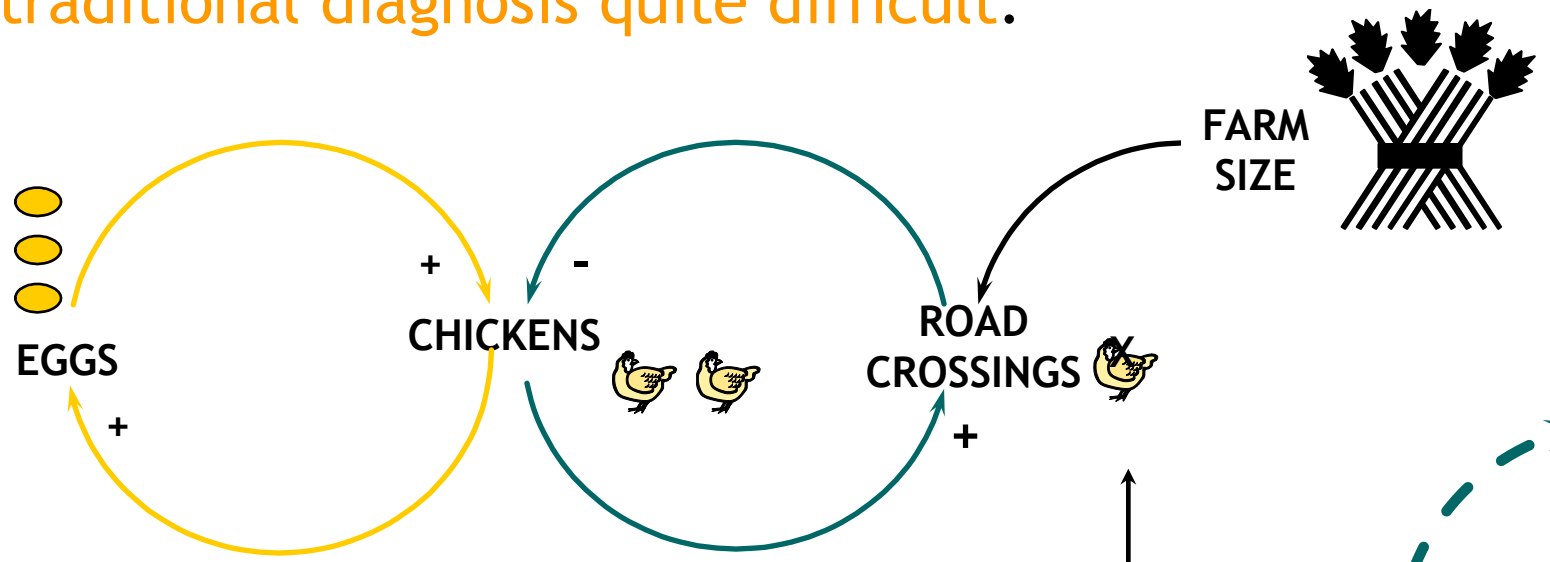


Exodus….

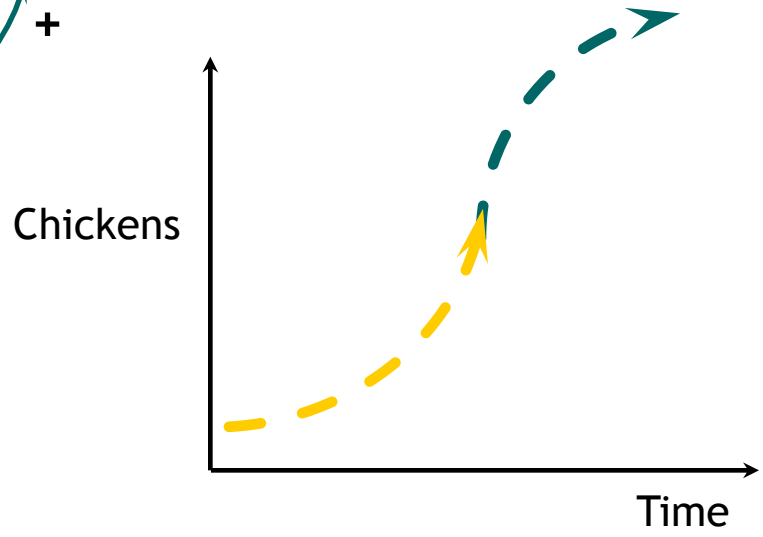


When interacting with one another…

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

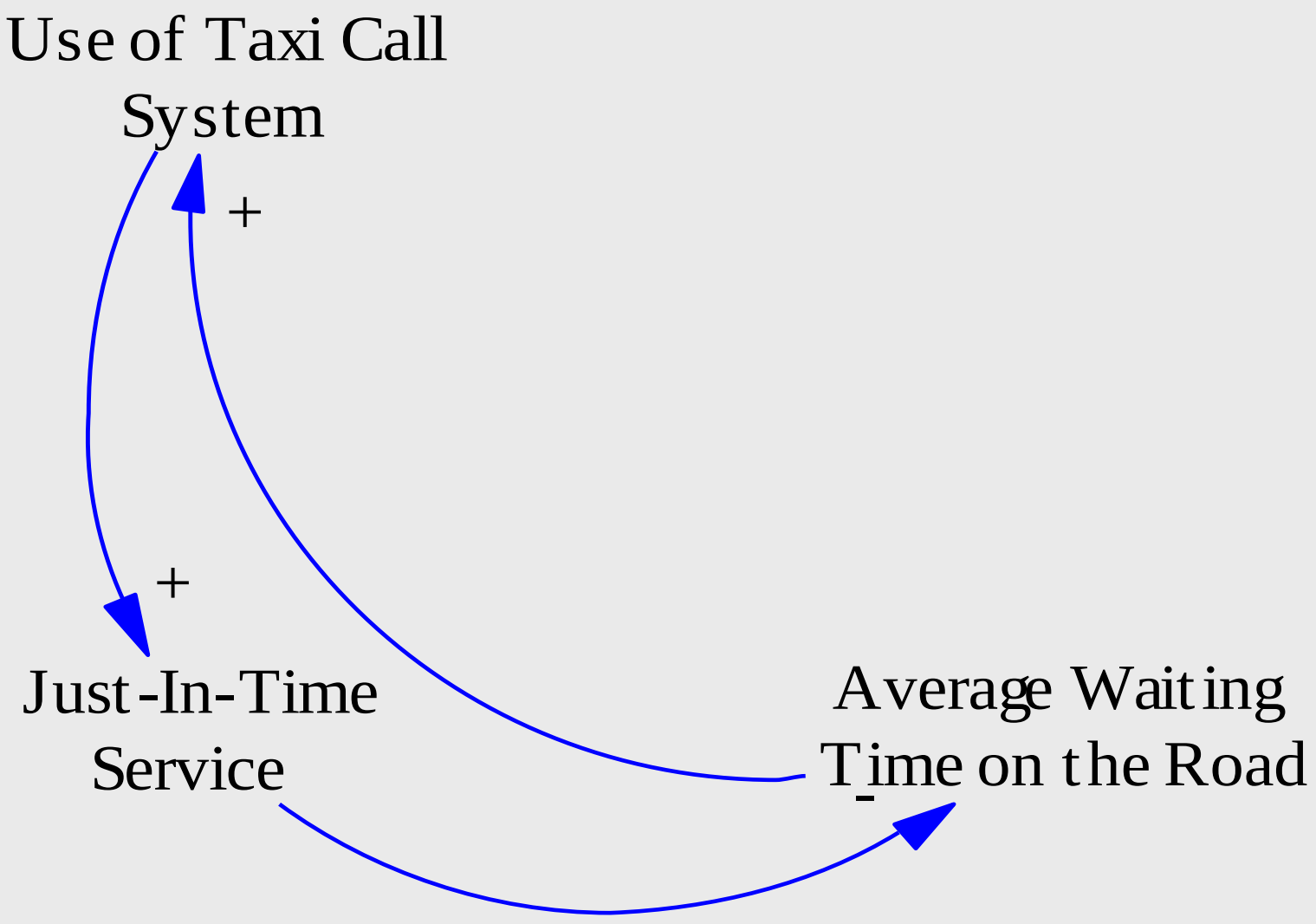


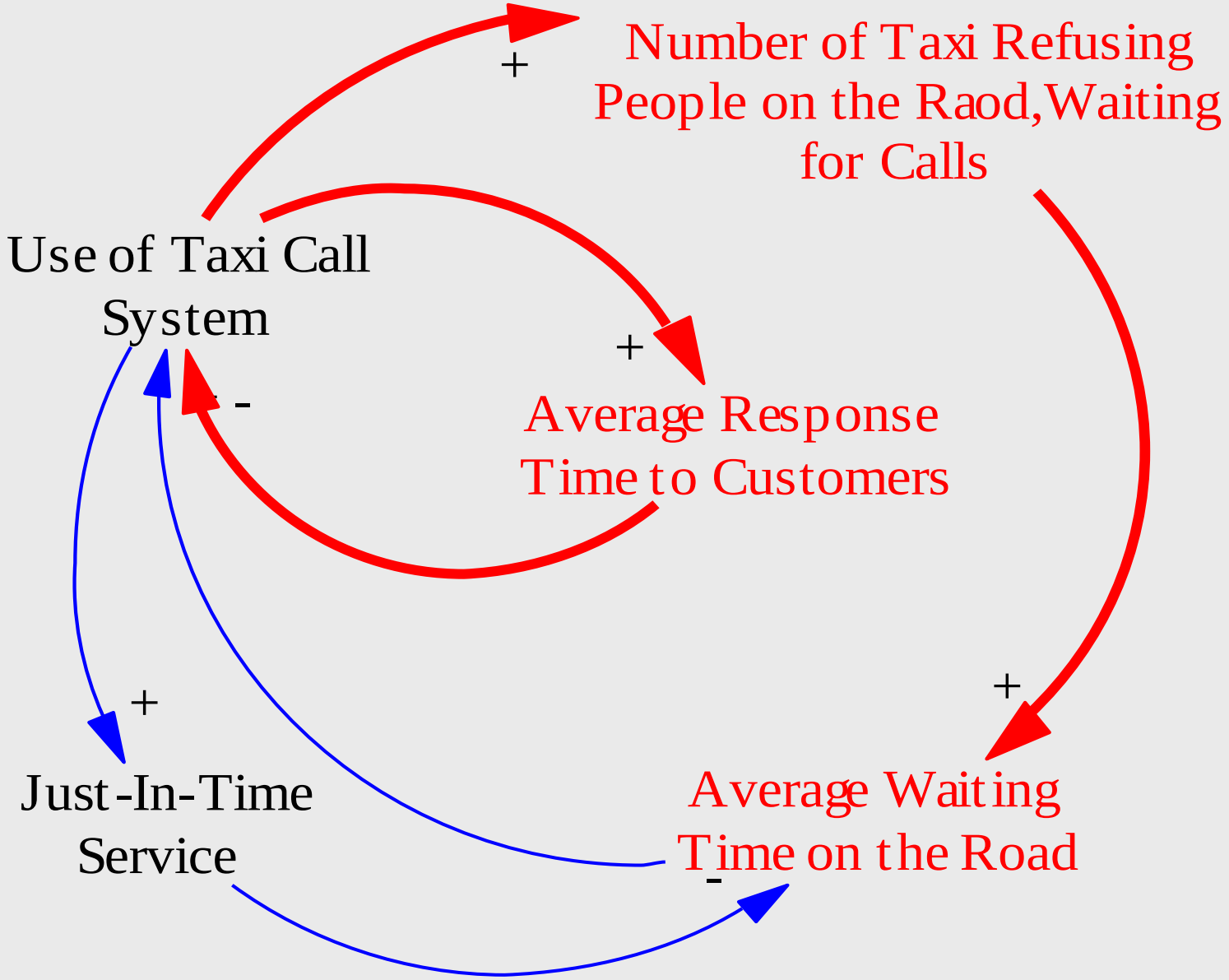
Such as with this "negative," or "balancing", feedback loop, which may slow or reverse growth.



Example

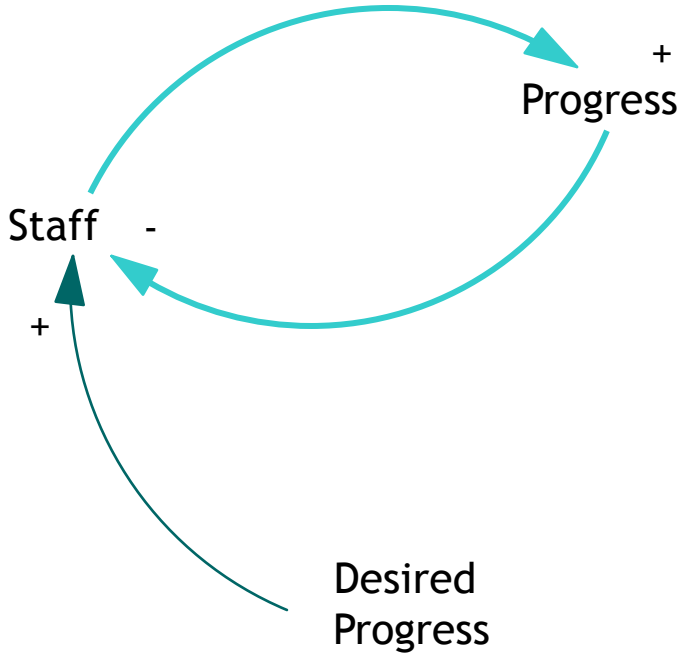
Taxi calling system in Singapore


Use of Taxi Call System
+
+
Just-In-Time Service
Average Waiting Time on the Road

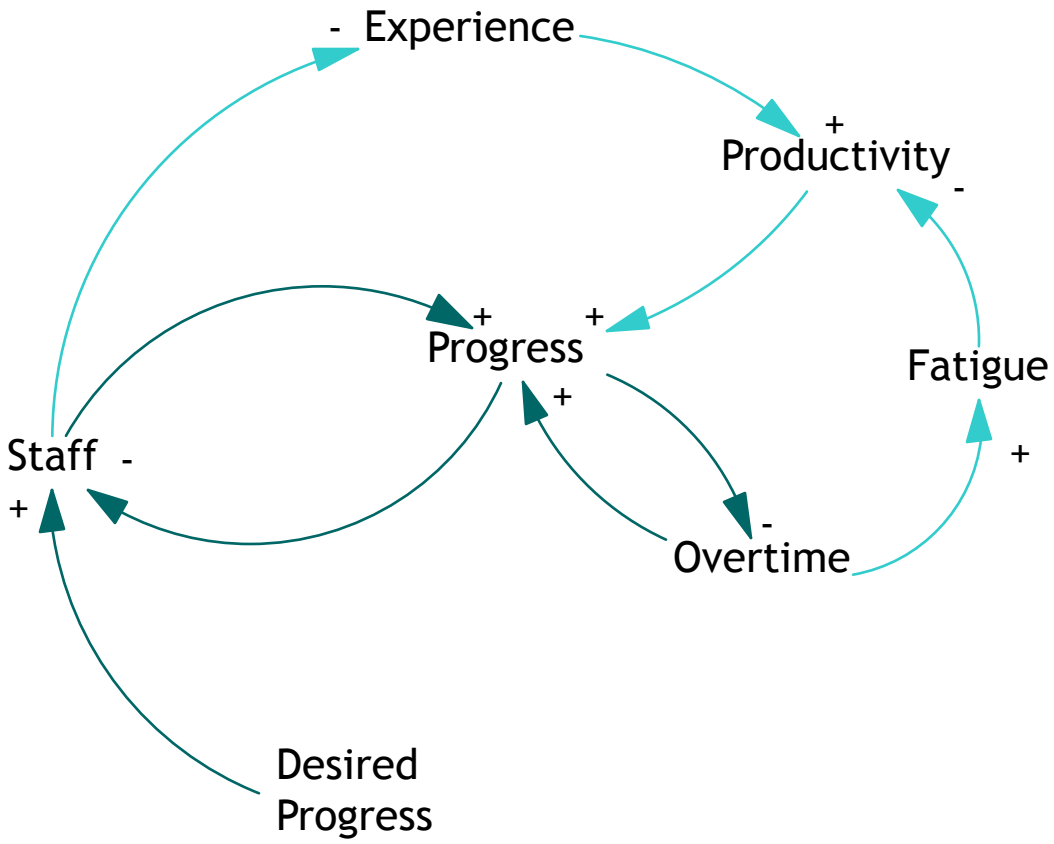

Number of Taxi Refusing People on the Raod,Waiting for Calls
+
Use of Taxi Call System
+
-
Average Response Time to Customers
+
+
Just-In-Time Service
Average Waiting Time on the Road
-

This also happens in PM…

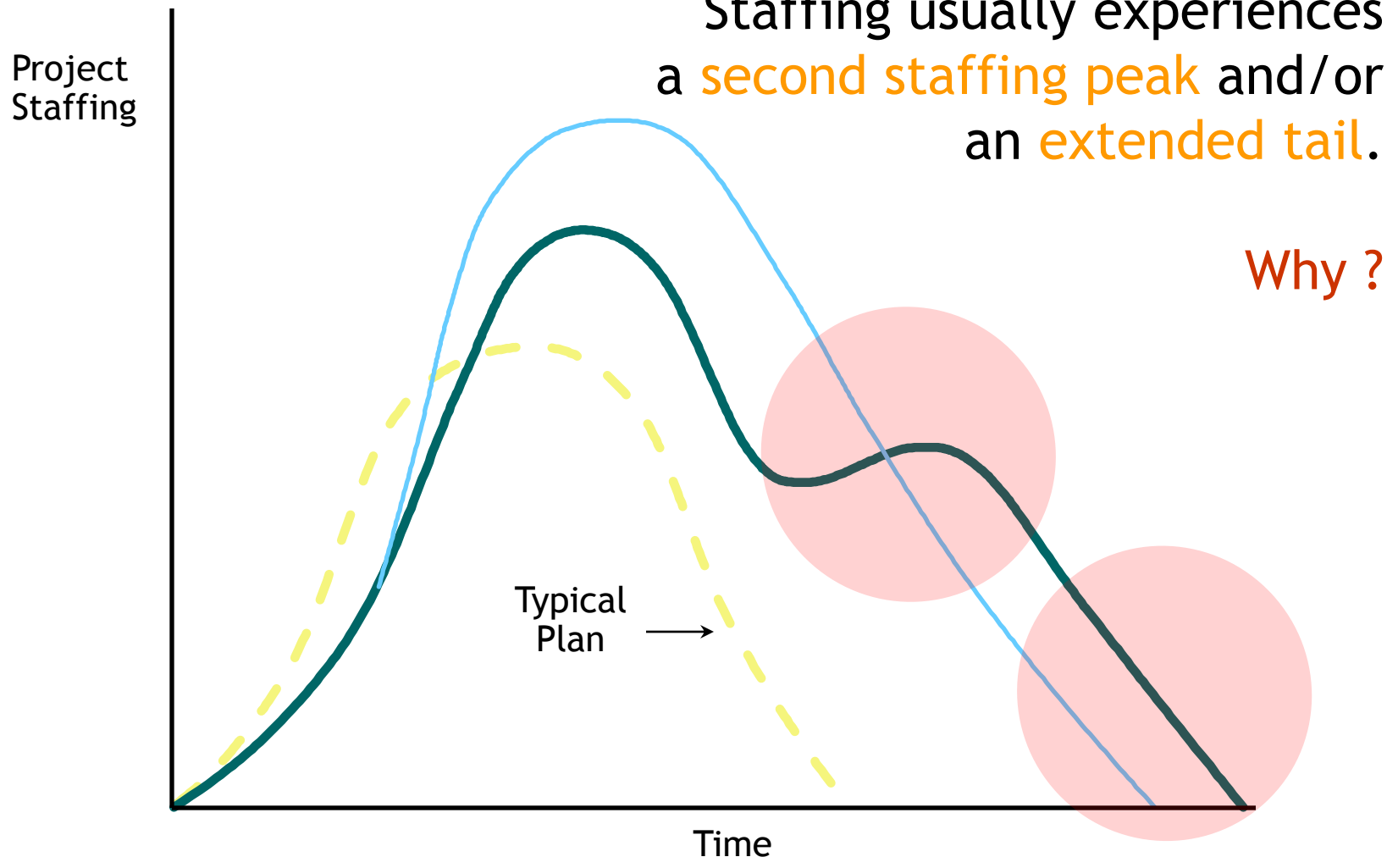
The “dominant” loop on a project may be a controlling loop.



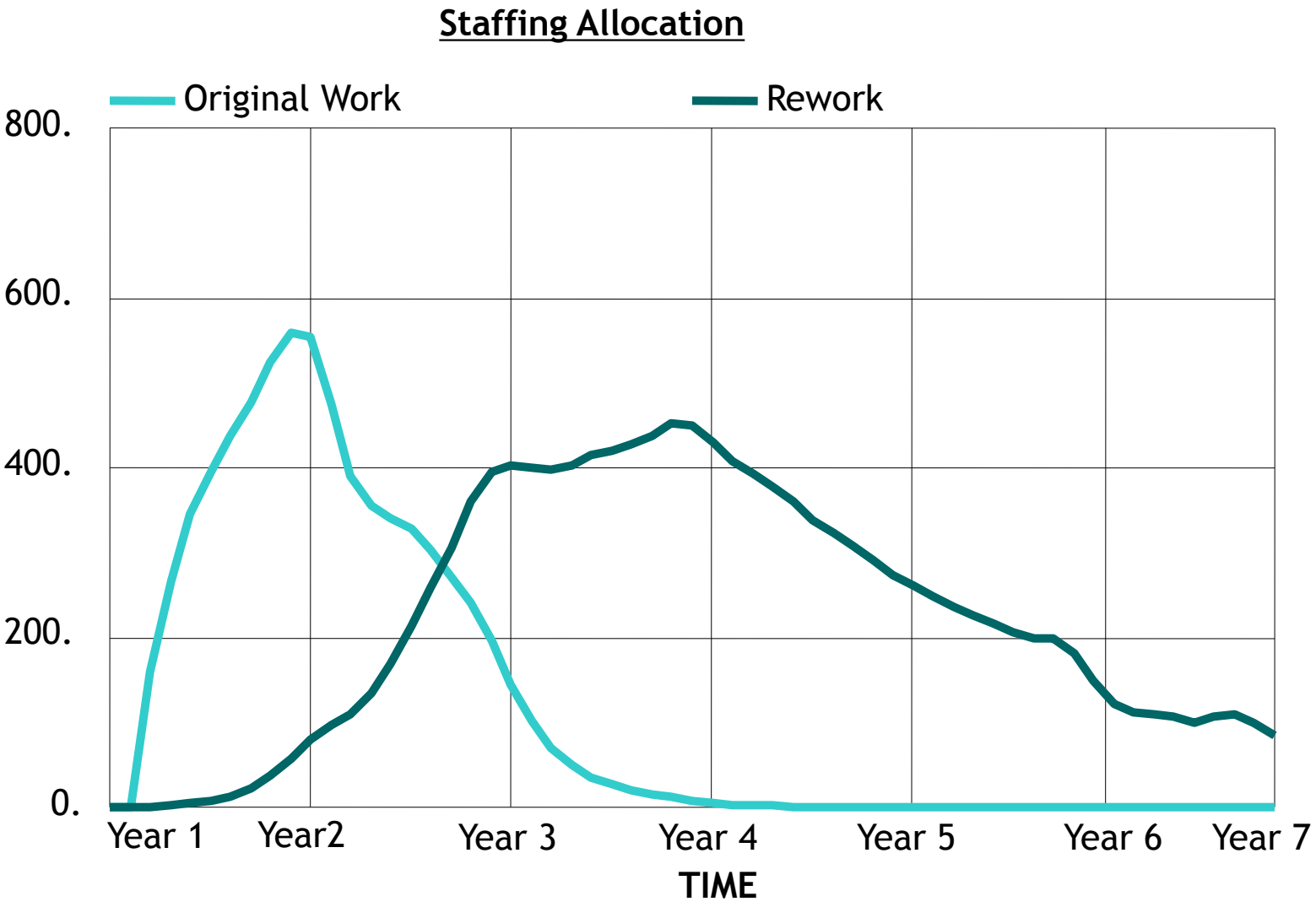
Reinforcing loops complicate that control...



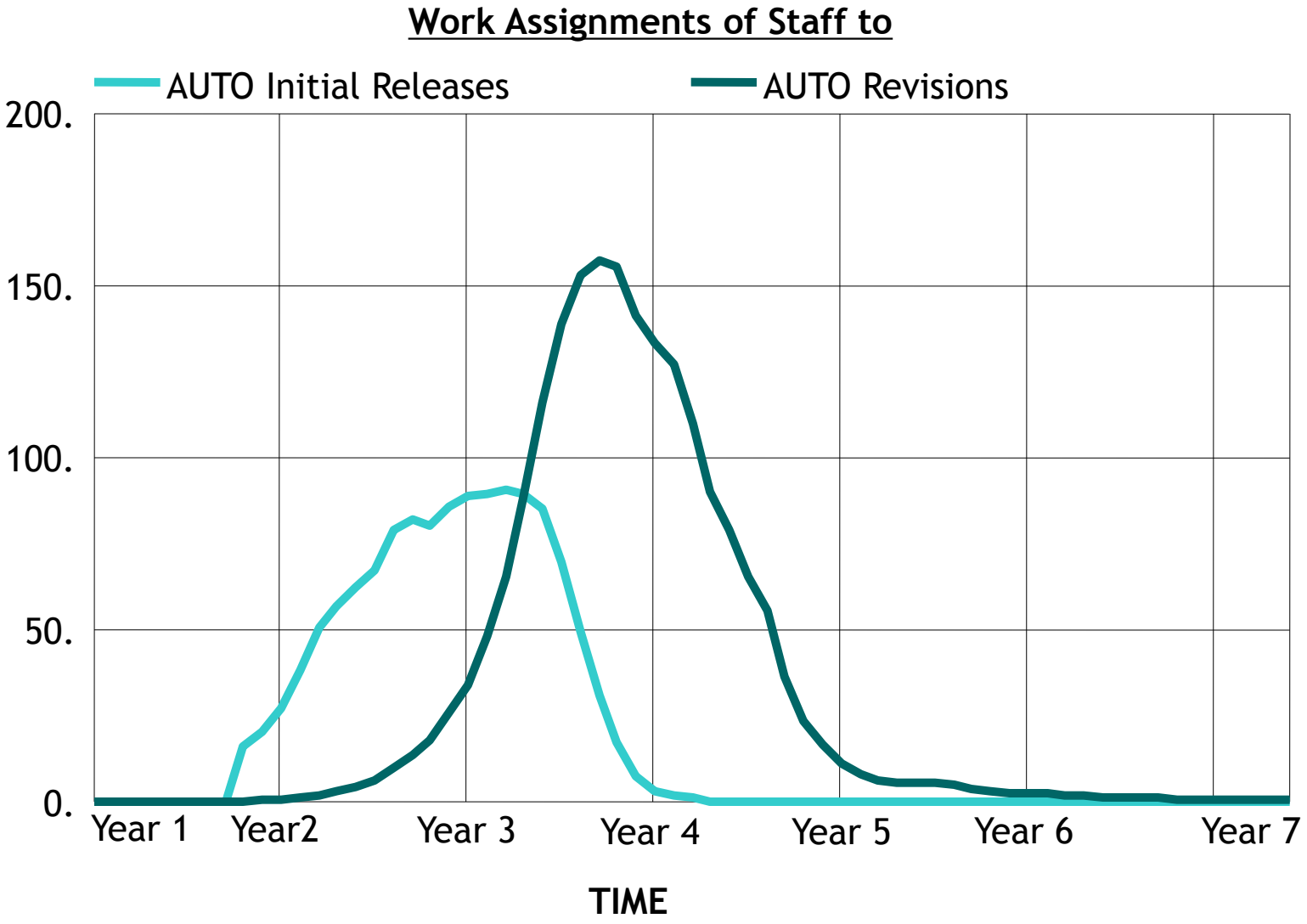
An Example on a Project



An extended tail caused by rework



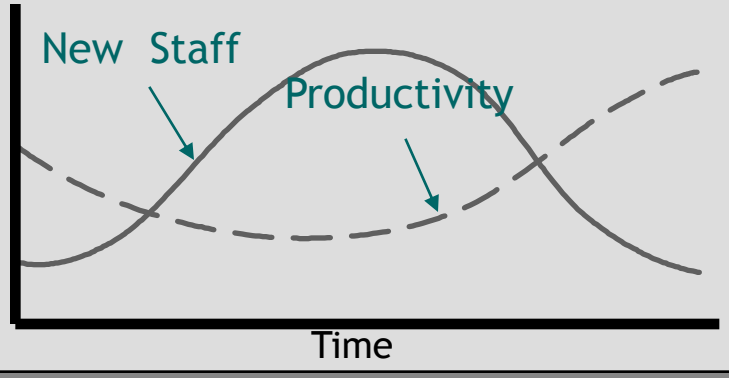
A second staffing peak caused by rework



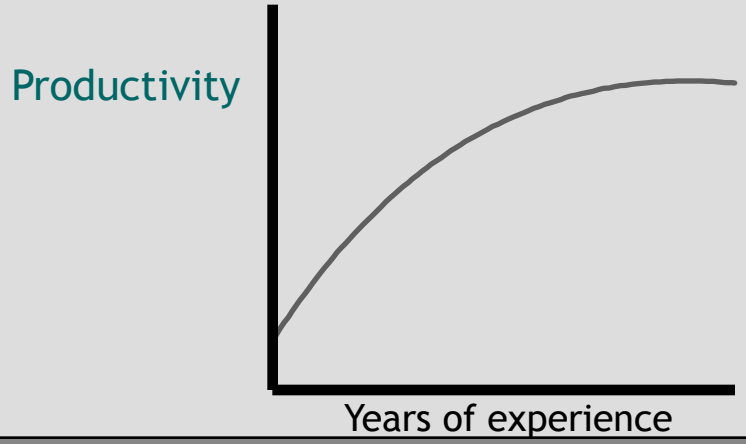
Main Elements within Feedback Loops

Cause-Effect Relationships

Time Delayed Action



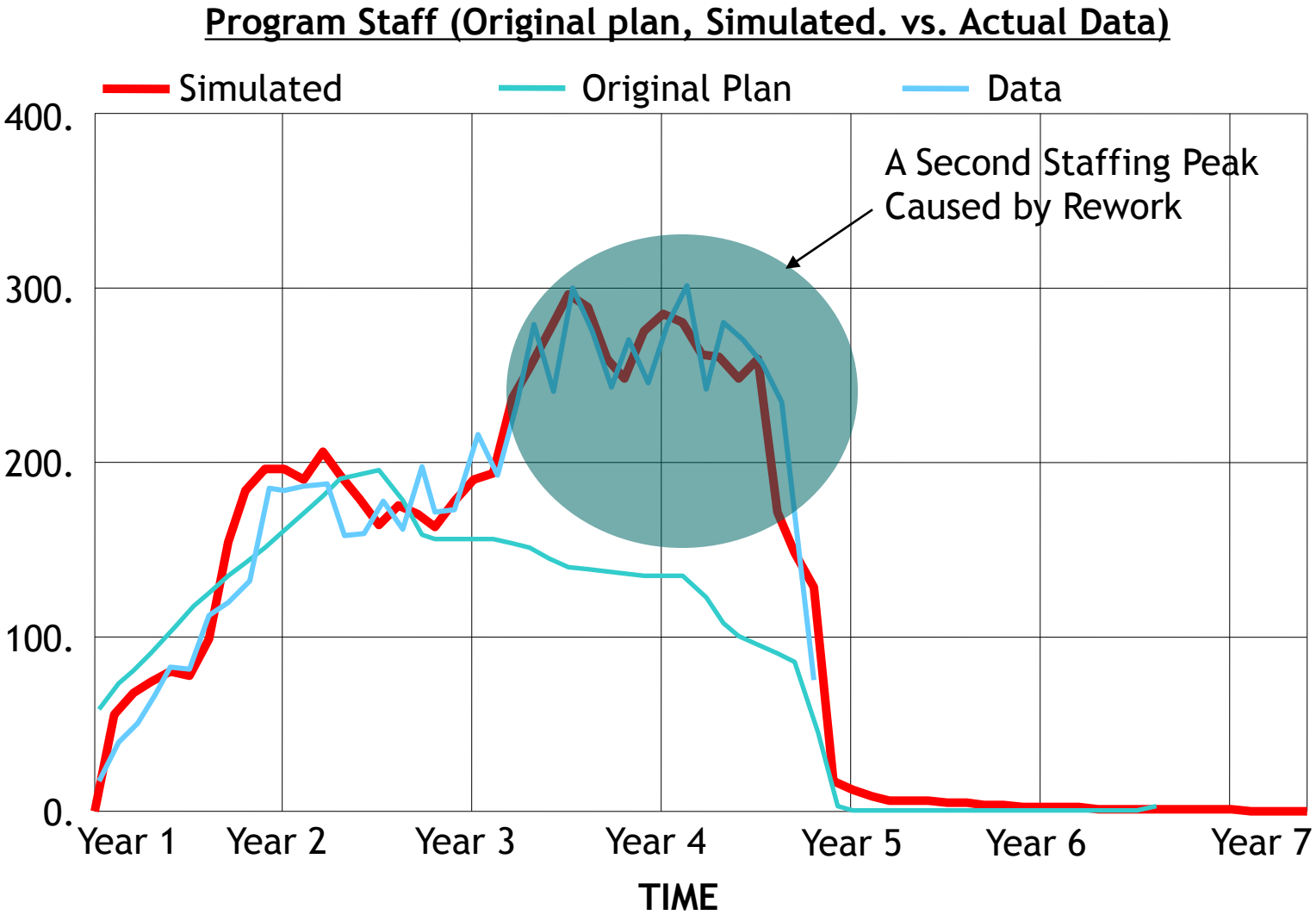
Non-linear responses



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



Potential Benefits of Dynamic Approach

Systems thinking and dynamic modeling provide a new approach

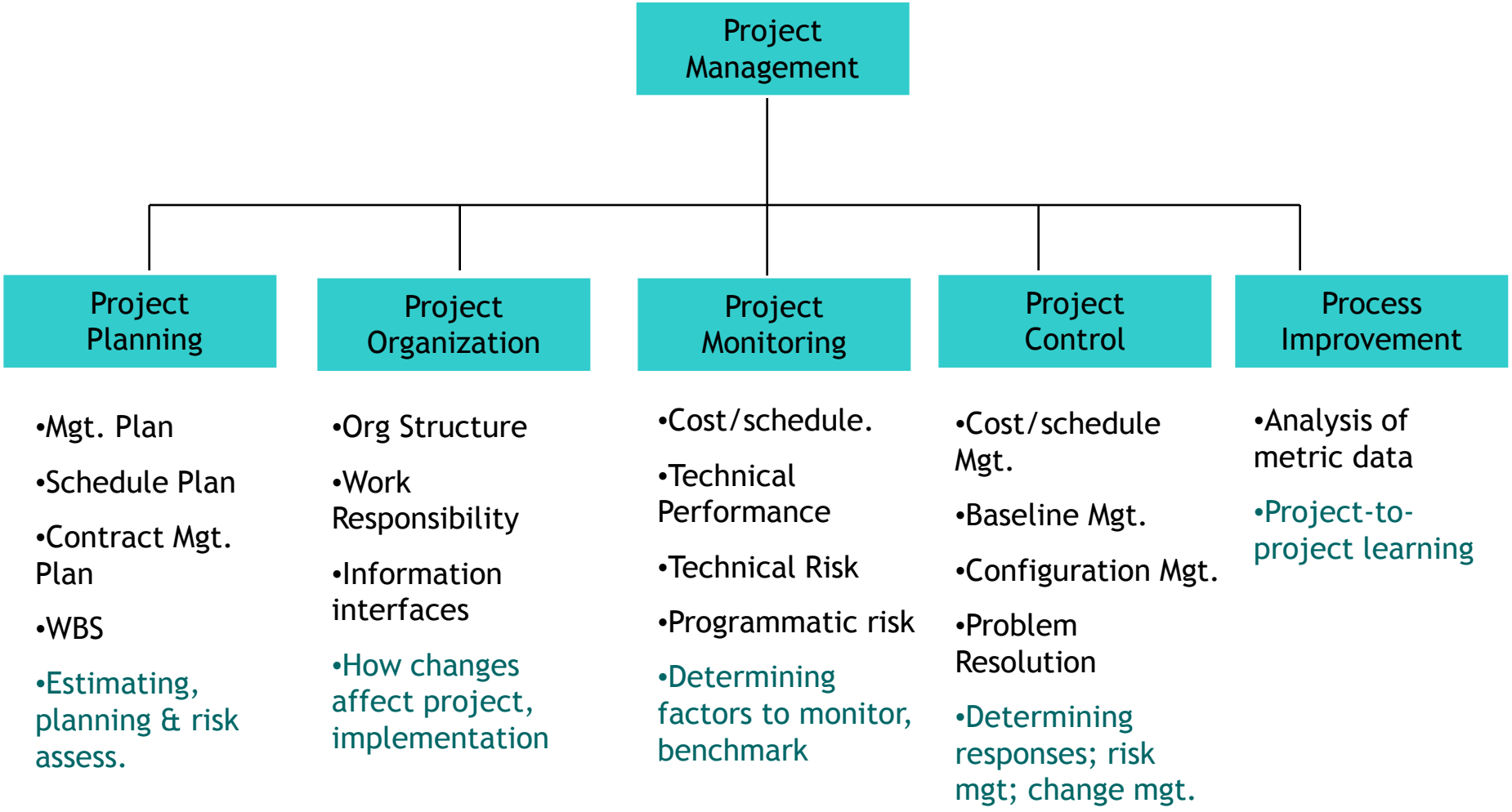
As a World View ...

- 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

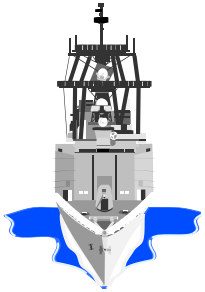
Project Management Context



Already applied in many industries..

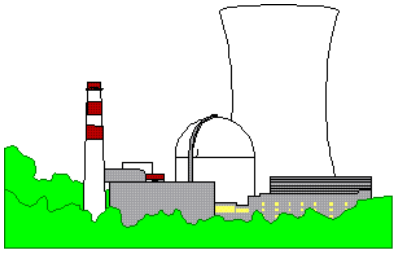
Aerospace/ Electronics

- 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 / C^3I
- Telephone Switching Systems
- Shipboard Control Systems
- Vehicles
- Power Trains

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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: 40% (4 x 10%)
- Term Project: 50% (only final presentation to be assessed)
- Quizzes, attendance etc: 10%

Others

- Lecture materials will be posted in etl of 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

181 cm, 83kg
Full 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
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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”,.
- Murdoch and Hughes, “Construction Contracts: Law and Management”, E&FN SPON, 1996
- Gray, Hughes and Bennett, “The Successful Management of Design”, Reading, 1994

The most important thing…

Grouping