

# Applying the Principles of Flow

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# Seven Big Ideas of 2GLPD

- 1. Understand your economics.**
- 2. Manage your queues.**
- 3. Exploit variability.**
- 4. Enable smaller batches.**
- 5. Control WIP and start rates.**
- 6. Prioritize based on economics.**
- 7. Accelerate feedback.**

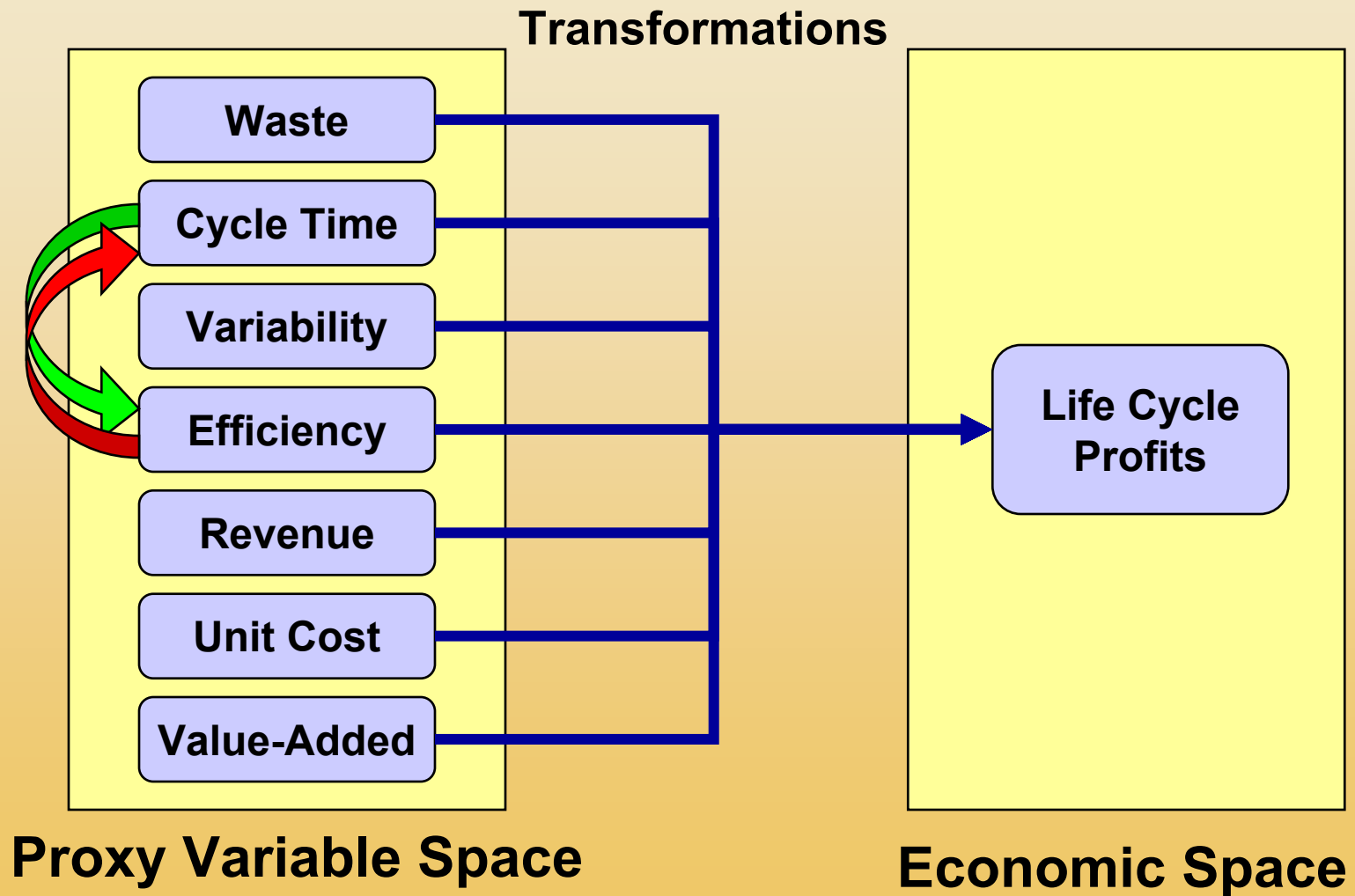
# 1. Understand Your Economics

- **In product development all difficult decisions involve multiple variables.**
- **Making decisions that affect multiple variables requires quantification.**
- **Doing such quantification, to a useful level of accuracy, is surprisingly easy.**

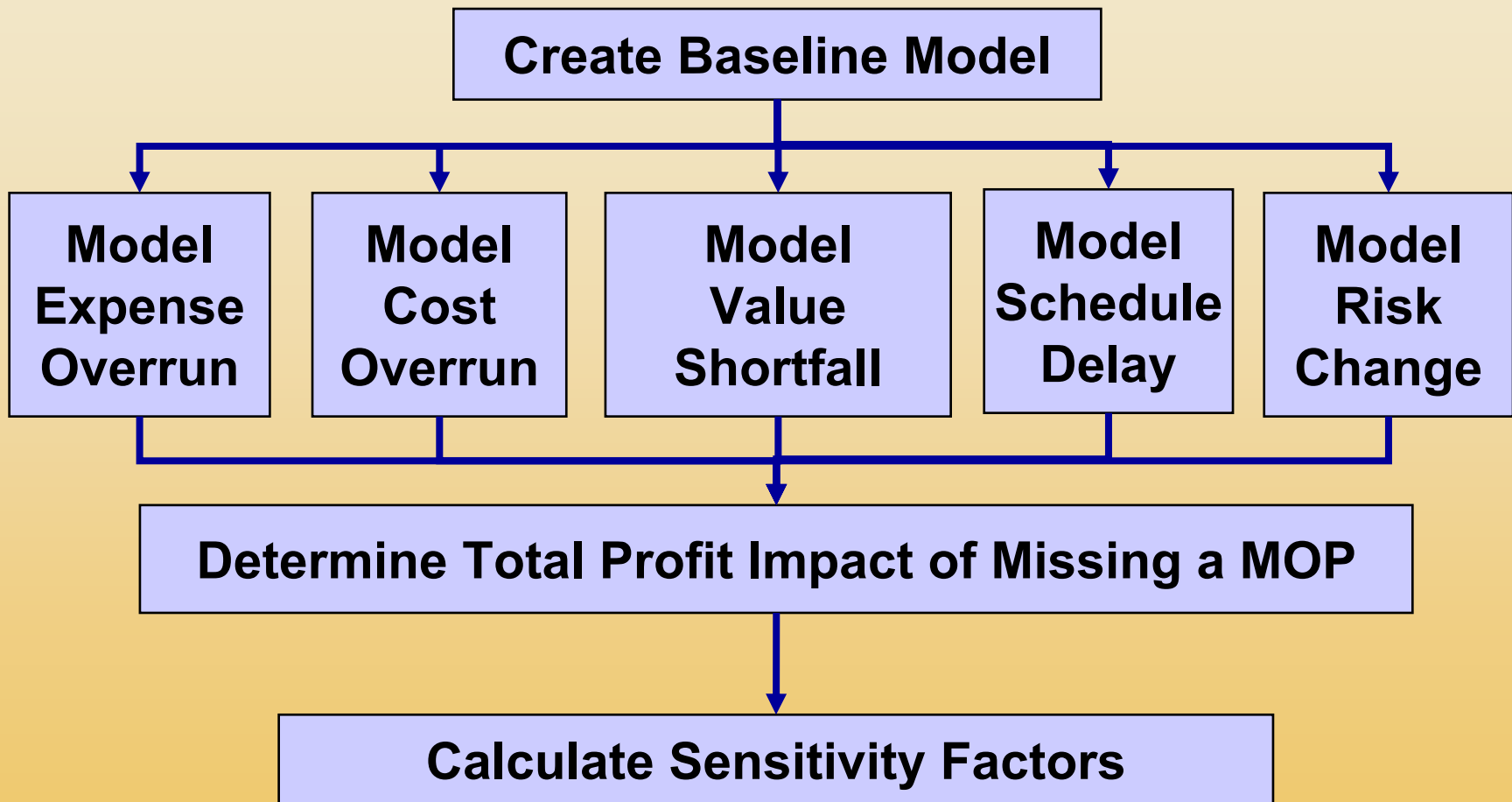
# A Typical Question

**Should we operate our testing process at 80 percent utilization with a 2 week queue, or at 90 percent utilization with a 4 week queue?**

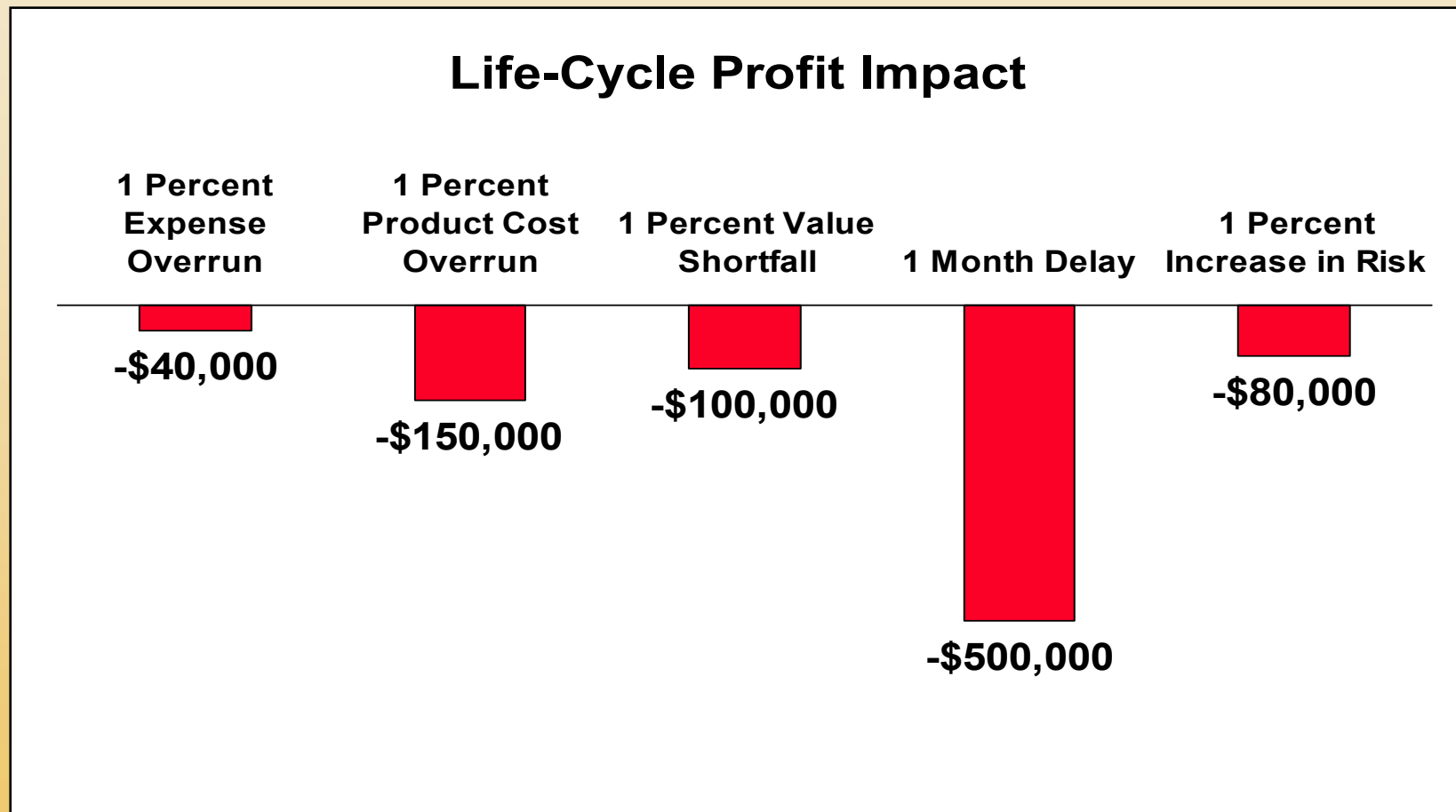
# Making Economic Decisions



# The Modeling Process

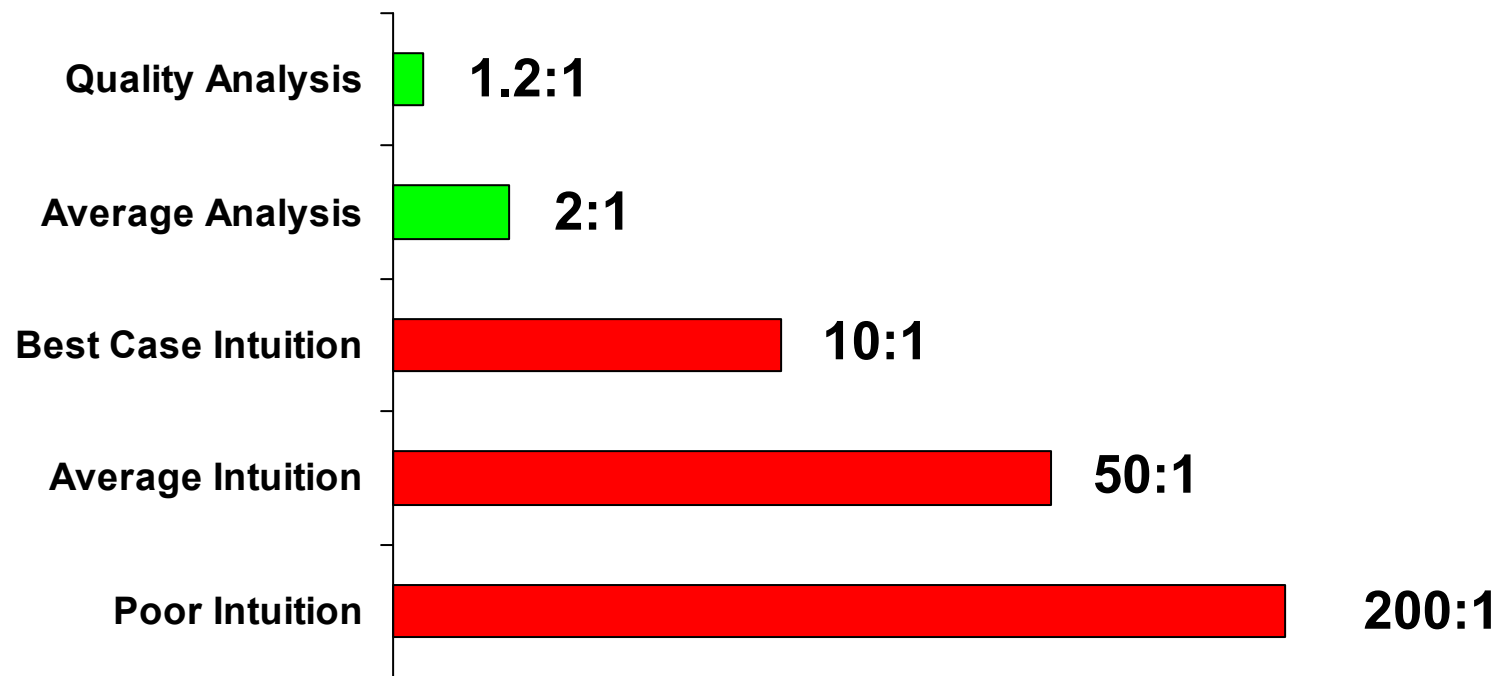


# The Model Output



# Any Analysis Beats Intuition

## Range of Cost of Delay Estimates



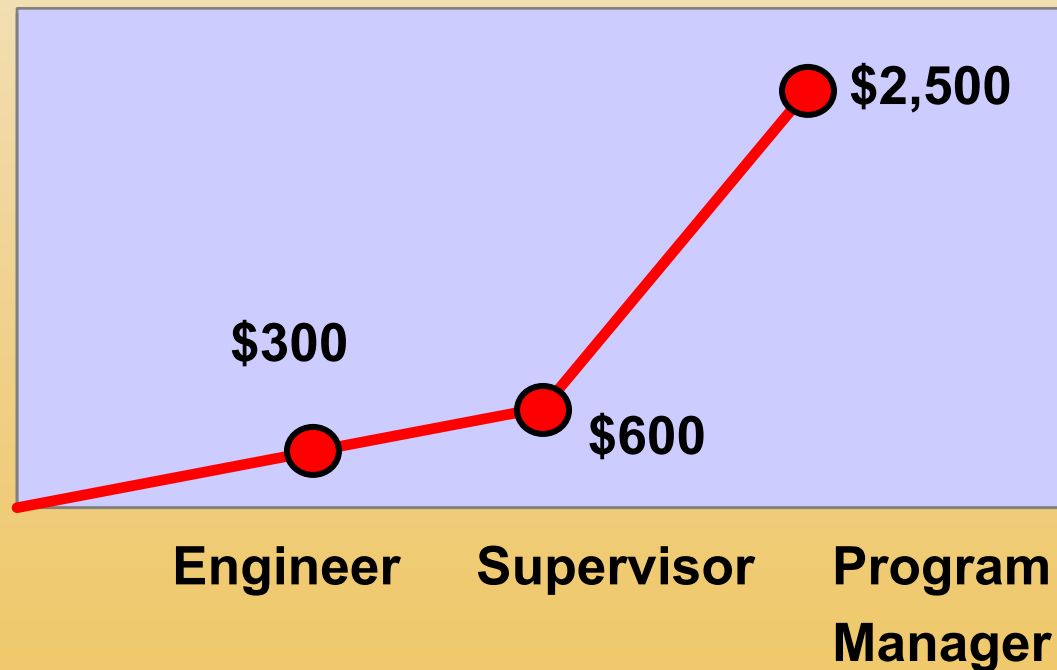
Source: Reinertsen & Associates Clients



# Managing Weight vs. Product Cost

## Boeing 777 Weight Reduction Decision Authority

Dollars  
per Pound



## **2. Manage Your Queues**

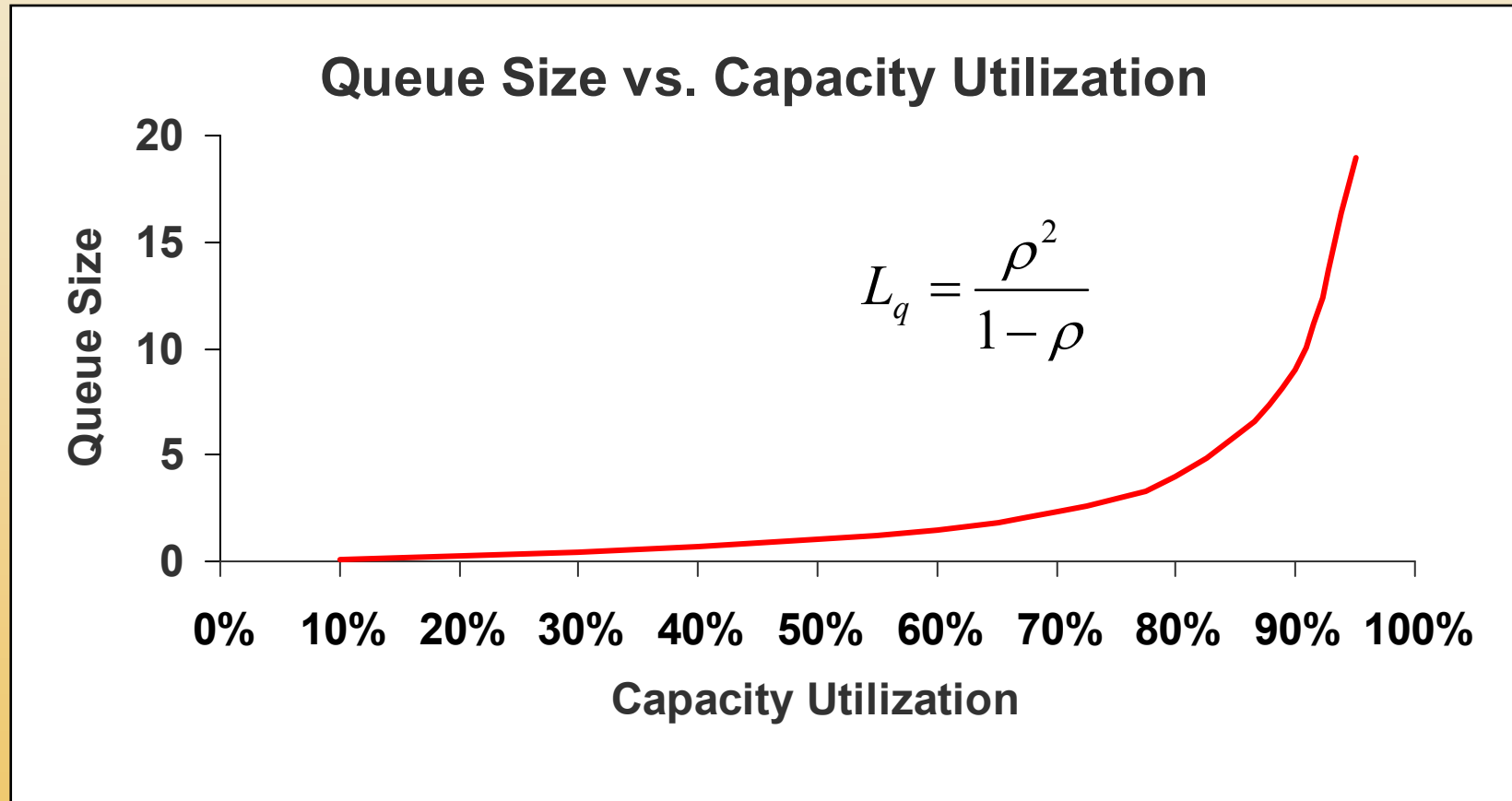
- **Many product developers assume higher utilization leads to faster development.**
- **They neither measure nor manage the invisible queues in their process.**
- **Consequently, they underestimate the true cost of overloading their processes.**
- **Such overloads severely hurt all aspects of development performance.**

**Traffic at rush hour illustrates the classic characteristics of a queueing system.**

Photo Copyright 2000 Comstock, Inc.

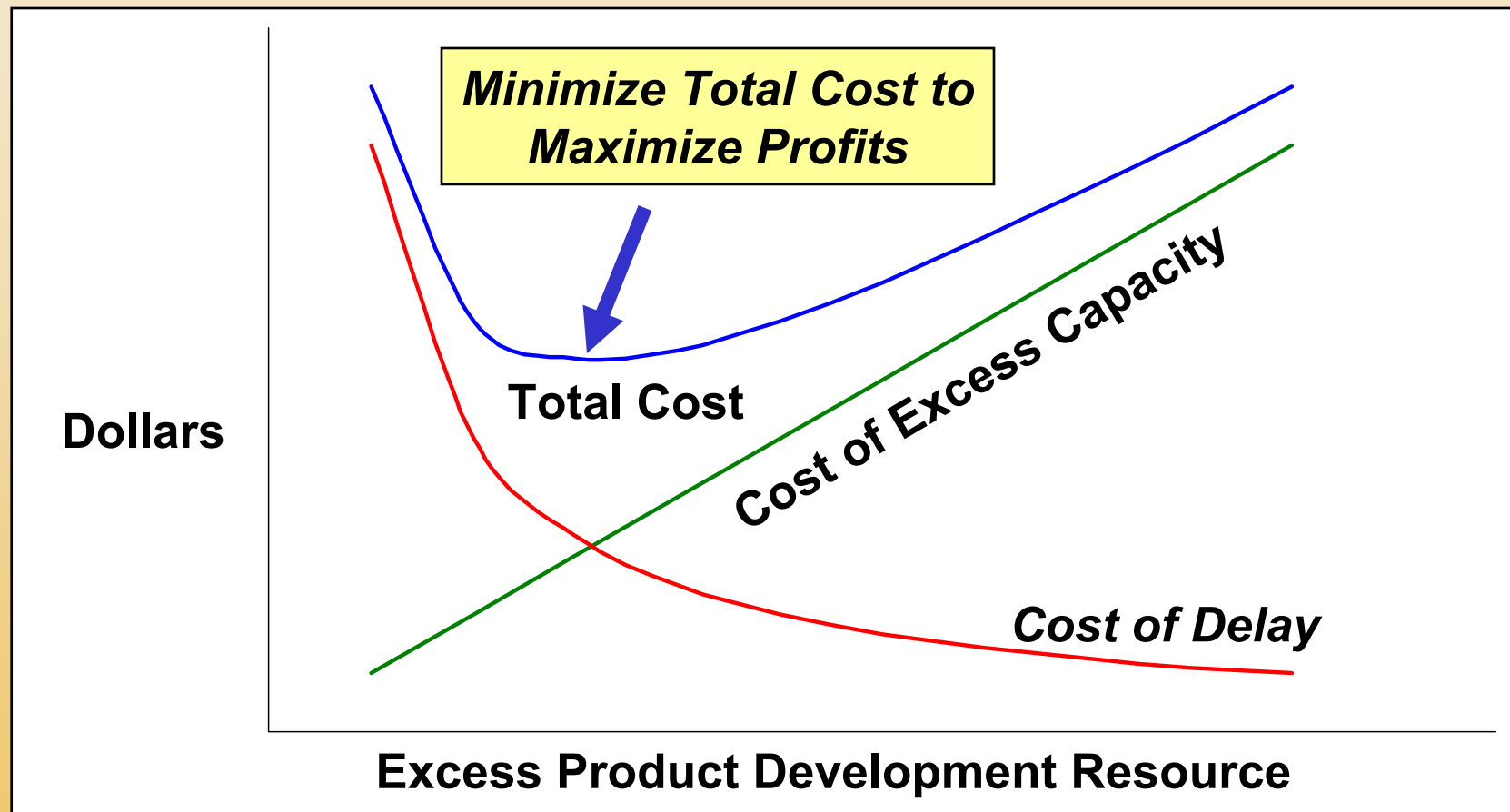


# The Effect of Capacity Utilization



Notes: Assumes M/M/1/∞ Queue,  $\rho$  = Capacity Utilization

# Managing Queues



# Why Queues Matter

*Managing Queues is the key to improving product development economics.*

**Queues Create...**

**Longer Cycle Time**

**Lower Quality**

**More Variability**

**Increased Risk**

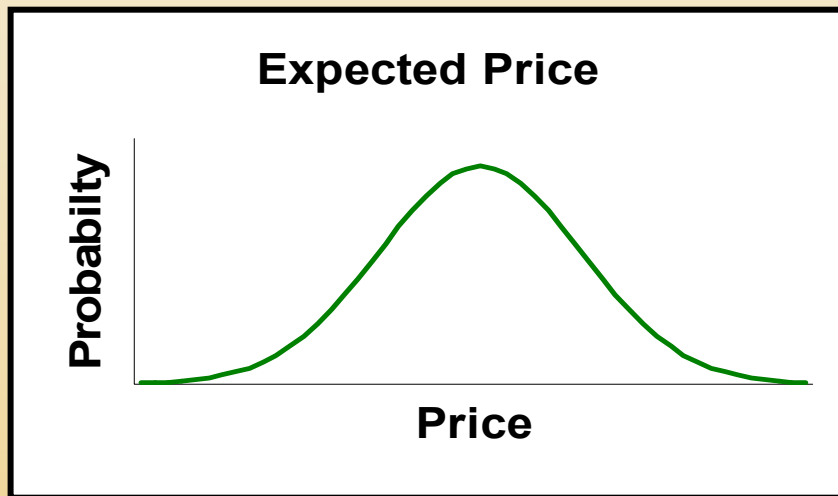
**More Overhead**

**Less Motivation**

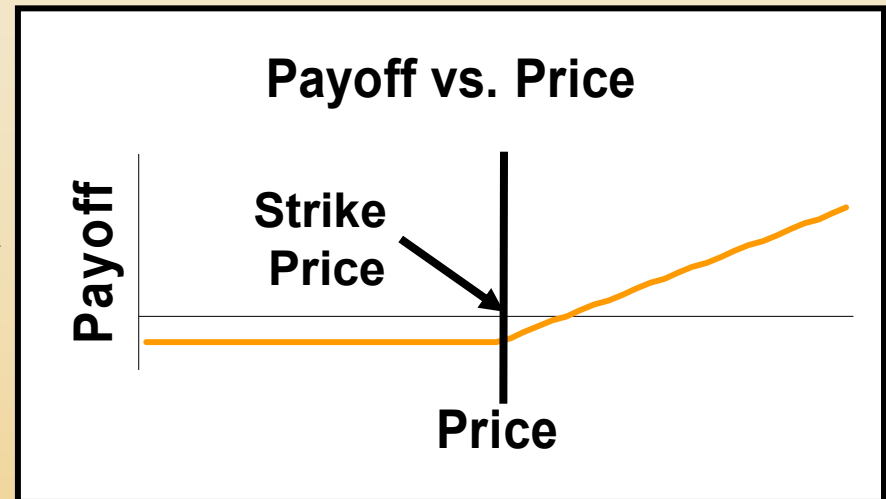
## **3. Exploit Variability**

- **In manufacturing it is always desirable to reduce variability.**
- **In product development eliminating variability eliminates innovation.**
- **We must understand the specific conditions that make variability valuable and manage our process to create these conditions.**
- **We need development processes that function in the presence of variability.**

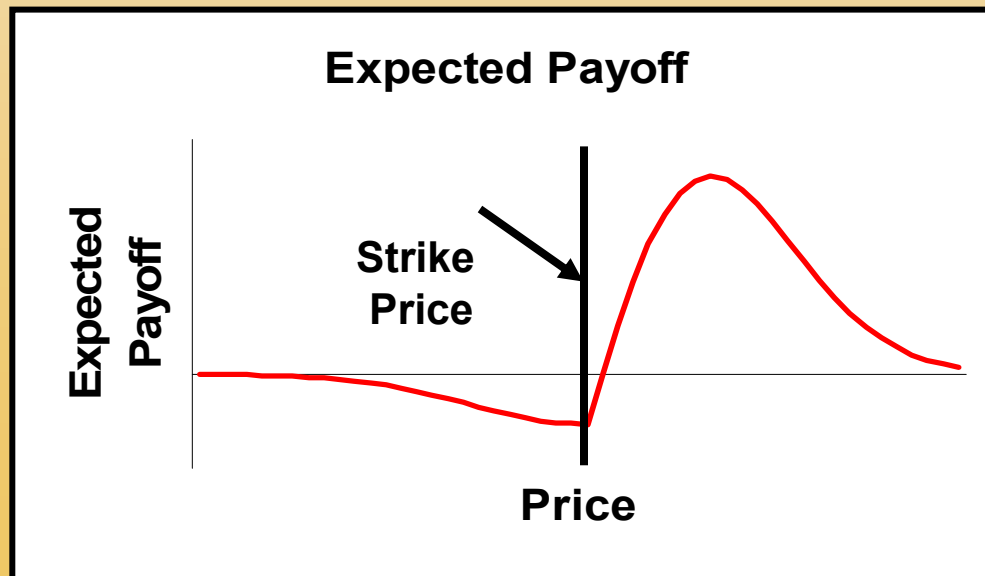
# Asymmetric Payoffs and Option Pricing



X

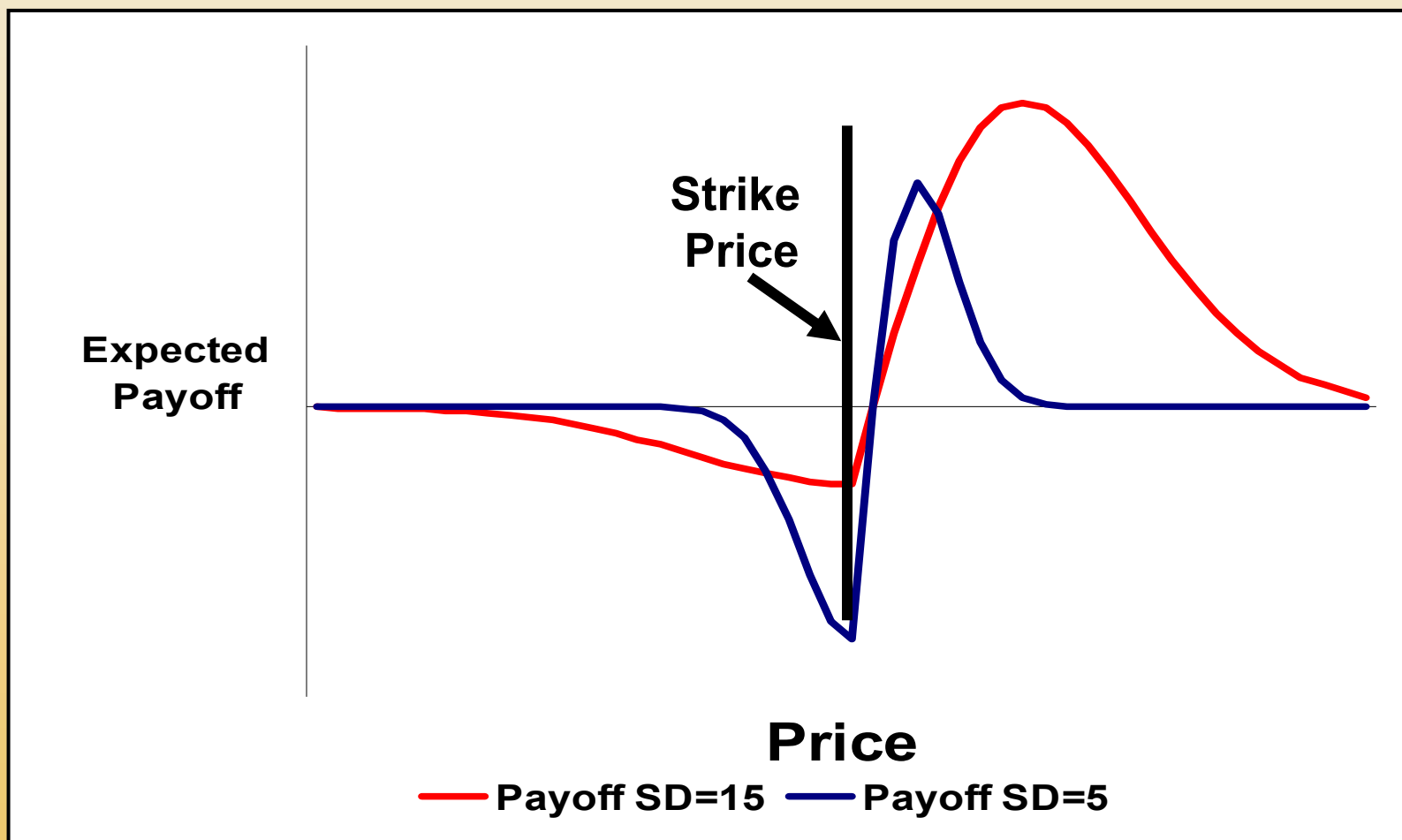


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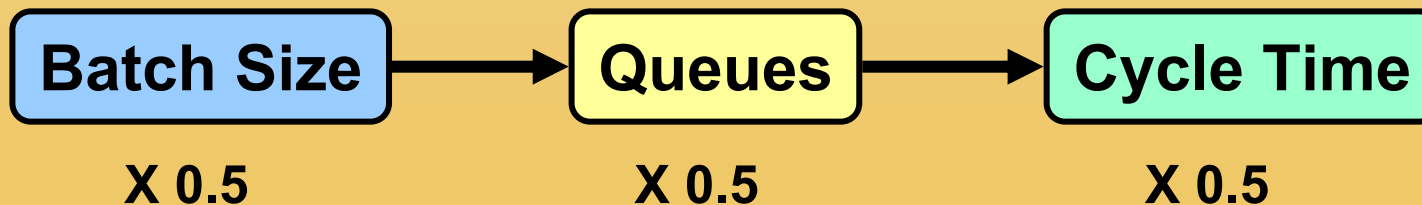
# Higher Variability Raises This Payoff



**Option Price = 2, Strike Price = 50,  
Mean Price = 50, Standard Deviation = 5 and 15**

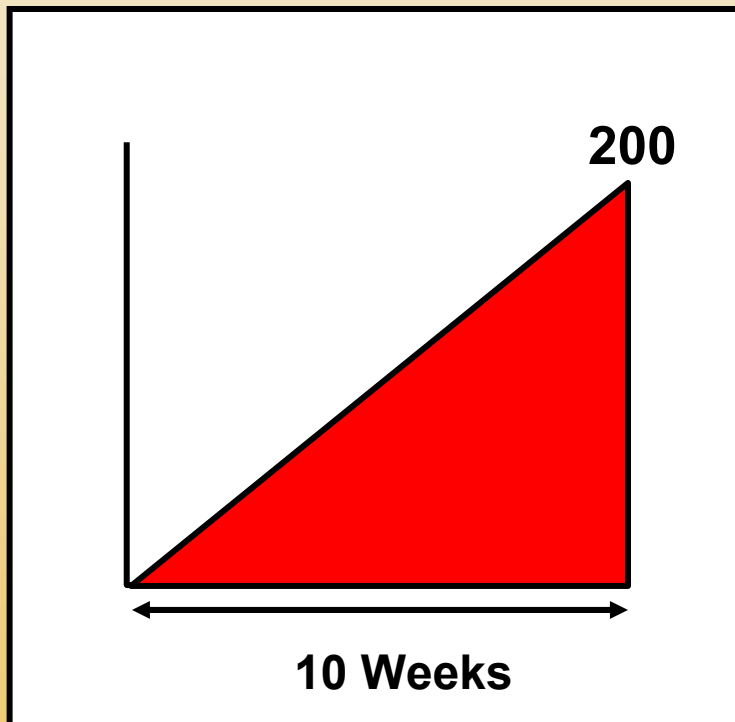
## 4. Enable Smaller Batches

- When work products are invisible, batch sizes are invisible.
- When batch sizes are invisible, product developers pay little attention to them.
- Many companies institutionalize large batch sizes.
- Batch size reduction is attractive because it is fast, easy, cheap, granular, leveraged, and reversible.
- It is a great starting point for LPD.

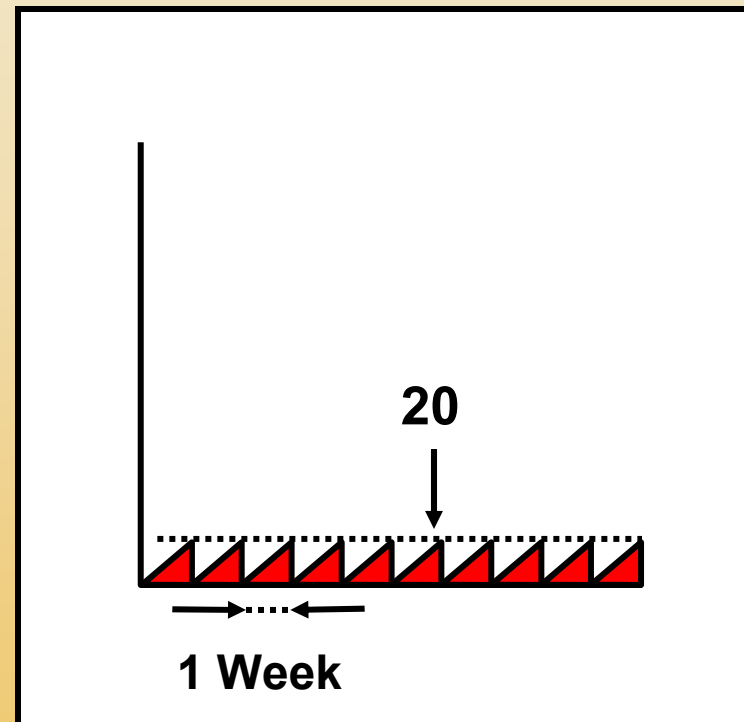


# Drawing Review Process

Large Batch



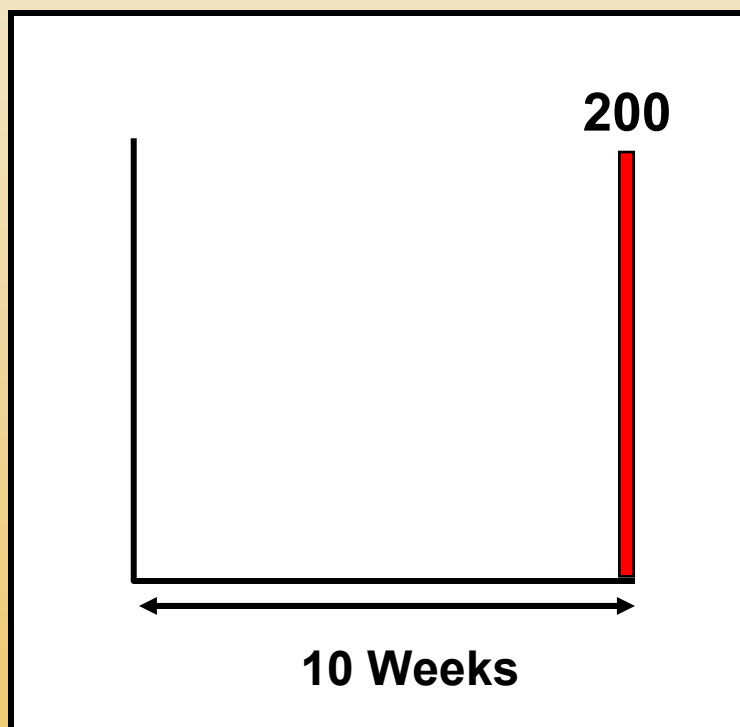
Small Batches



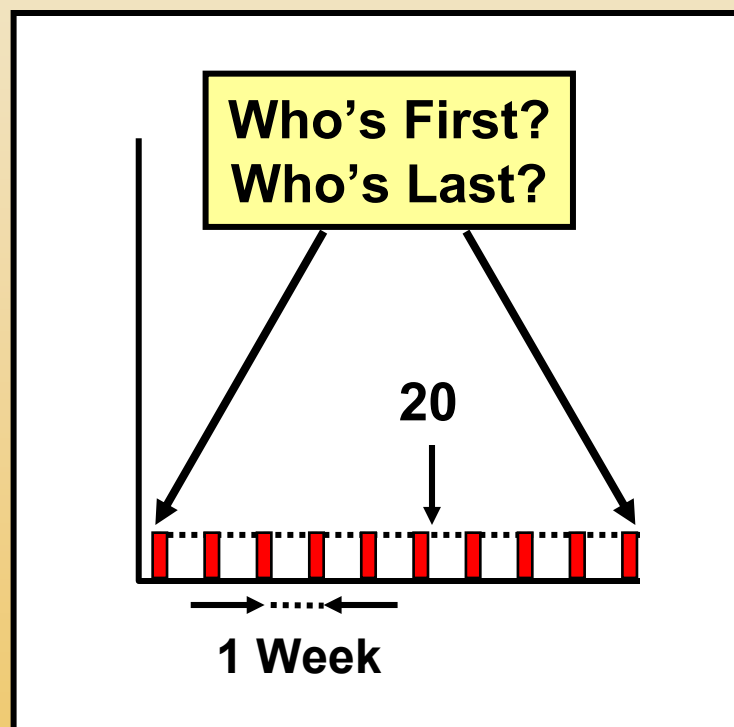
Unreviewed Drawings

# Drawing Arrival Rate

## Large Batch

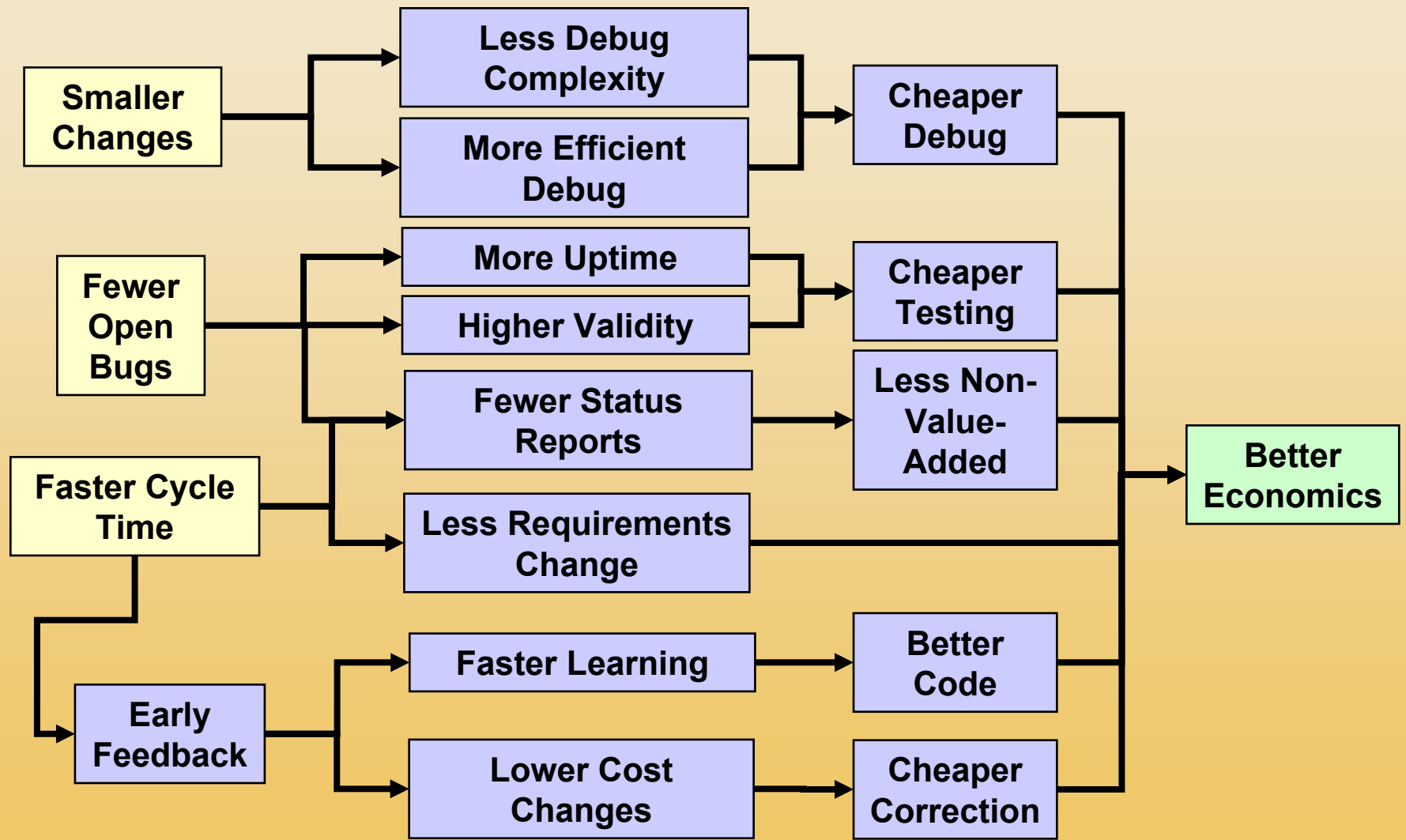


## Small Batches

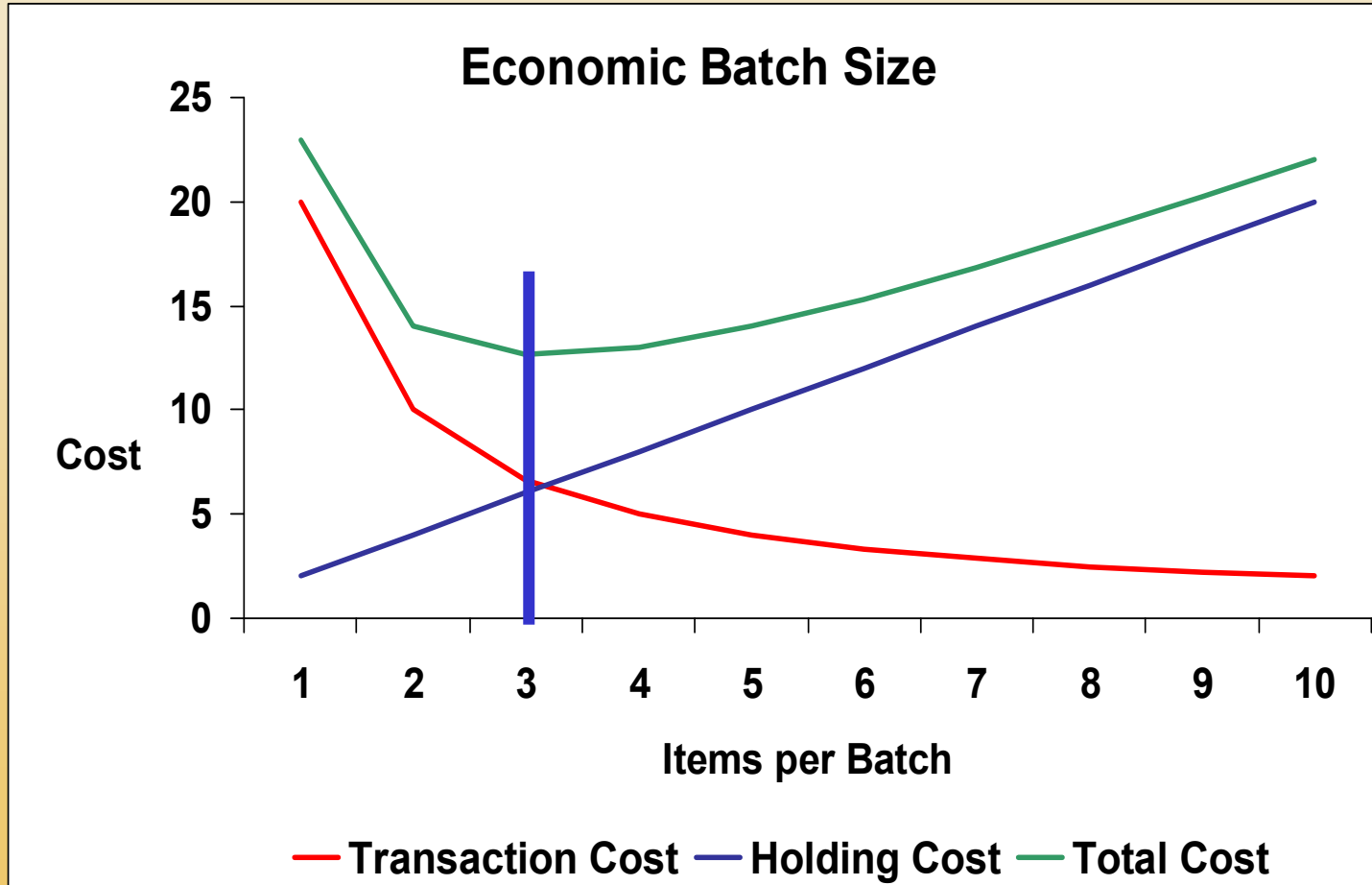


**Unreviewed Drawings**

# Benefits of Small Batch Testing



# Setting Batch Size



## **5. Control WIP and Start Rates**

- **Many developers incorrectly assume that the sooner they start work, the sooner they will finish it.**
- **They are constantly tempted to start too much work.**
- **This dilutes resources and causes long transit times through their processes.**
- **A long transit time hurts efficiency, quality, and responsiveness.**

# Little's Formula

$$W_q = \frac{L_q}{\lambda}$$

Average Wait Time in Queue =  $W_q$

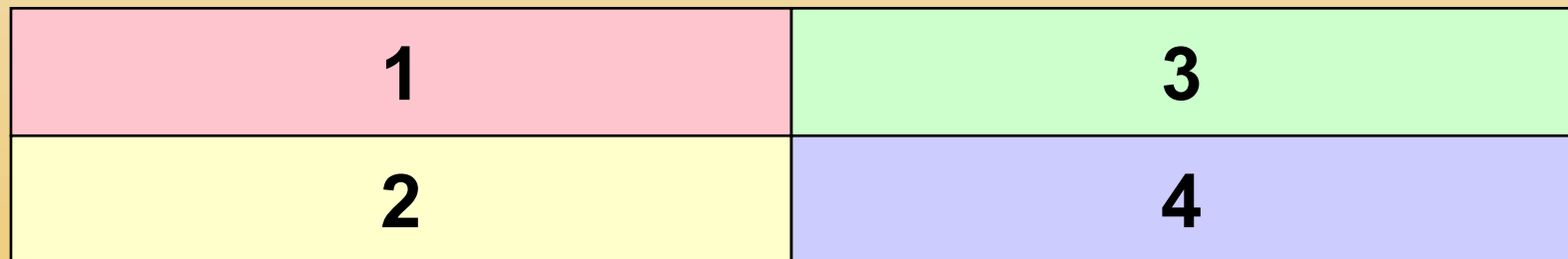
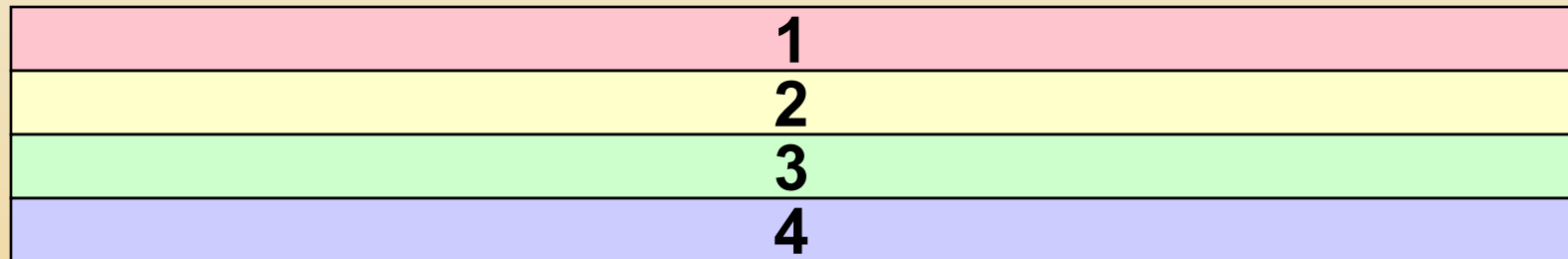
Average Number of Customers in Queue =  $L_q$

Average Departure Rate =  $\lambda$

- **By constraining WIP in development processes we can control cycle time.**
- **This approach, which is known as Lean Kanban, is currently growing rapidly in software development.**



# Control Number of Active Projects

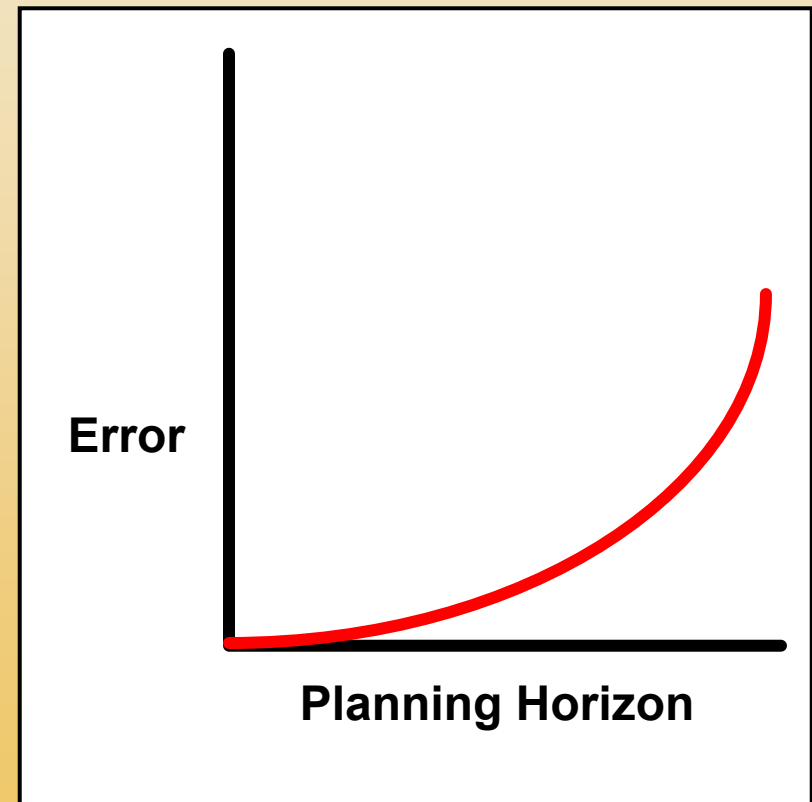
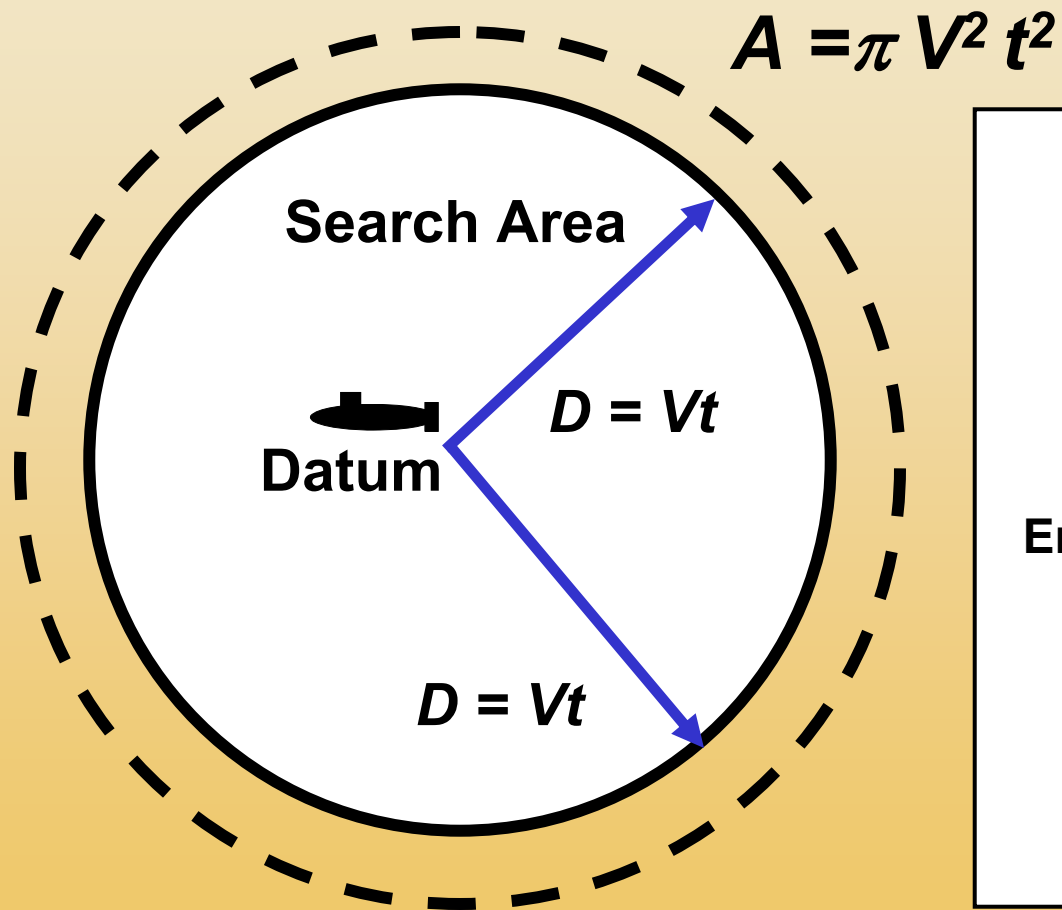


**COD Savings of Project 1 and 2**

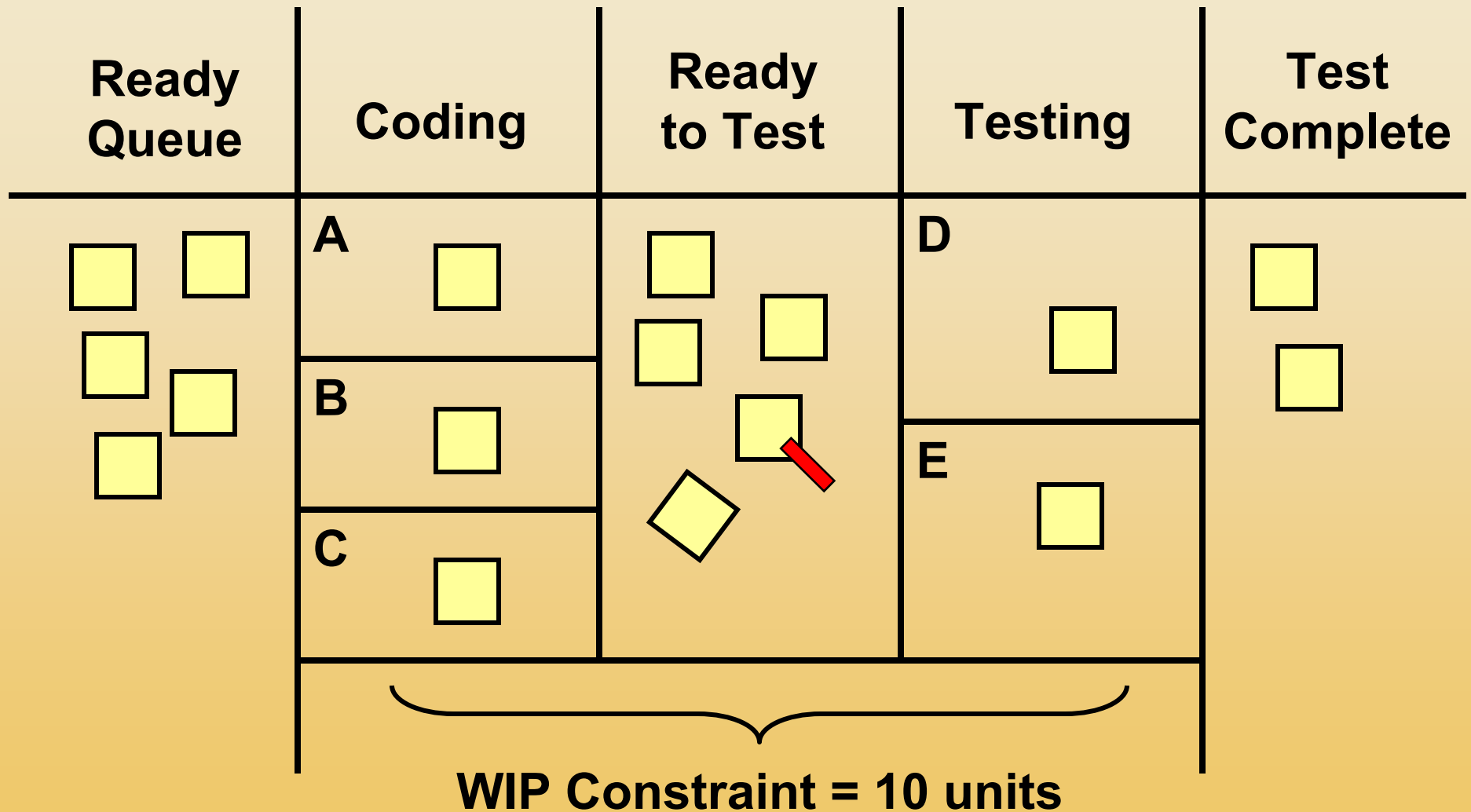


**Late Start Advantages  
for Project 3 and 4**

# Avoiding Long Planning Horizons



# Visual WIP Control Boards



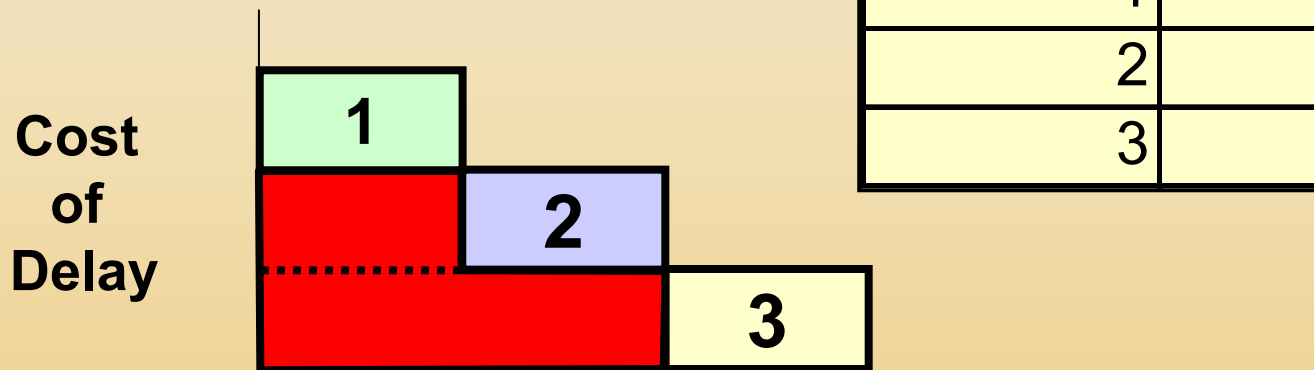
**WIP constraints can be local, regional, or global.**

## **6. Sequence Work Correctly**

- **The sequence in which work is processed is called the queueing discipline.**
- **By changing the queueing discipline we can reduce the cost of a queue without decreasing the size of the queue.**
- **Since manufacturing has homogeneous flows it always uses FIFO (First-In-First-Out).**
- **For the non-homogeneous flows of product development other approaches have better economics.**

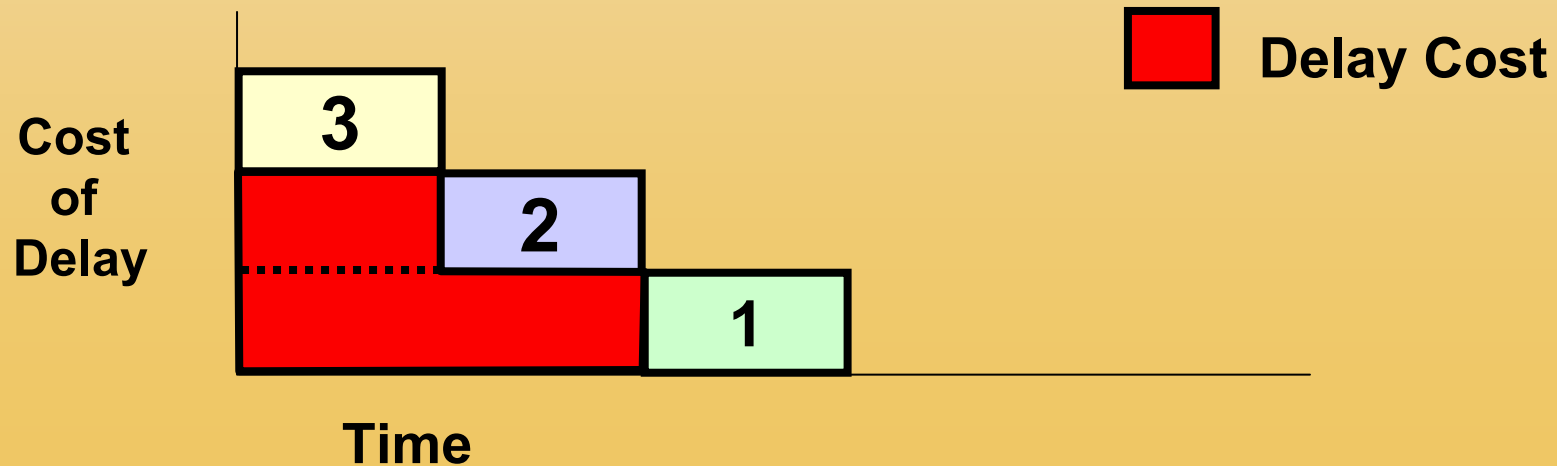
# Use FIFO for Homogeneous Flow

## First-In First-Out



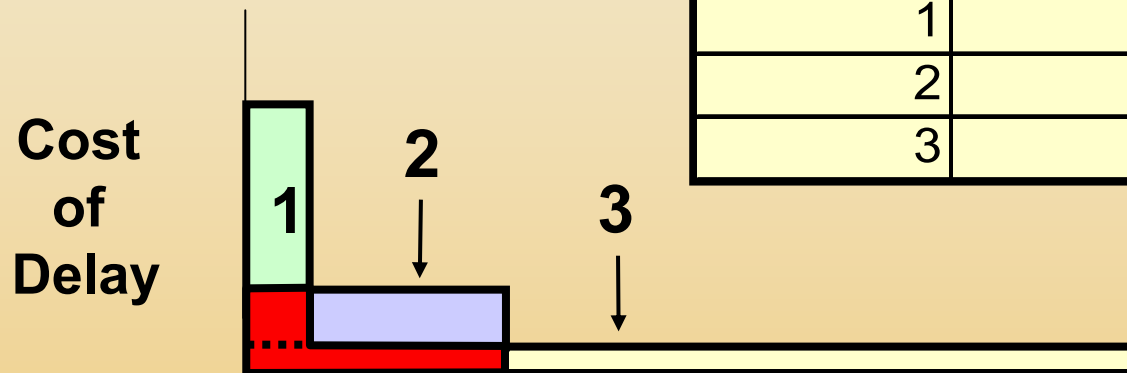
Project	Duration	Cost of Delay
1	3	3
2	3	3
3	3	3

## Last-In First-Out



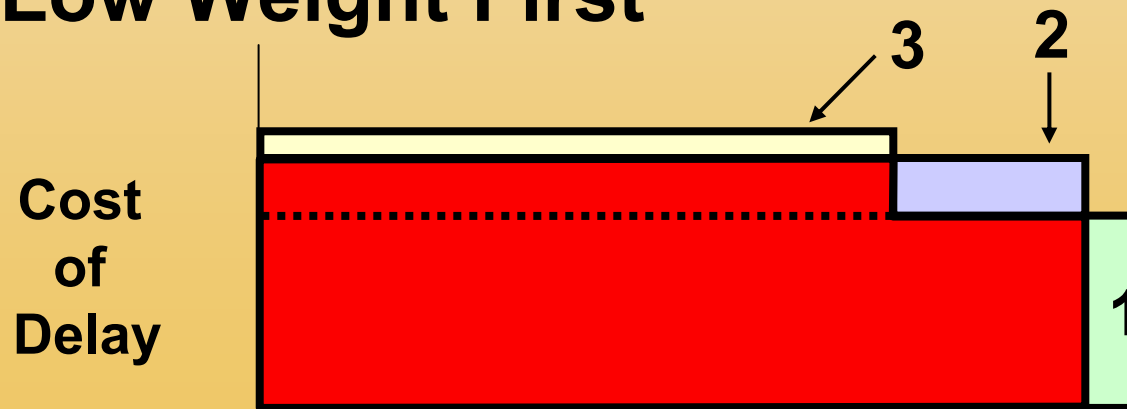
# Weighted Shortest Job First (WSJF)

## High Weight First



Project	Duration	Cost of Delay	Weight = COD/Duration
1	1	10	10
2	3	3	1
3	10	1	0.1

## Low Weight First



160 → 7  
96 Percent Reduction!

■ Delay Cost

Time

## **7. Create Faster Feedback**

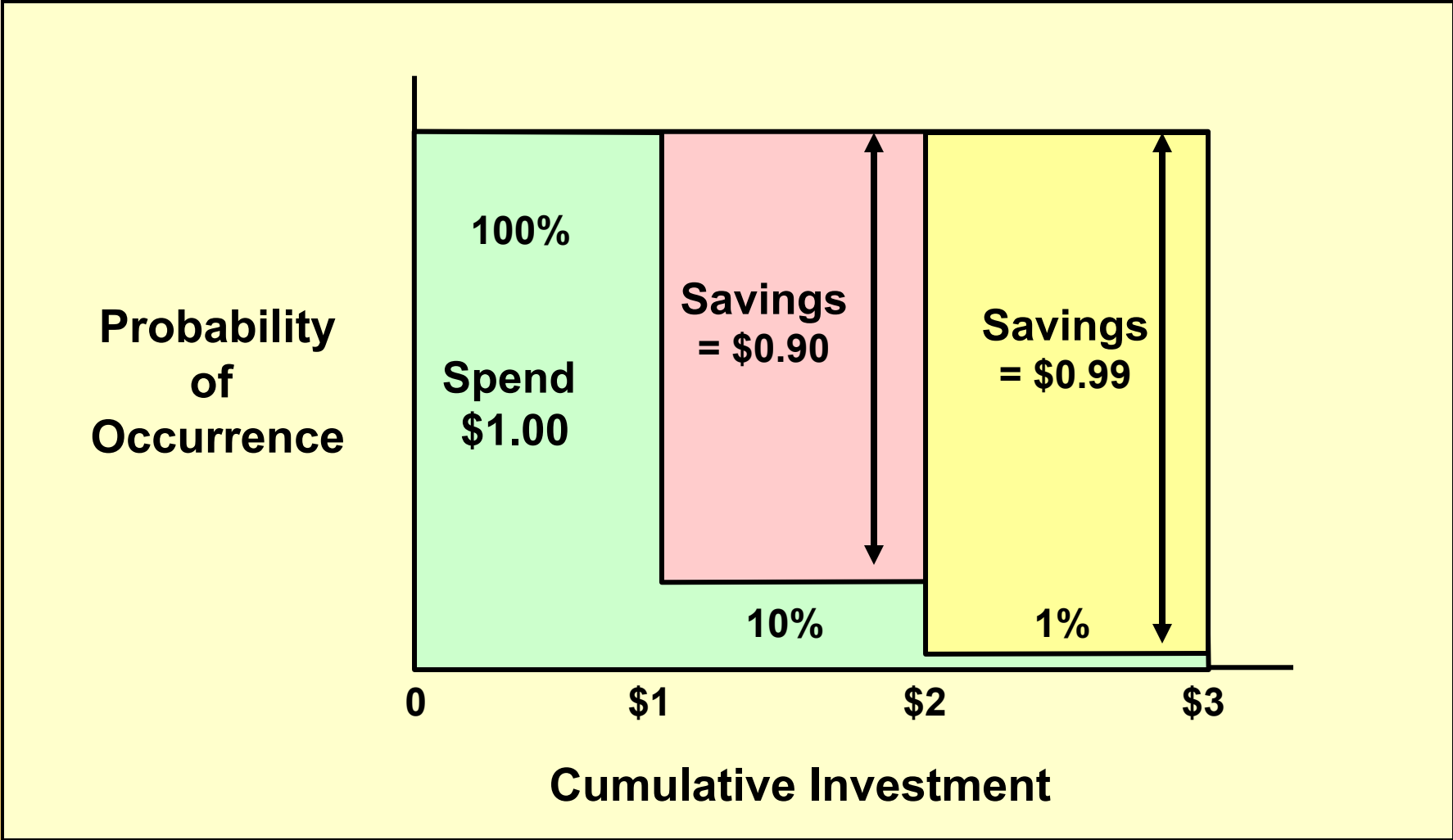
- **When queues and batch sizes are large feedback is slow.**
- **Slow feedback hurts quality, efficiency, and cycle time.**
- **Feedback speed has enormous economic leverage in product development, but it is rarely explicitly managed.**

# The Front-Loaded Lottery

- A lottery ticket pays \$3000 to the winning three digit number.
- You can pick the numbers in two ways:
  - Pay \$3 to select all three digits at once.
  - Pay \$1 for the first digit, find out if it is correct, then choose if you wish to pay \$1 for the second digit, and then choose if you wish to pay \$1 for the third digit.



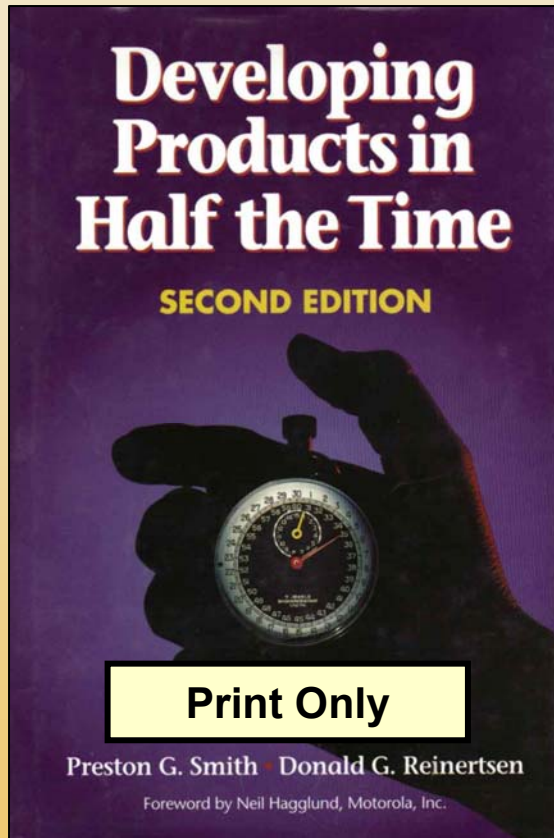
# Value of Feedback



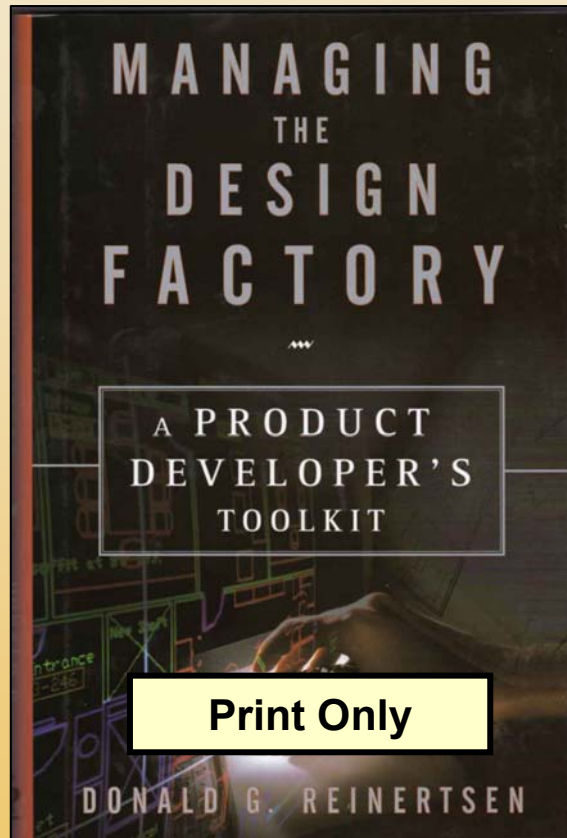
# Seven Big Ideas of 2GLPD

- 1. Understand your economics.**
- 2. Make your queues visible and control them.**
- 3. Create a process to exploit variability.**
- 4. Enable smaller batches.**
- 5. Control cycle time by controlling WIP.**
- 6. Sequence work based on economics.**
- 7. Accelerate feedback with smaller batches.**

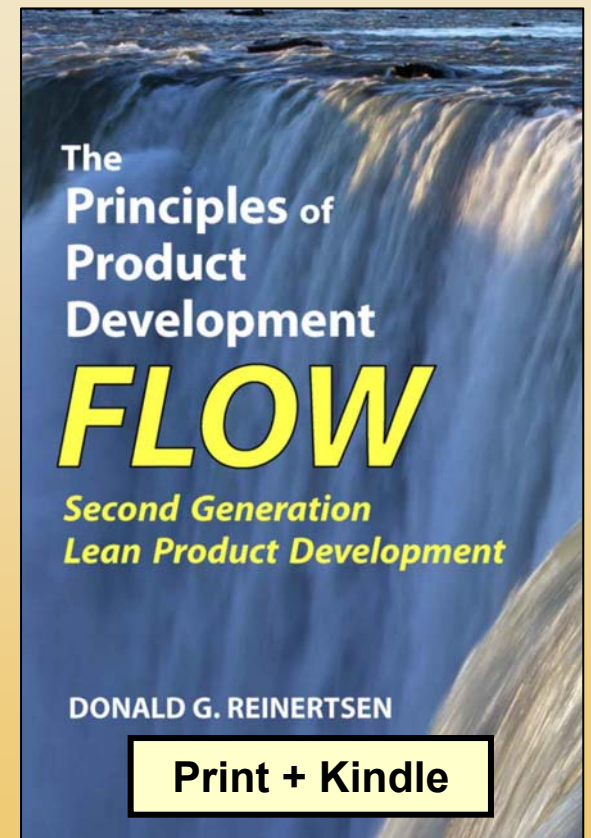
# Going Further



1991 / 1997



1997



2009

