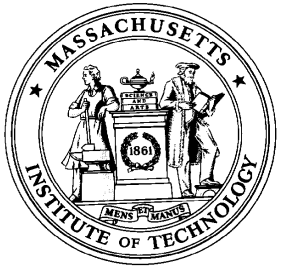
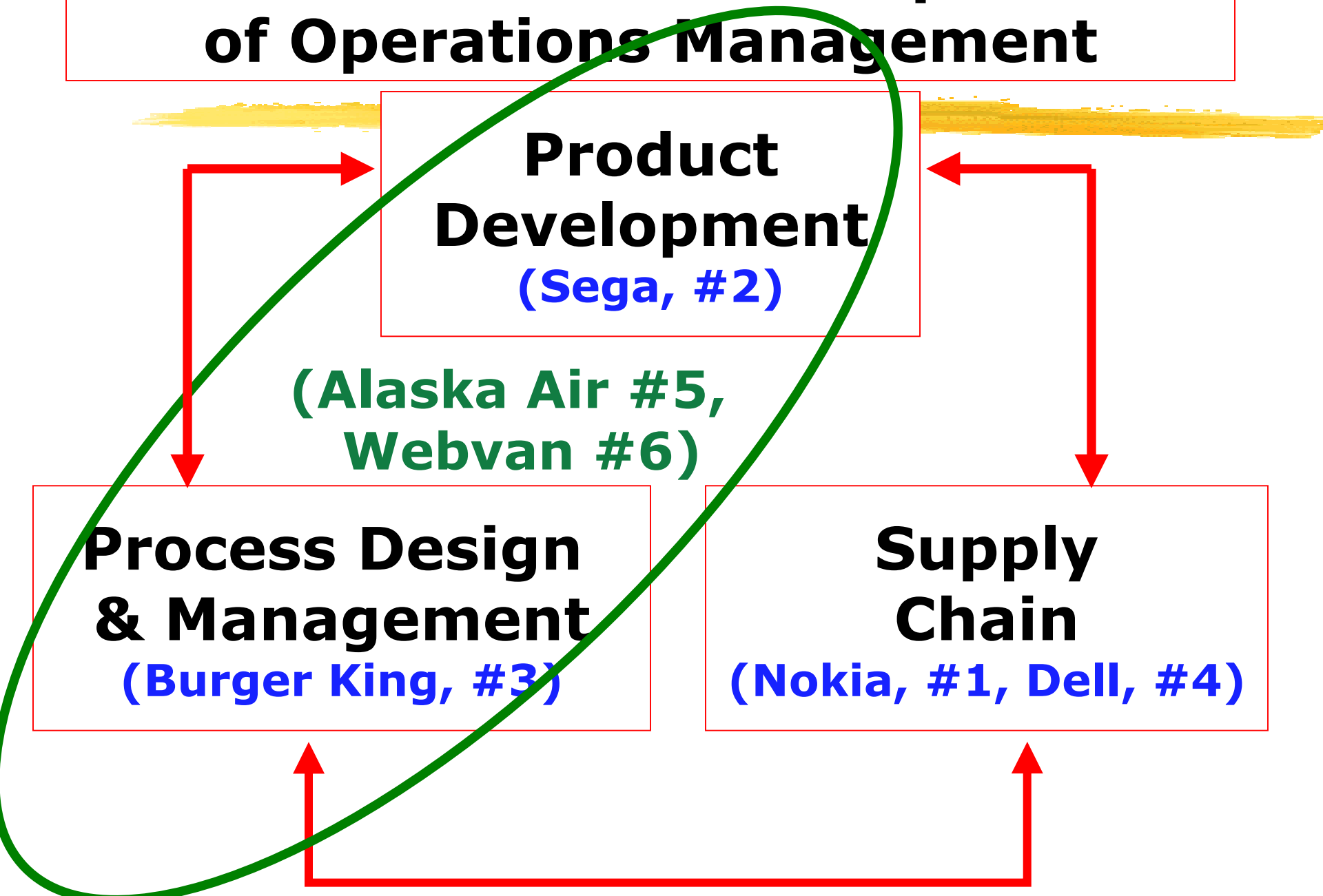
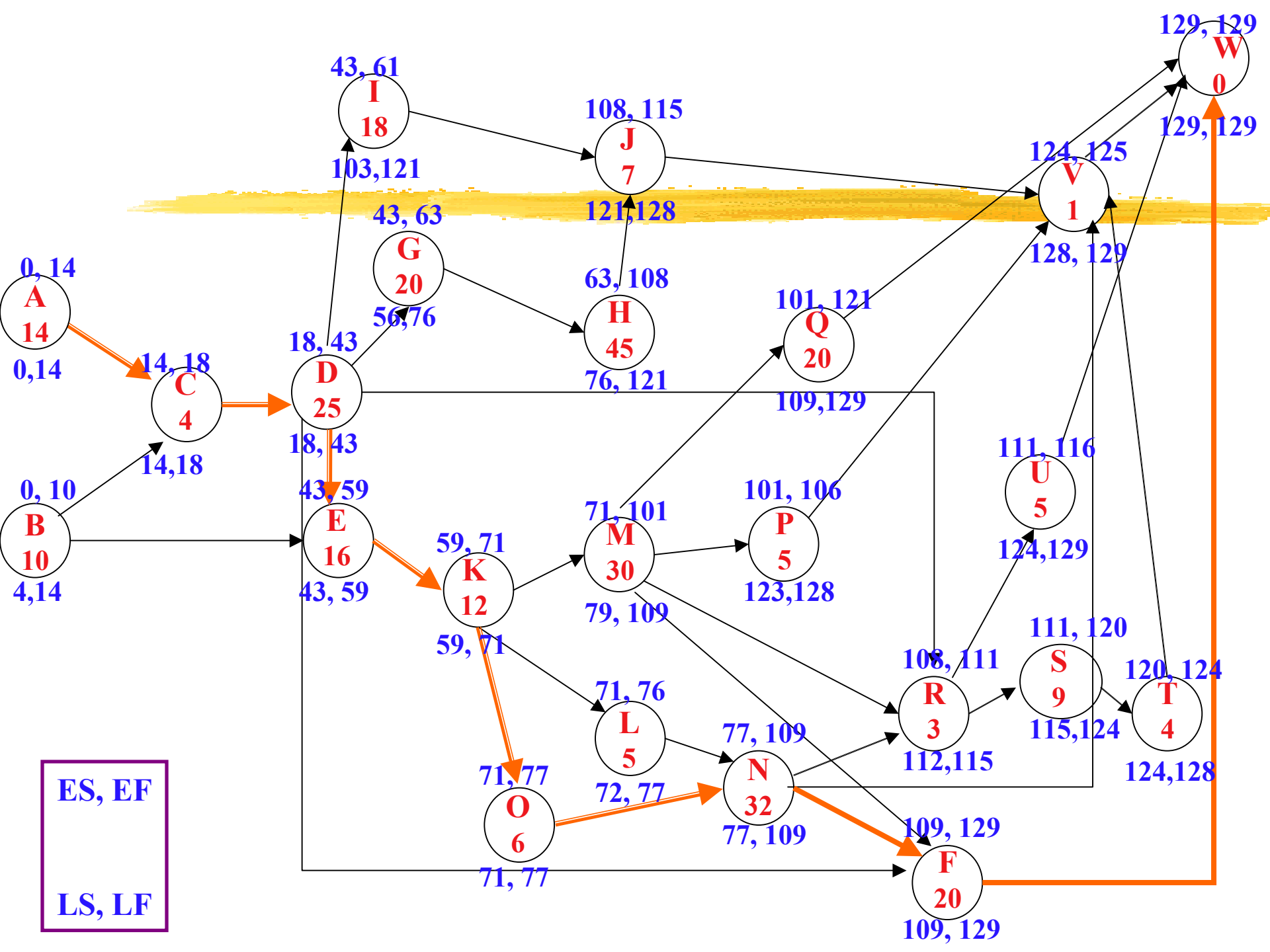
Retrospective: Introduction to Operations Management



Three Foundational Components of Operations Management




A
14
0, 14
0,14
B
10
0, 10
4,14
C
4
14, 18
14,18
D
25
18, 43
18, 43
E
16
43, 59
43, 59
I
18
43, 61
103,121
G
20
43, 63
56,76
J
7
108, 115
121,128
H
45
63, 108
76, 121
K
12
59, 71
59, 71
L
5
71, 76
72, 77
M
30
71, 101
79, 109
N
32
77, 109
77, 109
O
6
71, 77
71, 77
P
5
101, 106
123,128
Q
20
101, 121
109,129
R
3
108, 111
112,115
S
9
111, 120
115,124
T
4
120, 124
124,128
U
5
111, 116
124,129
V
1
124, 125
128, 129
W
0
129, 129
129, 129
F
20
109, 129
109, 129
ES, EF
LS, LF

Process Design & Management

- **Process Design: Options & Assessment**
  - **-Queueing Analysis**
  - **-Capacity Analysis**
    How did Nokia assess capacity in the crunch? How did they change capacity?
  - **-Uncertainty Analysis**
    How did each company prepare for difficult-to-anticipate events?

- **Inventory Systems**

•Did N&E operate Just-in-Time, or did they hold big stores of chips waiting just in case?

- **Production Control**

Was Nokia's software the principal instrument of control?
How did they monitor the situation?

ERP/Software/Internet

•Was Nokia's software the principal instrument of communication?

- **Operations Excellence**
  - **- Continuous Improvement**
  - **- Just-in-Time**
  - **- Quality Management (SPC, 6σ)**

Three Foundational Components of Operations Management

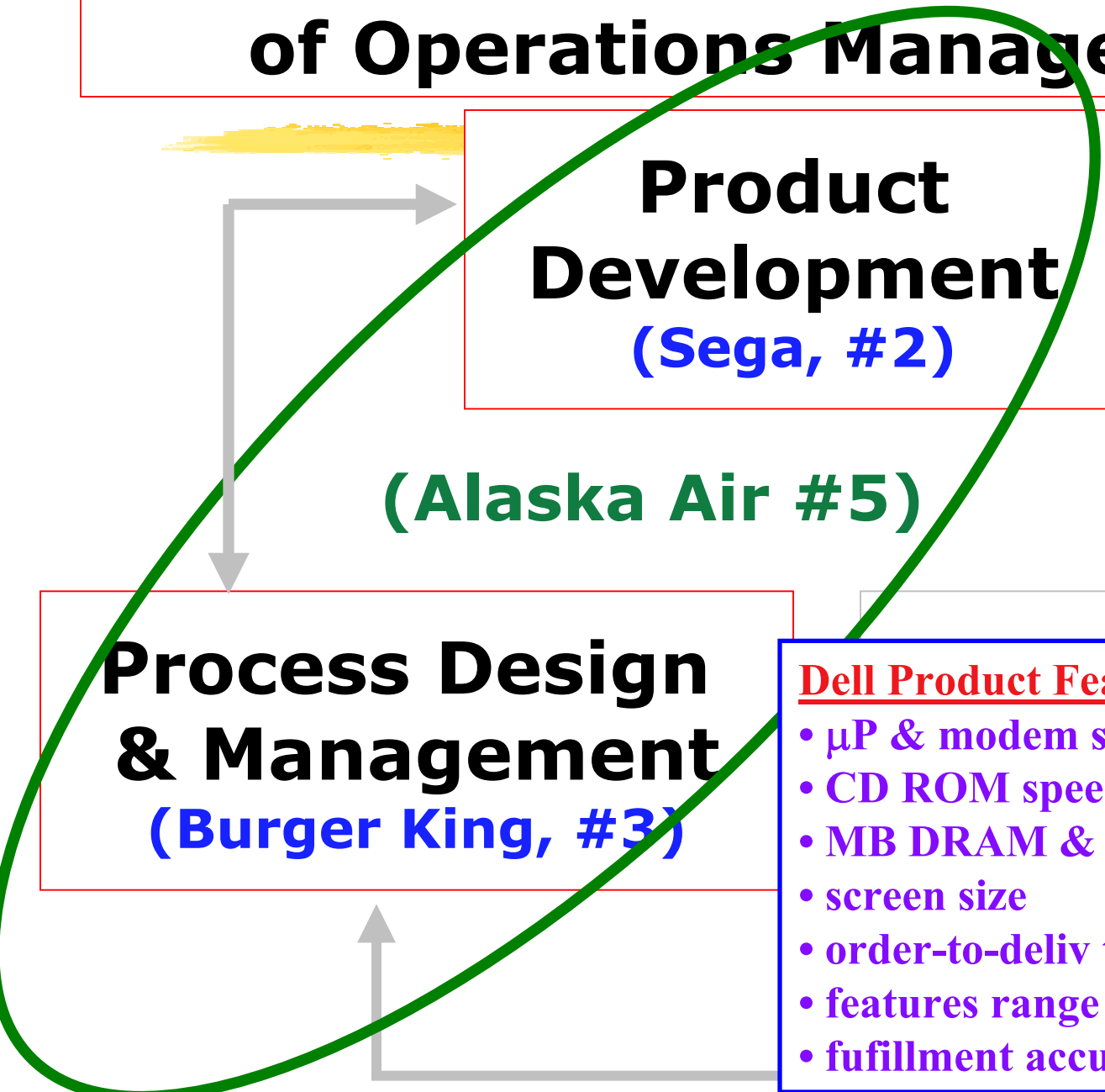
Product Development
(Sega, #2)

(Alaska Air #5)

Process Design & Management
(Burger King, #3)

AA Product Features
- check-in time
- reservations help
- meals
- price
- flight frequency
- mileage awards
- route coverage
- baggage handling
- customer coddling

Dell Product Features
- µP & modem speed
- CD ROM speed
- MB DRAM & HD
- screen size
- order-to-deliv time
- features range
- fufillment accuracy



Three Foundational Components of Operations Management

Product Development
(Sega, #2)

(Alaska Air #5, Webvan #6)

Process Design & Management
(Burger King, #3)

Webvan Features
- selection
- price
- quality/freshness
- shop any hour
- never leave home
- choose delivery time
- save your time
- same day delivery
- fulfillment accuracy
- no lugging required

Grocery Store Features
- selection
- price
- quality/freshness
- shopping environment

Who has the advantage on each dimension?

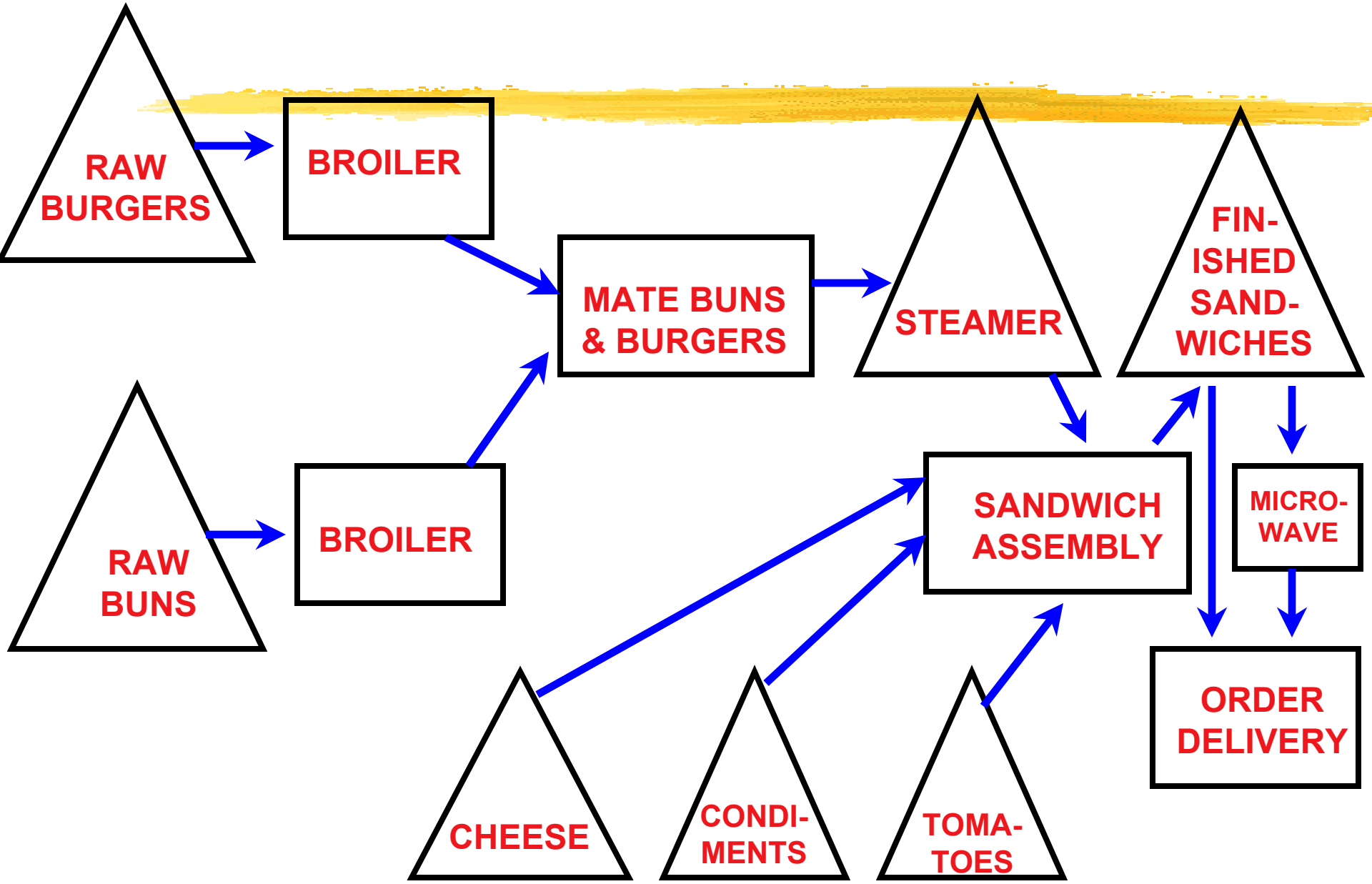
Challenges of Service Interface: Grocery Stores vs. Webvan

- **Intangibility - customer expectations vs. perceptions**
  - **Grocery Stores: quality, selection, *ENVIRONMENT***
  - **Webvan: quality, selection, *DELIVERY***
- **Perishability - use it or lose it**
  - **Grocery Stores: fresh foods (produce, meats, baked goods)**
  - **Webvan: fresh foods & *TRUCK CAPACITY***
- **Heterogeneity - inherent variability of service & customer**
  - **Grocery: checkout people, counter people, customer needs**
  - **Webvan: *DELIVERY PERSON***
- **Simultaneity - services simultaneously produced & consumed**
  - **Grocery: presentation in the store**
  - **Webvan: *DELIVERY TO THE HOME***

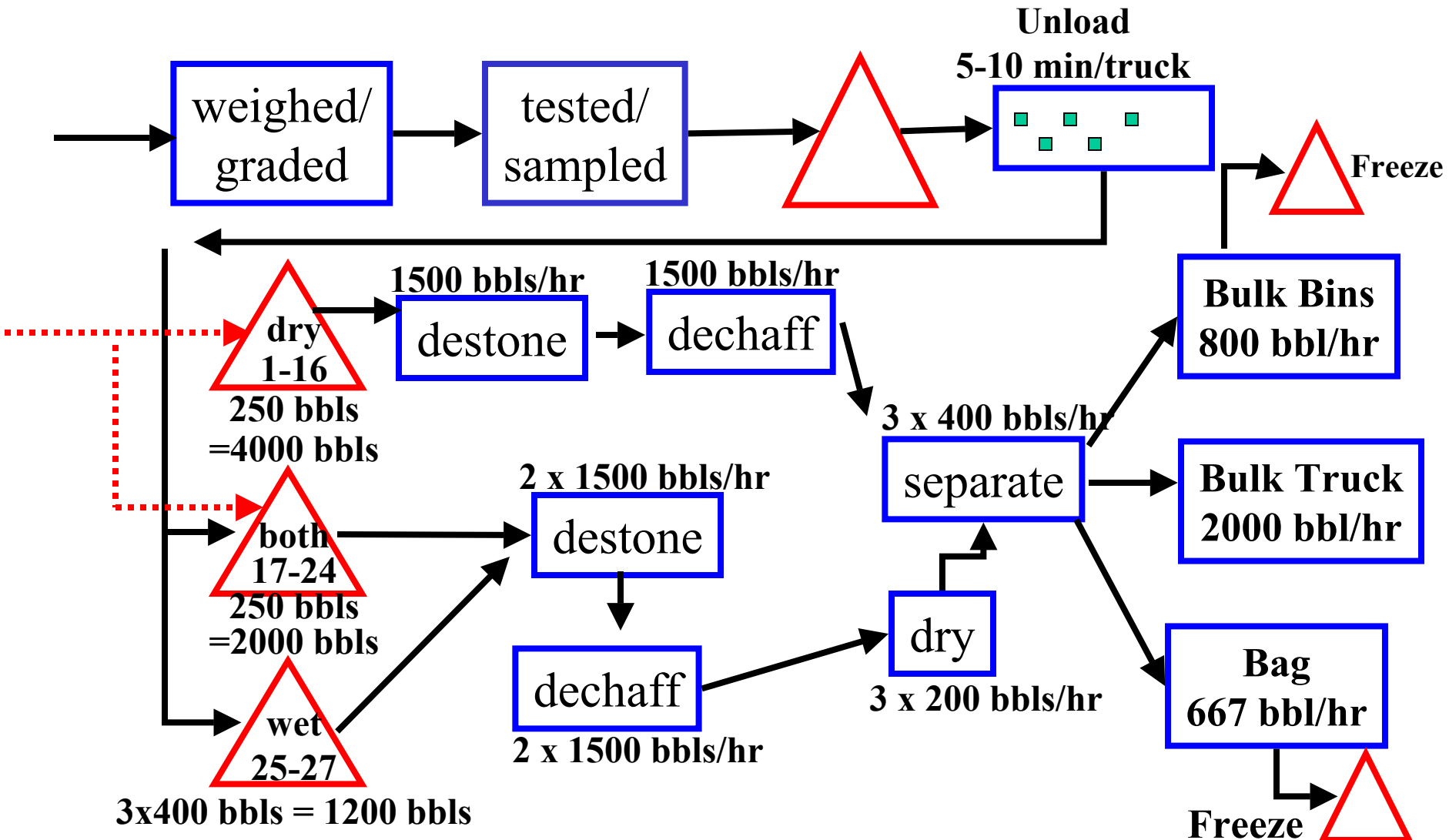
Supply Chain

- **Strategic Supply Chain Design**
  - **-Make Vs. Buy**
    - **Did sourcing strategy play a role in the differential performance of N & E?**
  - **-Supplier Selection , Sourcing**
    - **Single vs. Dual sourcing**
- **Supply Chain Management**
  - **-End-to-end coordination**
    - **Do we see here examples of integrated enterprise?**
  - **-Supplier Relations**
    - **hard-nosed, polite, hostile, collaborative?**
- **Delayed Differentiation**

BK: Process Flow Diagram for Sandwiches



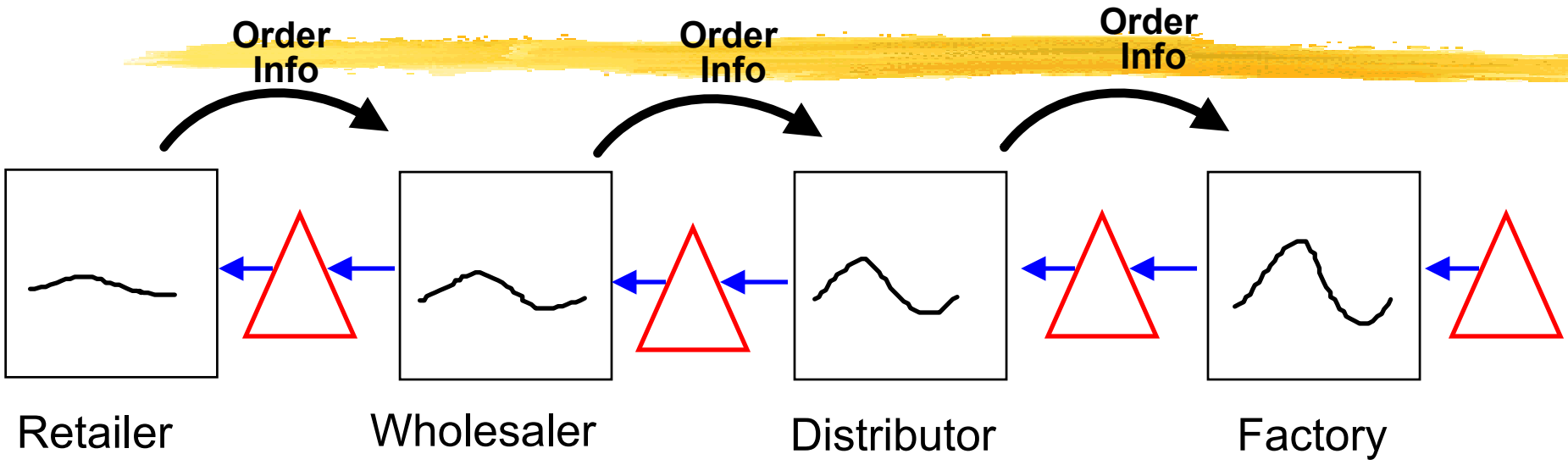
National Cranberry Process Flow Diagram



Restaurant Operations Management

1. What are the key **DESIGN** parameters for Burger King?
   A. Product
   B. Process Technology
   C. Facility
   D. Work System/HR System
2. What are the key **PLANNING** tasks for Burger King?
   A. Supply
   B. Demand
   C. Capacity/Workload
3. What are the key **CONTROL** processes for Burger King?
   A. Production Control
   B. Quality Control
   C. Process Control
4. What are the key **IMPROVEMENT** processes for BK?
   A. Quality Improvement
   B. Productivity Improvement
   C. Technological Improvement
   D. Systems Improvement

Volatility Amplification in the Supply Chain:
"The Bullwhip Effect"

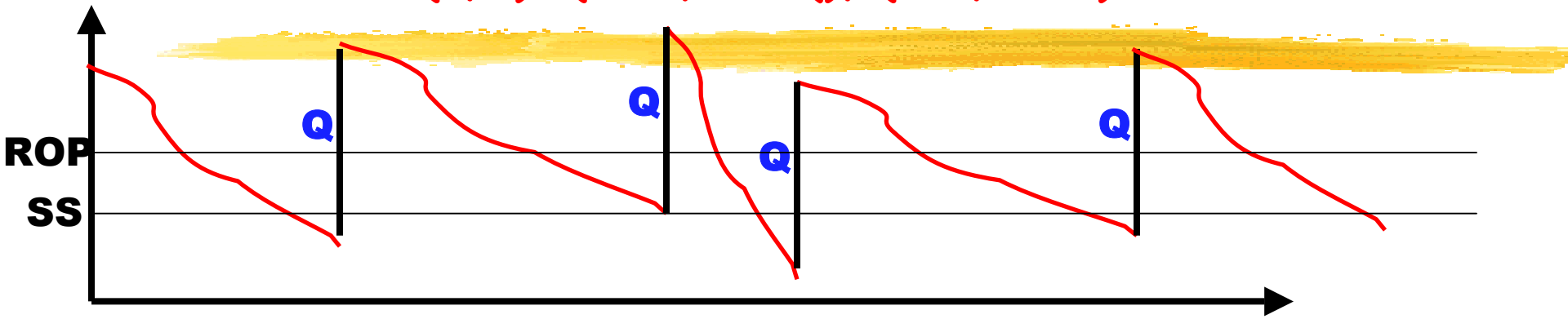


How does production control work in the Beer Game?

Information lags
Delivery lags
Over- and underordering
Misperceptions of feedback
Lumpiness in ordering
Chain accumulations

SOLUTIONS:
Countercyclical Markets
Countercyclical Technologies
Collaborative channel mgmt.
(Cincinnati Milacron & Boeing)

Applying EOQ and Newsvendor models to set Reorder Points and Reorder Quantities
(s,S) (ROP, ROQ), (min, max)



$$Q = \sqrt{\frac{2RS}{CK}} = \text{ROQ (REORDER QUANTITY)}$$

ROP=Reorder Point = Expected Demand During the order lead time + safety stock
= E{DDL} + SS

Prob {DDL≤ROP} = Cu/(Co+Cu)

Cu=Cost of Underage (*r-c* in newsvendor); Co=Cost of Overage (*c* in newsvendor)

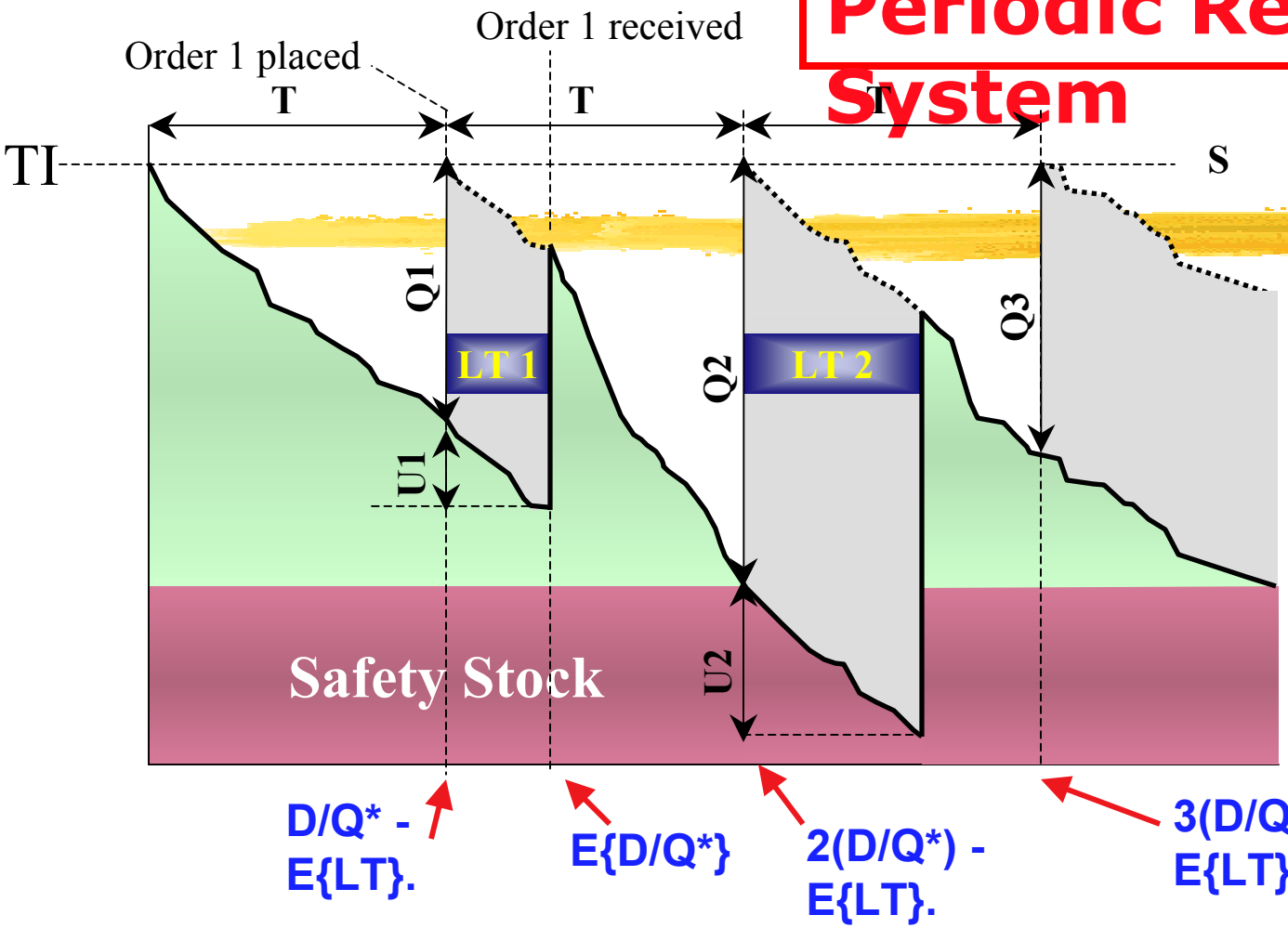
But, Co with nonperishables is c x cost of holding

ROP=SS+E{DDL}; DDL = X1 + X2 + . . . + XL; E{DDL} = E{L} x E{X}

i.e., DDL has a mean of Expected lead time x Expected avg demand/unit time

Variance{DDL}~Var{X} x E{L} + Var{L} x $E\{X^2\}$

Periodic Review System



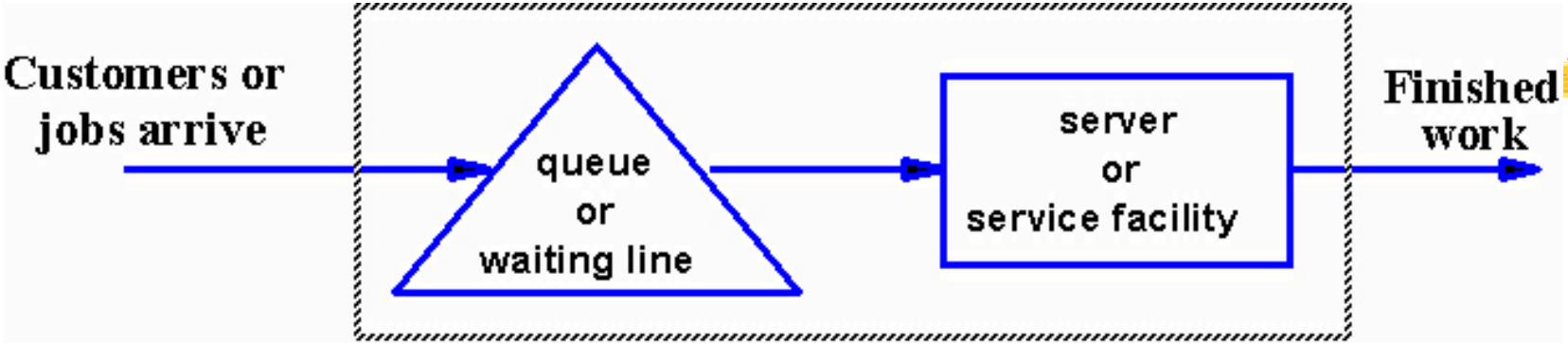
LT = Lead Time
T = Cycle Time or Review Period
U = Actual Demand During Lead Time
Q = Order Size
S = Order Up To Level

If $Q^*=EOQ=\sqrt{\frac{2DS}{CK}}$, where Demand Rate=D units per week,

Then T=Time between orders = D/Q^*.

Want Q1 units to arrive at time D/Q^*, so order at D/Q^*- E{LT}.

15.760 Class #8:
Basic Concepts in Queueing

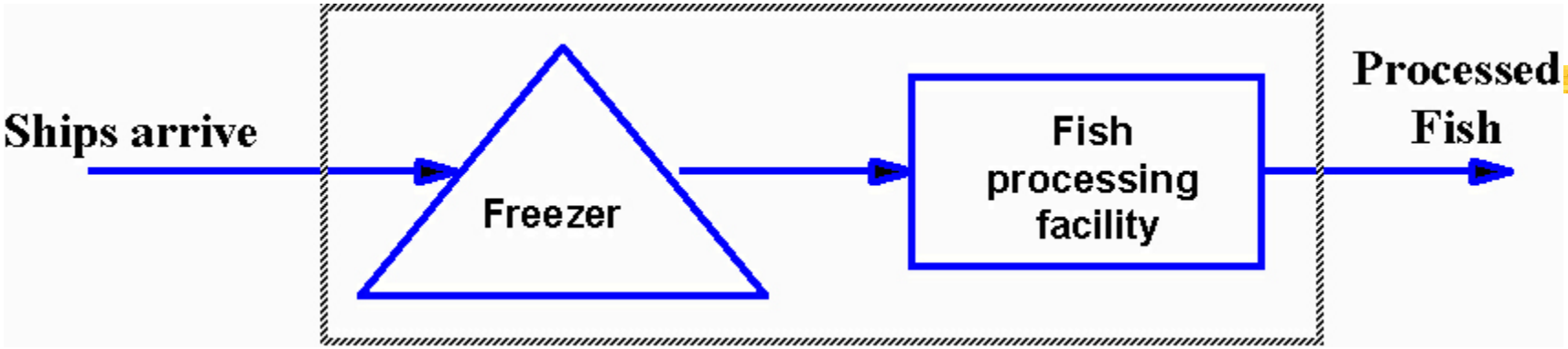


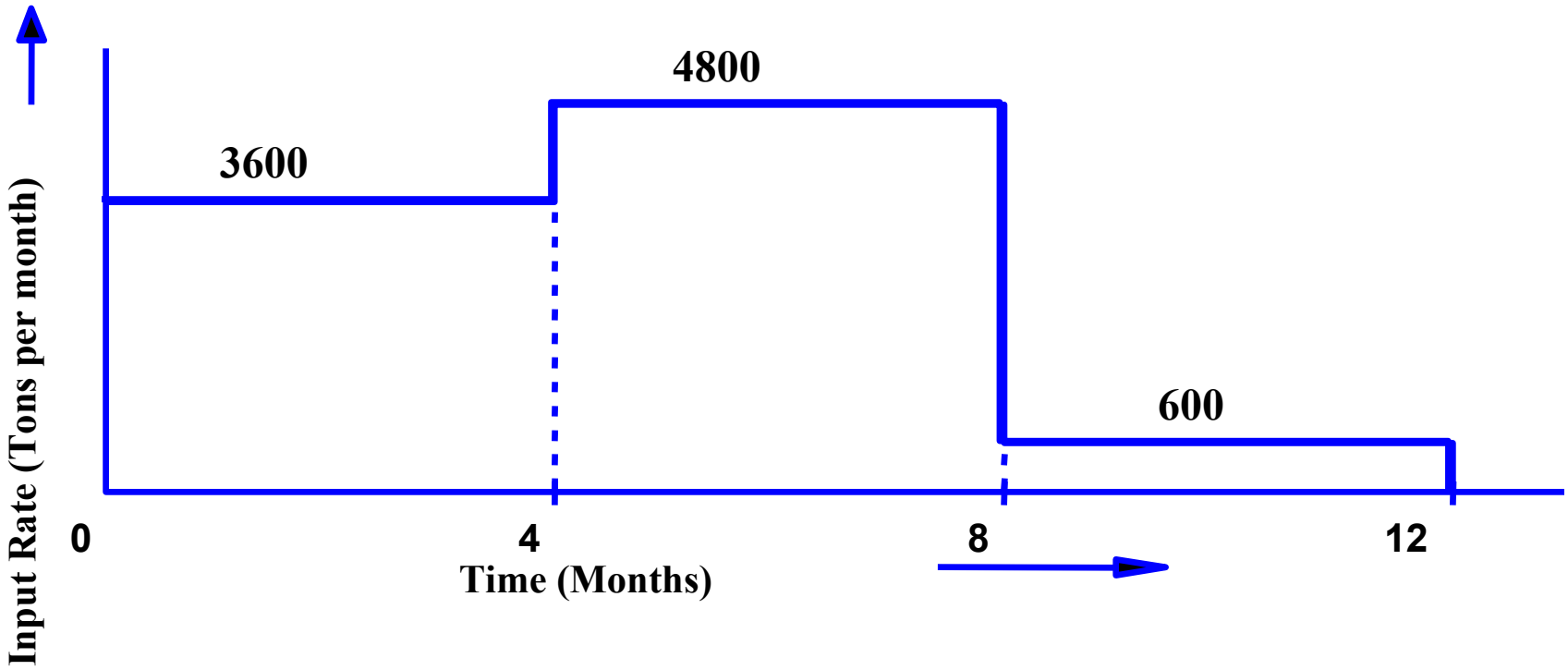
System Performance = f(System parameters)

Output/throughput rate	(λ)
Inventory Level/Queue Size/ Line length	(□)
Waiting Time/Cycle Time	(W)
Capacity or Server utilization	(ρ)
Probability that Queue is full	(P_{full})

Arrival rate	(λ)
Service rate	(μ)
Service time	(M)
Number of servers	(S)
Queue/Buffer capacity	(R)
Capacity or Server utilization	(ρ)
Number of Service classes	(K)

Fish Processing Example





ASSUMPTIONS OF THE QUEUEING MODELS

Poisson arrivals/exponential service times

steady state

$\rho < 1$, when computing the queue lengths and waiting times

Constant # of servers

FIFO service

Single-line queue (to MD's)

Infinite queue capacity

Ignore special priority emergencies

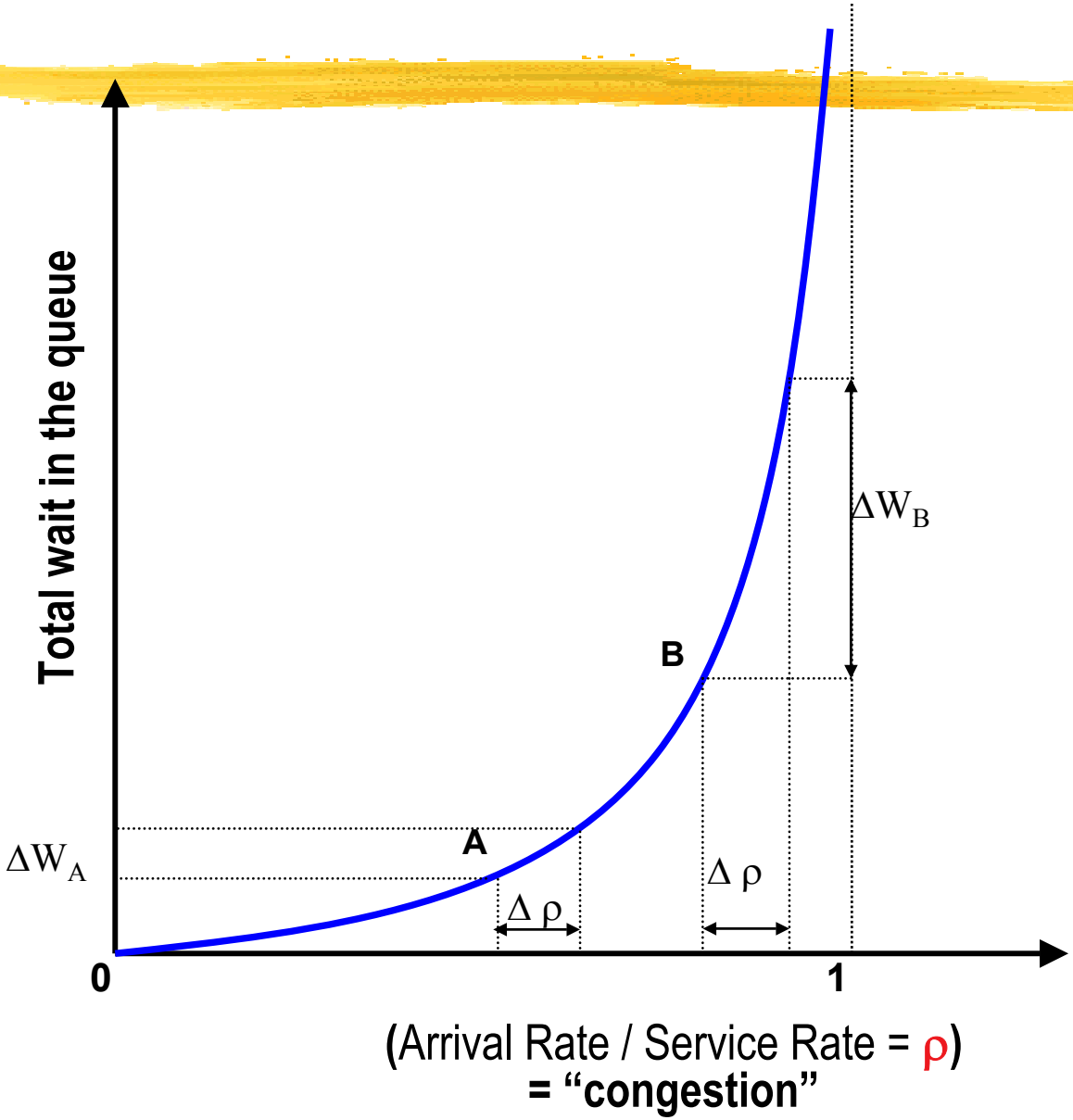
Ignore special priority requests

Basic Concepts in Queueing: Nonlinearities in Congestion in Stochastic Systems

If service times and interarrival times have exponential distributions, then

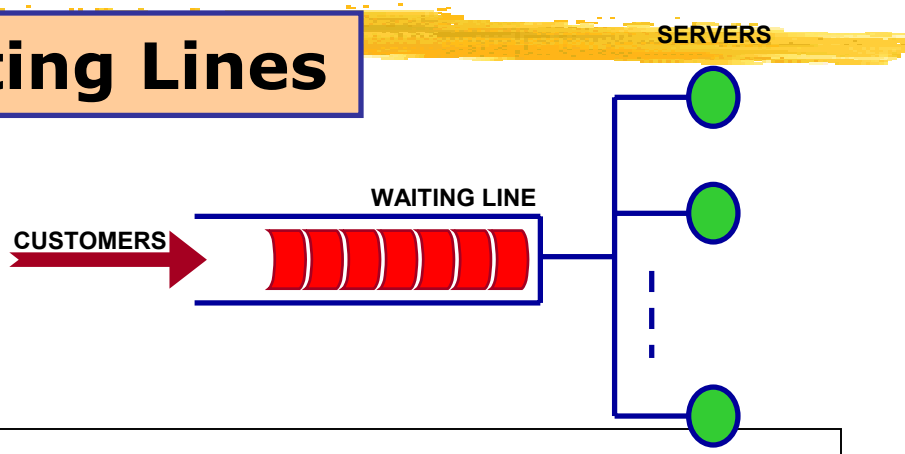
$$L = \rho^2/(1-\rho)$$

$$W = \rho^2/\lambda(1-\rho)$$



Management of Queues

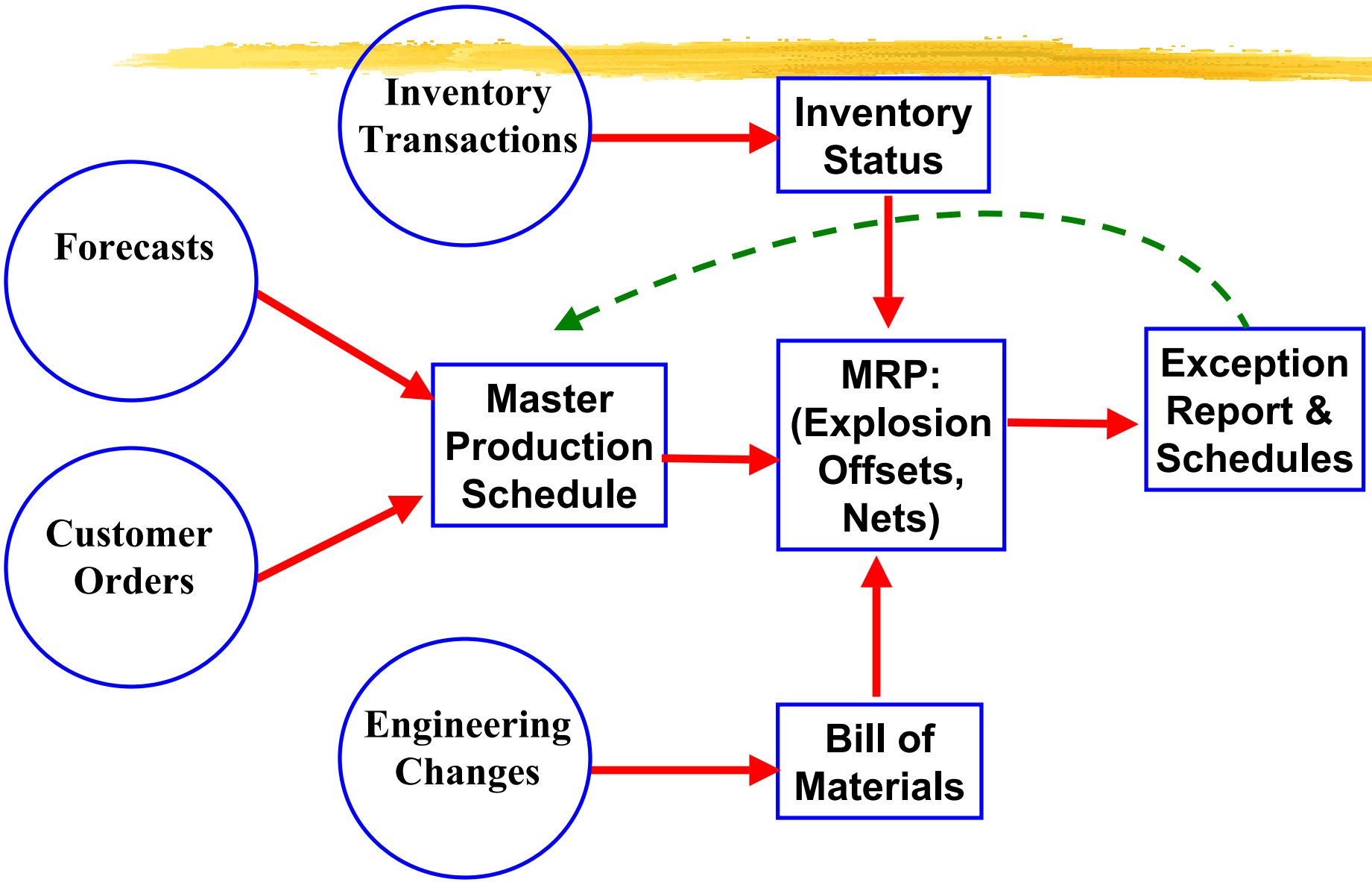
The Psychology of Waiting Lines



Propositions

1. Unoccupied time feels longer than occupied time
2. Process waits feel longer than in process waits
3. Anxiety makes waits seem longer
4. Uncertain waits seem longer than known, finite waits
5. Unexplained waits are longer than explained
6. Unfair waits are longer than equitable waits
7. The more valuable the service, the longer the customer will wait
8. Solo waits feel longer than group waits

What is the Purpose and Logic of MRP ?



Clockspeed:

The Dimension of Time on Operations Management

Study the Industry Fruitflies

Evolution in the natural world:

FRUITFLIES
evolve faster than
MAMMALS
evolve faster than
REPTILES

THE KEY TOOL:

Cross-SPECIES Benchmarking of Dynamic Forces

Evolution in the industrial world:

INFOTAINMENT is faster than
MICROCHIPS is faster than
AUTOS evolve faster than
AIRCRAFT evolve faster than
MINERAL EXTRACTION

THE KEY TOOL:

Cross-INDUSTRY Benchmarking of Dynamic Forces

TQM 15.760, Spring 2002

TOTAL QUALITY MANAGEMENT

FOUR LEVELS OF QUALITY

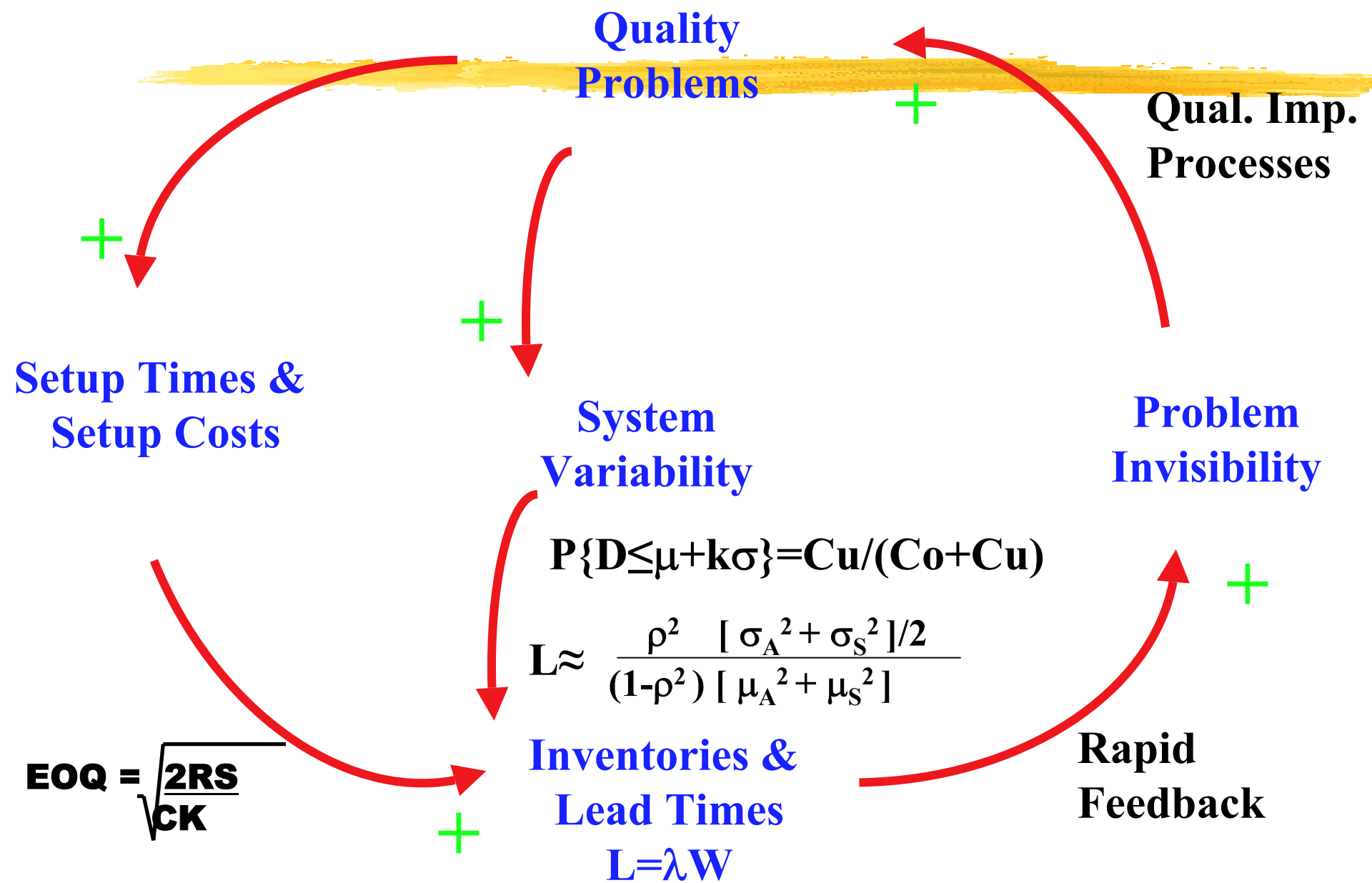
FOUR THOUGHT REVOLUTIONS

Customers first
Continuous Improvement
Total Participation
Societal Learning

ORGANIZATIONAL MANAGEMENT

Information & Measurement Systems
Education
Incentive Systems
Organizational Change

The Logic and Processes of JIT Improvement



See Karmarkar: Getting Control of JIT, HBR, Sept-Oct 1989

From Reengineering to Process Management and Beyond

or

In the Footsteps of the Buffalo Springfield

"Something's happening here; what is ain't exactly clear . . . "

MIT Sloan School
Dr. Michael Hammer
March 2002

Summary: Seven Things to Remember

- Process
- Process redesign
- Process evolution
- Process enterprise
- Process ownership
- Process as universal enabler
- Process integration across enterprise boundaries

Operations Lessons from The Goal

1. Measuring Operations Performance
2. Flow System management
3. Bottleneck Management

HP Supply Chain Problems

- Long chain with bullwhip
- local customization needs with unpredictable demands

Postponing customization allows inventory pooling which provides greater Coverage with less stock

Possible solutions:

- **Air Ship**
- **Europe Factory**
- **Universal Model**
- **Better Forecast**
- **Product Line change**
- **Shorten Review Period**
- **More Inventory**

A thumbnail sketch of the 20th century's big ideas in operations management

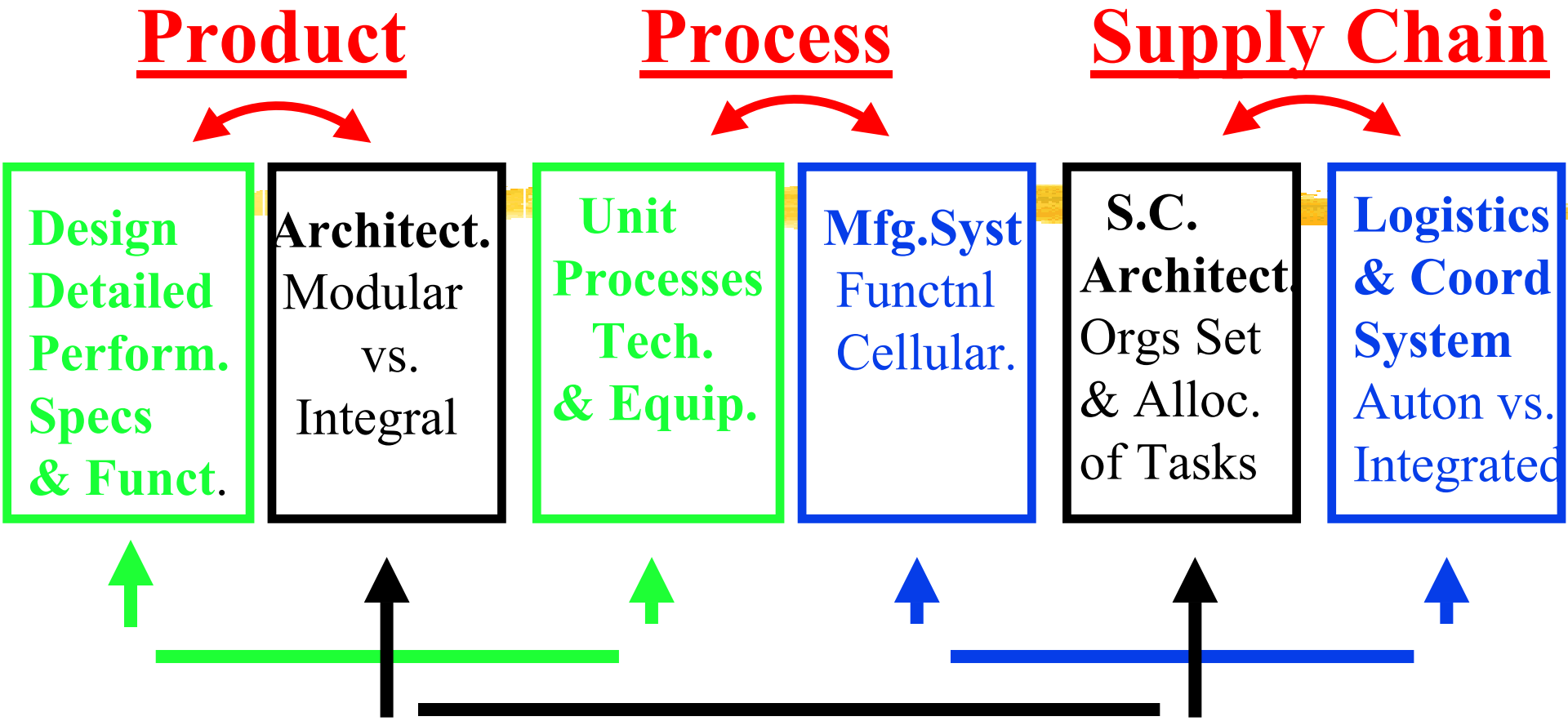
1920's: Ford & Taylor
- Moving Production line and standardized work

1930's: Shewhart
- Statistical Control of Quality

1960's: Ohno
- Lean Production System

1980's: Goldratt & Kaplan
- Measurement & Theory of Constraints

1990's: Hammer
- Reengineering & Process Focus



- Focus
- Architecture
- Technology

A 3-D CE decision model illustrating the *imperative* of concurrency

All Conclusions are *Temporary*

Clockspeeds are increasing almost everywhere

Supply Chain Relationships must anticipate Industry and Value Chain Dynamics

Proactive Relationships Design is a key organizational competency

Supply Chain Relationships must be designed concurrently with the products and systems they will deliver

Study of Fruit Flies can help with crafting strategy