2007-05-01

Optimal Inventory Policy for Two-echelon Remanufacturing

Ferrer, Geraldo

Acquisition Research Program:
Creating Synergy for Informed Change

Optimal Inventory Policy for Two-echelon Remanufacturing

Prof. Geraldo Ferrer

Graduate School of Business and Public Policy

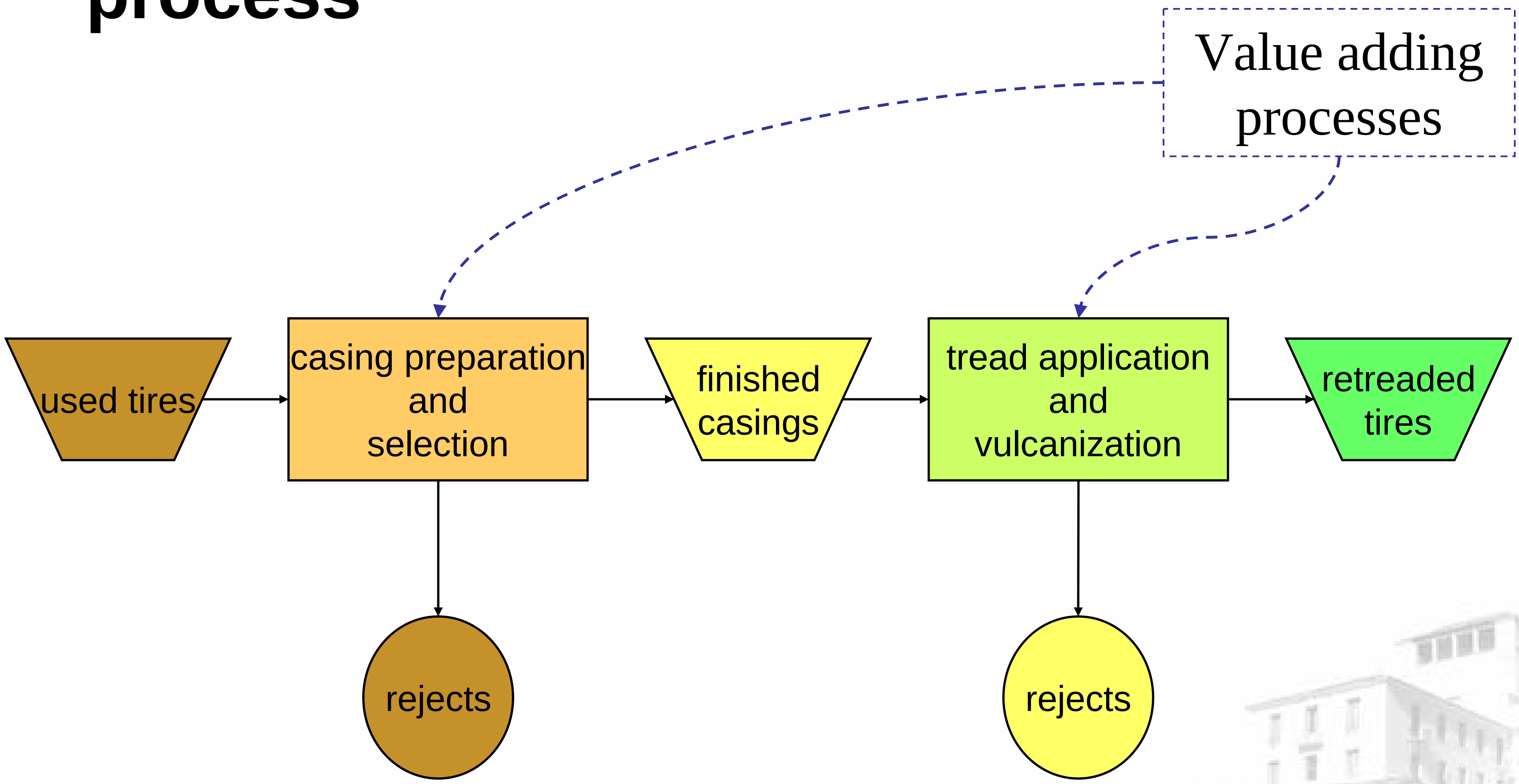
Introduction

- OBJECTIVE: Identify the inventory policies that will fit a remanufacturing environment:
  - sequential disassembly and selection processes
  - random yield in each process
  - known demand
- ASSUMPTION: There is no shortage of used goods to feed the process:
  - plentiful stock of used goods
  - uncertainty is generated by the wear state

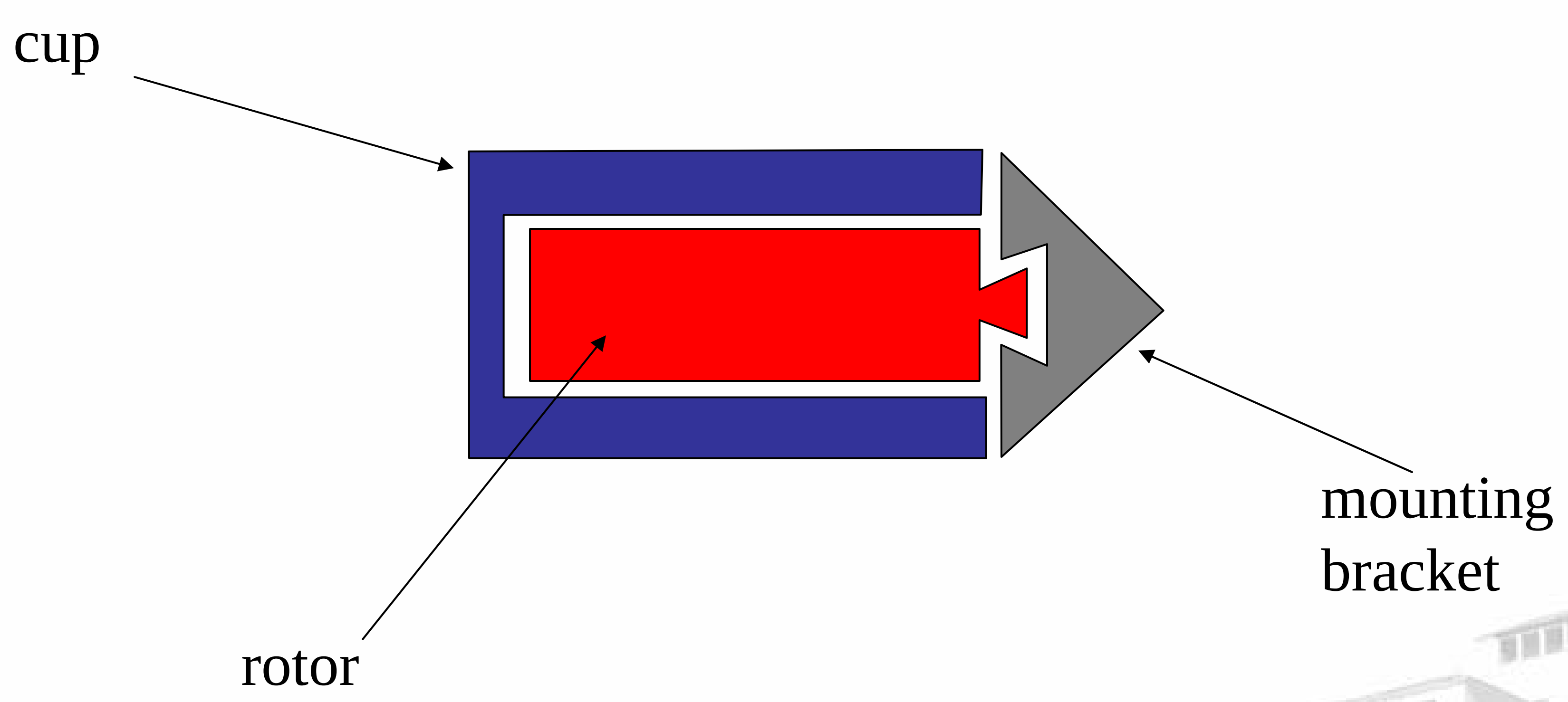
Some related literature

	Single Process		Multi Process	
	Constant Process Yield	Random Process Yield	Constant Process Yield	Random Process Yield
Constant Demand	Harris 1913	various	Clark, Scarf 1960	
Random Demand	various	various	DeBodt and Graves 1985	

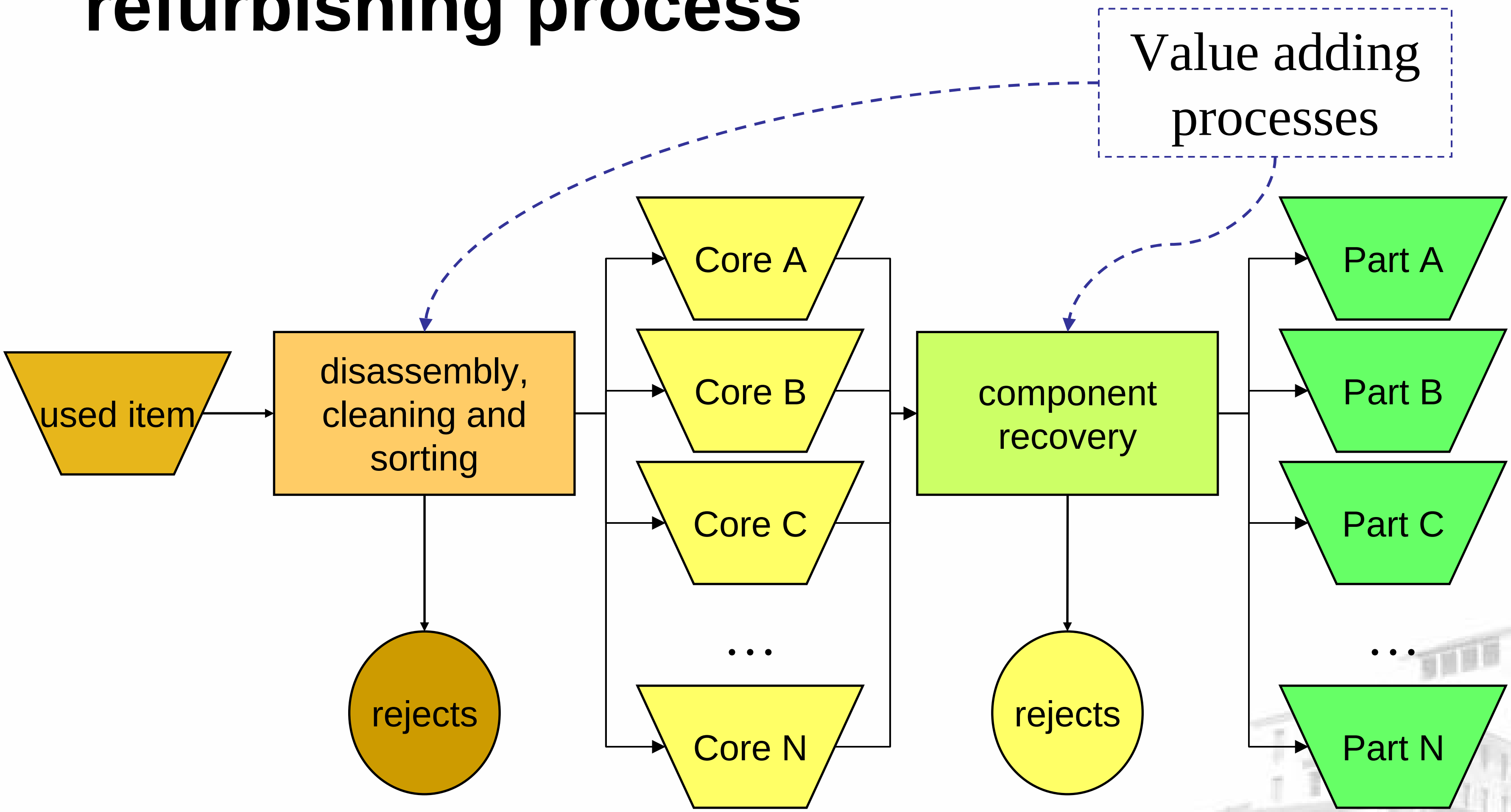
Used tires flow in the retreading process



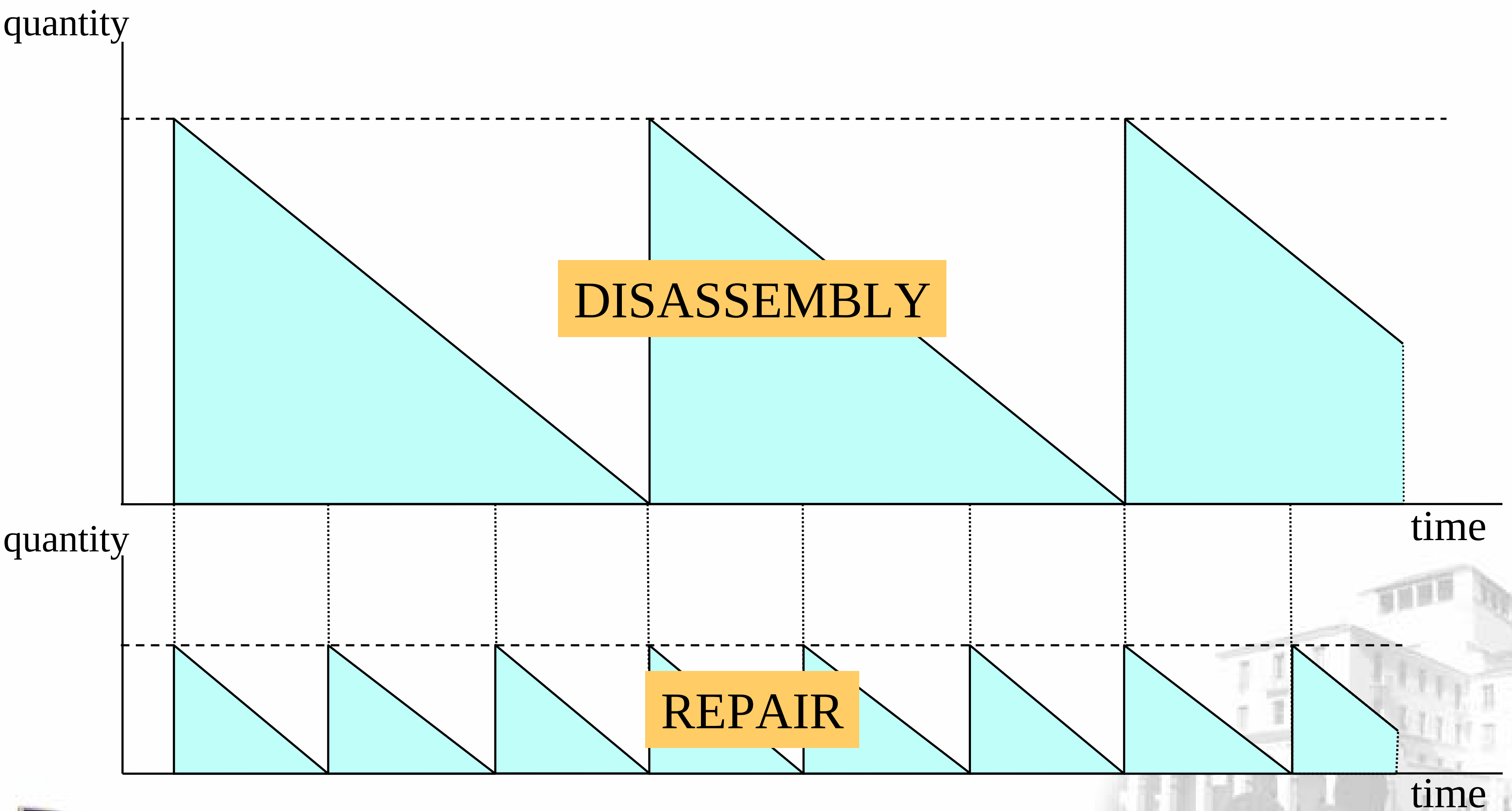
Electric Components



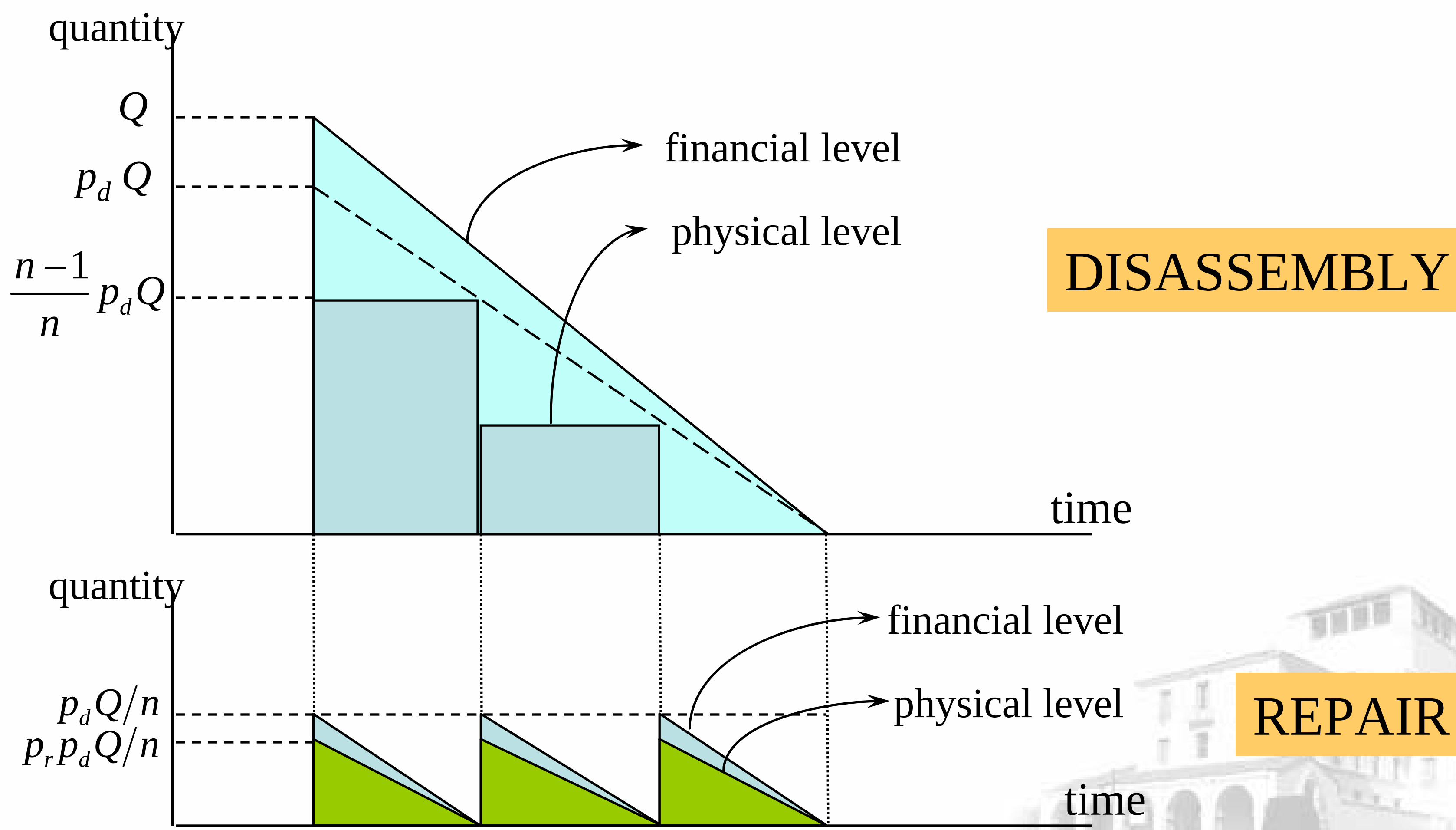
Material flow of complex equipment refurbishing process



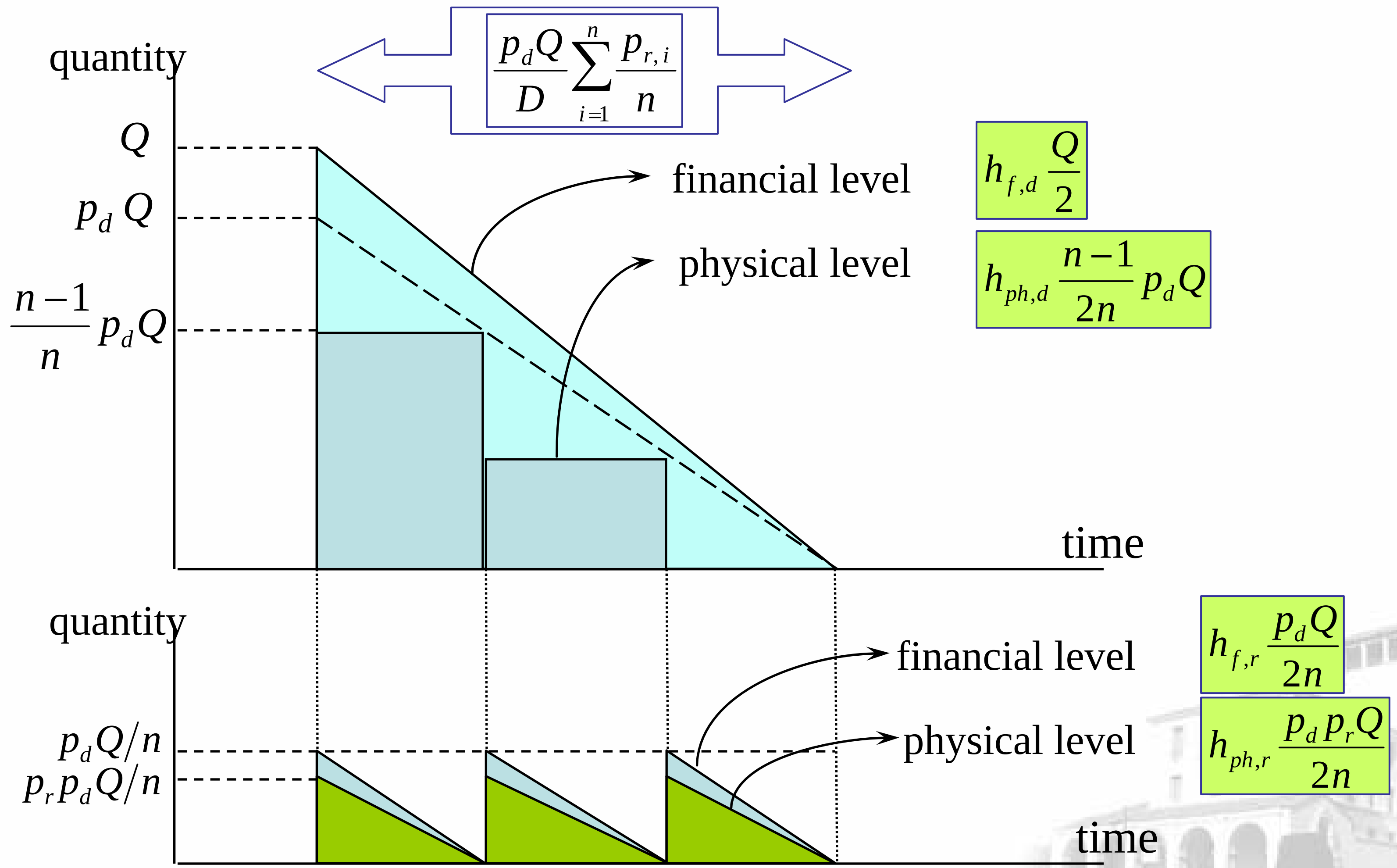
Multi-Echelon Inventory Process



Financial and Physical Stock

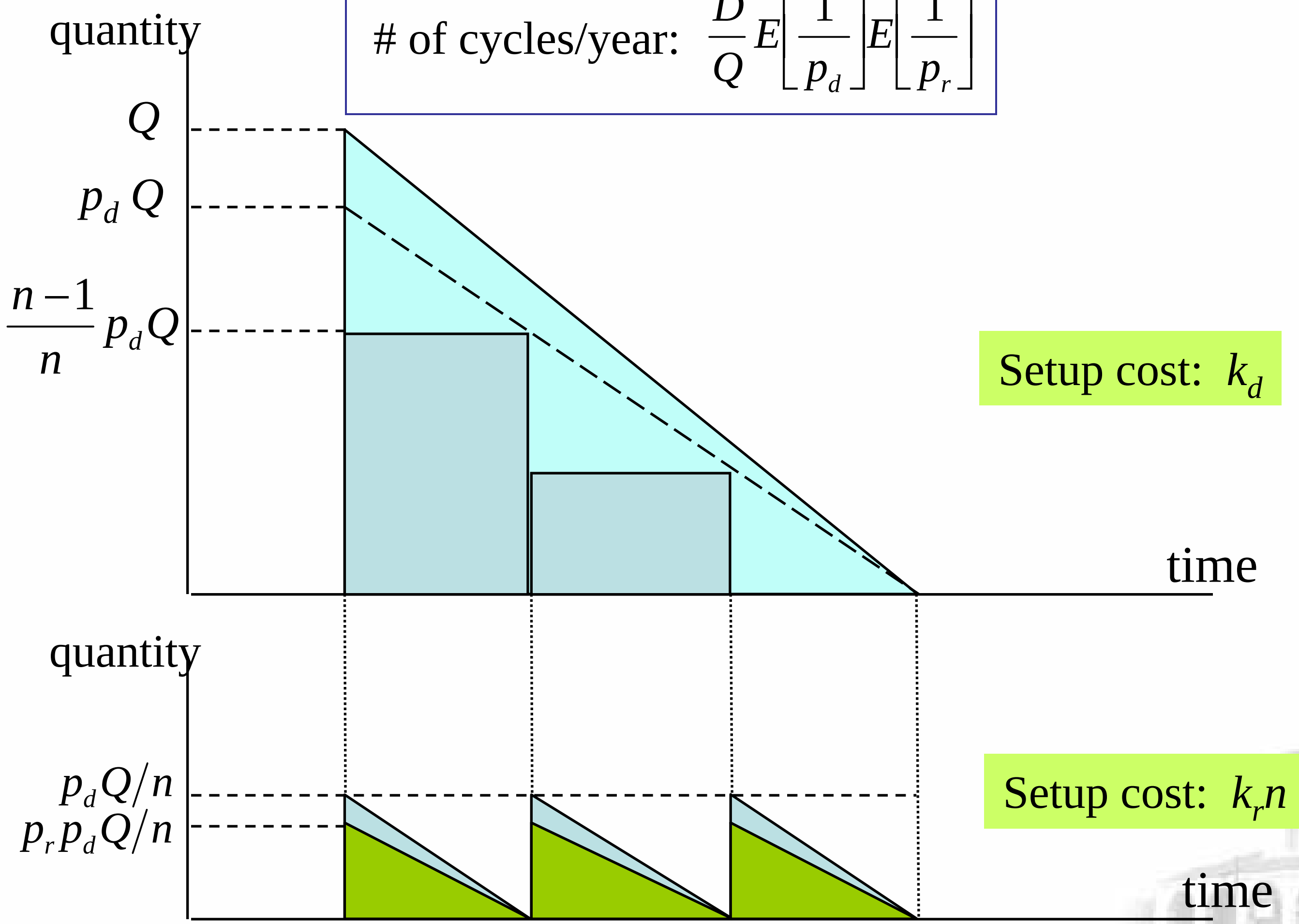


Financial and Physical Holding Cost



Financial and Physical Setup Cost

of cycles/year: $\frac{D}{Q} E\left[\frac{1}{p_d}\right] E\left[\frac{1}{p_r}\right]$



Optimal Inventory Policy

Considering:

$$\begin{cases} n = \sqrt{\dfrac{E[p_d]\left(h_{f,r} - h_{ph,d} + h_{ph,r}E[p_r]\right)}{h_{f,d} + h_{ph,d}E[p_d]} \dfrac{k_d}{k_r}} \\ H(n) = h_{f,d} + \dfrac{E[p_d]}{n}\left(h_{ph,d}(n-1) + h_{f,r} + h_{ph,r}E[p_r]\right) \\ K(n) = (k_d + nk_r)E[1/p_d]E[1/p_r] \end{cases}$$

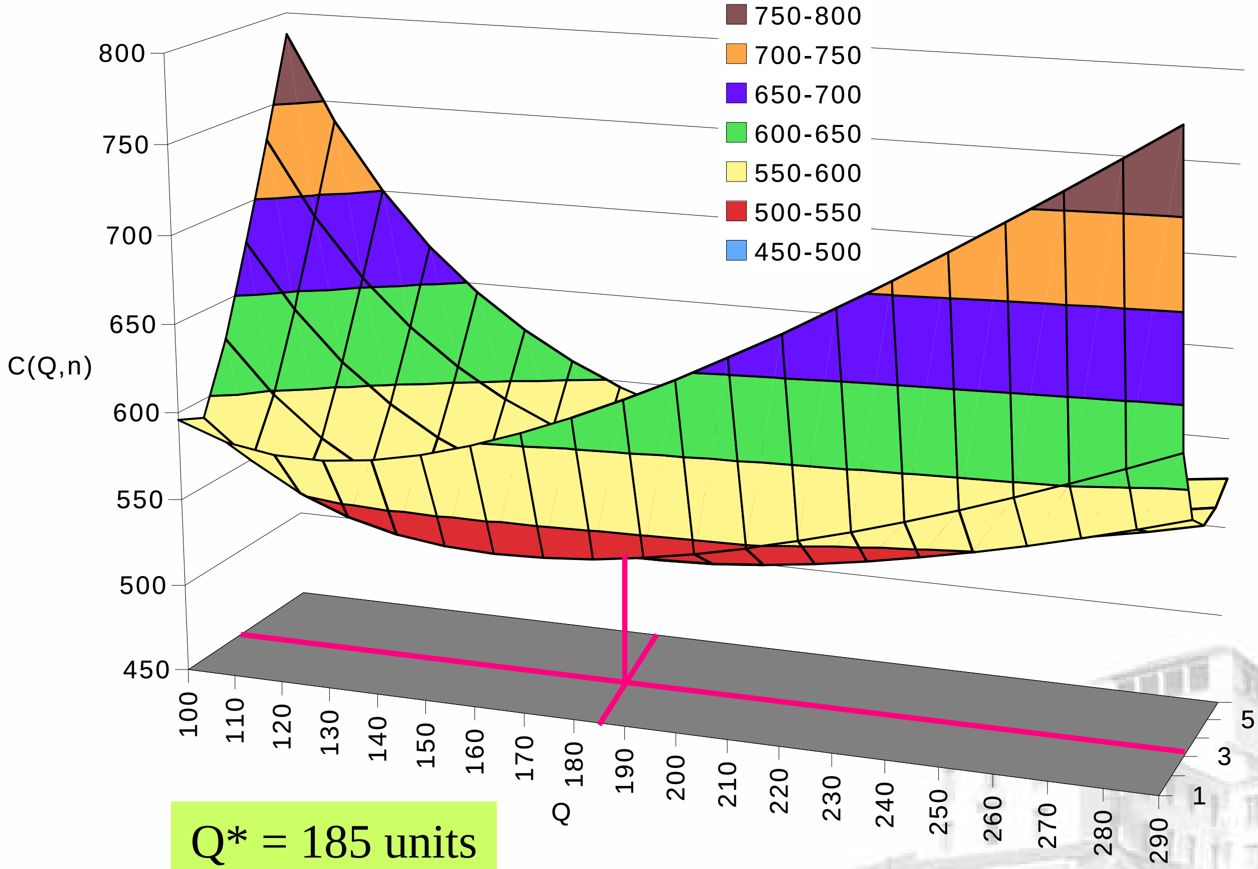
Optimal Inventory Policy $Q^*(n) = \sqrt{\dfrac{2DK(n)}{H(n)}}$

Example

Disassembly Process:
k_d = \$30/process
$h_{f,d}$ = \$0.5/unit-yr
$h_{ph,d}$ = \$2/unit-yr
p_d = U[0.5, 0.95]

Repair Process:
k_r = \$6/process
$h_{f,r}$ = \$4/unit-yr
$h_{ph,r}$ = \$2/unit-yr
p_r = U[0.75, 0.95]

D = 600 units/yr



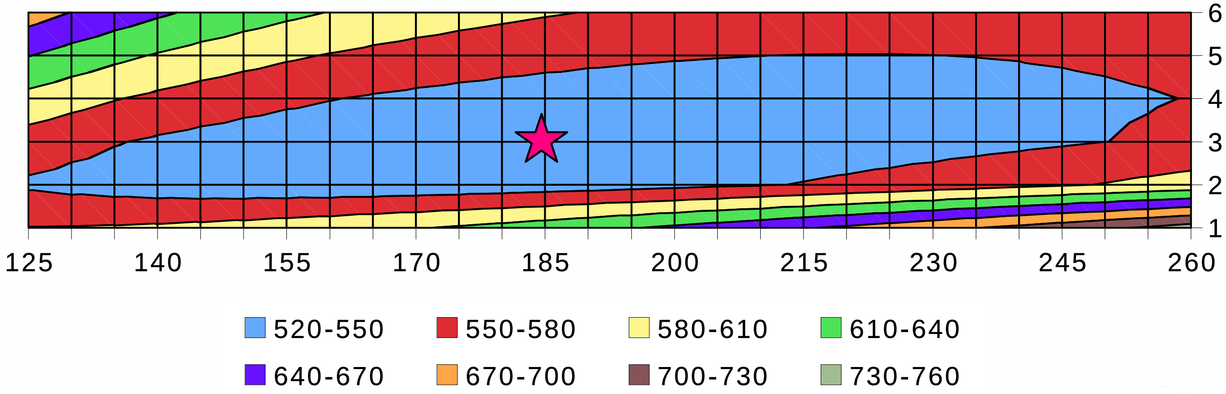
Q* = 185 units
n* = 3

Example

Disassembly Process:
k_d = \$30/process
$h_{f,d}$ = \$0.5/unit-yr
$h_{ph,d}$ = \$2/unit-yr
p_d = U[0.5, 0.95]

Repair Process:
k_r = \$6/process
$h_{f,r}$ = \$4/unit-yr
$h_{ph,r}$ = \$2/unit-yr
p_r = U[0.75, 0.95]

D = 600 units/yr



Q* = 185 units
n* = 3