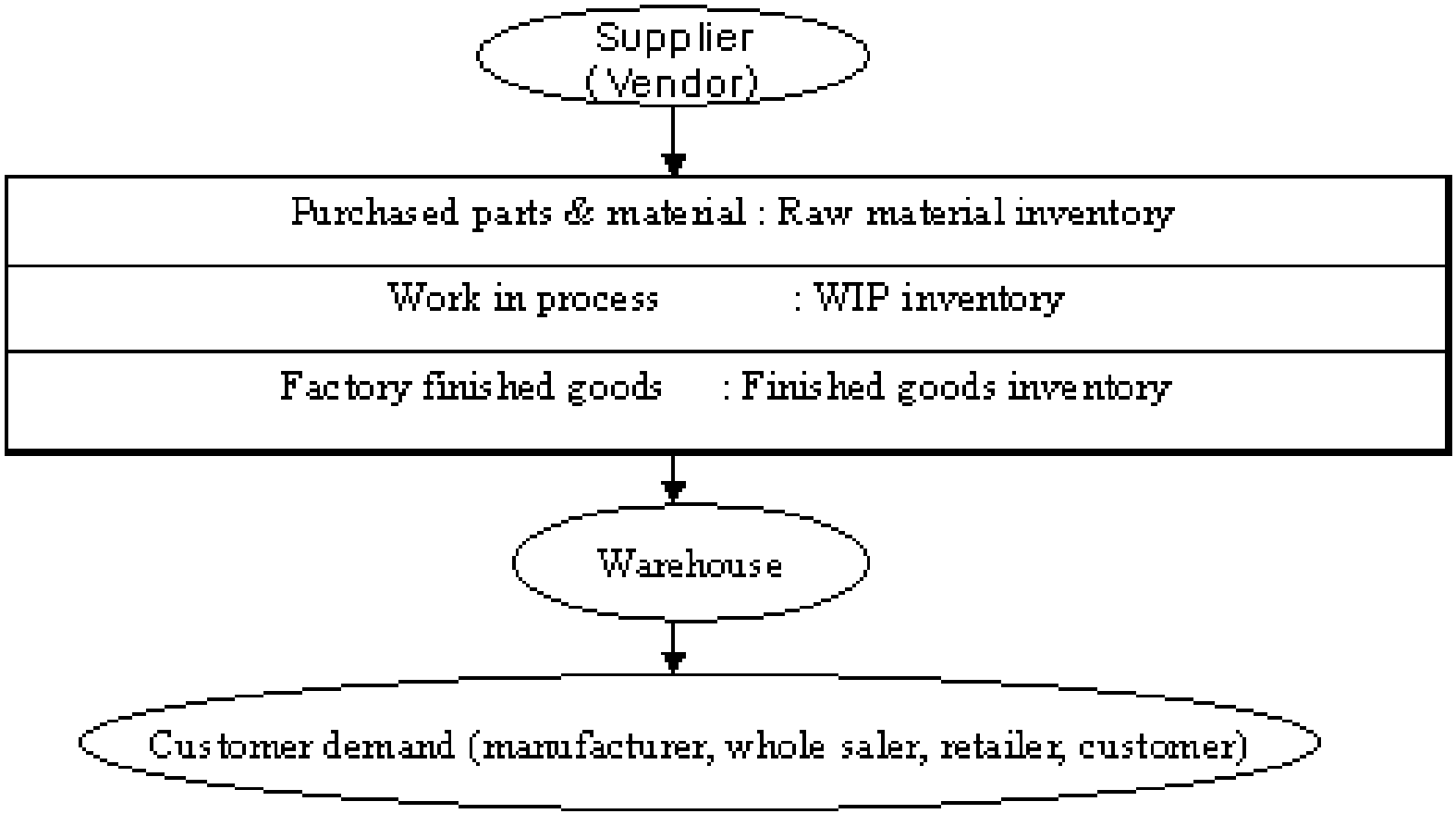
Chapter 17 Inventory Control
(재고관리)

<1> Introduction

(1) Definition of inventory

Inventory is the stock of any item or resource used in an organization and can include: raw materials, component parts, work-in-process, and finished products.

* Inventory and Flow of material



(2)Independent demand & Dependent demand (p.549)

① 독립수요품목 : 완제품, 예비품목 (수요 : 시장조건)

. stationary

. 보충(replenishment)의 개념

. safety stock 필요

② 종속수요품목 : 원자재, 부품 (수요 : 생산계획)

. lumpy

. 소요(requirement)의 개념

. safety stock 불필요

(3) Functional classification of inventory (p.445)

① Fluctuation inventory
covers fluctuations in both demand & supply

② Lot size inventory (Cycle inventory, 주기재고) : EOQ
to minimize the total preparation (ordering, set up) & carrying costs

③ Hedge inventory
price of material의 상승이 예견 될 때

④ Anticipation inventory
peak demand, vacation shut downs, possible strikes 등에 앞서 미리 축적하는 stock

⑤ Seasonal inventory

계절적 주기 흡수

⑥ Decoupling inventory

각 생산활동을 독립적으로 수행하게 해 줌

⑦ Transportation inventory

(pipeline inventory, transit inventory, 보급선재고)

material between plants or between manufacturing & distribution facilities

(4) Objective of inventory management

* 각 기능 부서에 따라 상충 (Managing inventory means managing conflict)

- Define and attain a desired customer service level
- Achieve a desired return on investment (Keep inventory investment below a certain level)
- Support the achievement of specified operating efficiency (equipment utilization level)

* Inventory turnover rate (ITR, 재고회전율) : pp.566-567

$$ITR = \frac{annualized\ \ CGS}{inventory\quad investment}$$

(cf) 재고회전율이 1년에 3번 = 재고투자회수기간
(inventory recovery period)이 4개월

(cf) Return on investment :

ROI = (income-costs) / (investment)

<2> Inventory control models

(1) Decision variables

① Order release timing : When should the inventory be replenished?

. Scheduling period (T)
. Reorder point (R)

② Lot size : How much should be added to inventory?

. Order quantity (Q)
. Order level (M)

* periodic review vs. continuous review

(2) Inventory Control Systems

① Single-Period Inventory System(pp.551-555)

② Multi-Period Inventory System(pp.555-570)

- Fixed-Order Quantity Models (고정주문량모형)
- Fixed-Time Period Models (고정기간모형, 정기주문모형)

(3) 재고결정에 연관된 비용들 (pp.548-549)

① Item costs : C
. cost of an item
(cf) quantity의 함수일 수도 있음

② Preparation costs
- ordering cost :C_o
- set-up cost :C_s

③ Inventory carrying(holding) costs : C_h
.cost of capital invested in inventory
.cost of storage (handling, security, space, record,...)
.cost of obsolescence, pilferage, deterioration,...

④ Stock out costs : C_b
- Backorder 상황
- Non backorder 상황

<3>고정 주문량 모형 (pp.556-564)

(1) 확정적 모형 : EOQ (economic order quantity), <도표 17-4>

① 가정 : p.558
(D, L, C, C_o, Q, R)

② EOQ, ROP 의 유도 : <그림 17-5>
D= annual demand rate

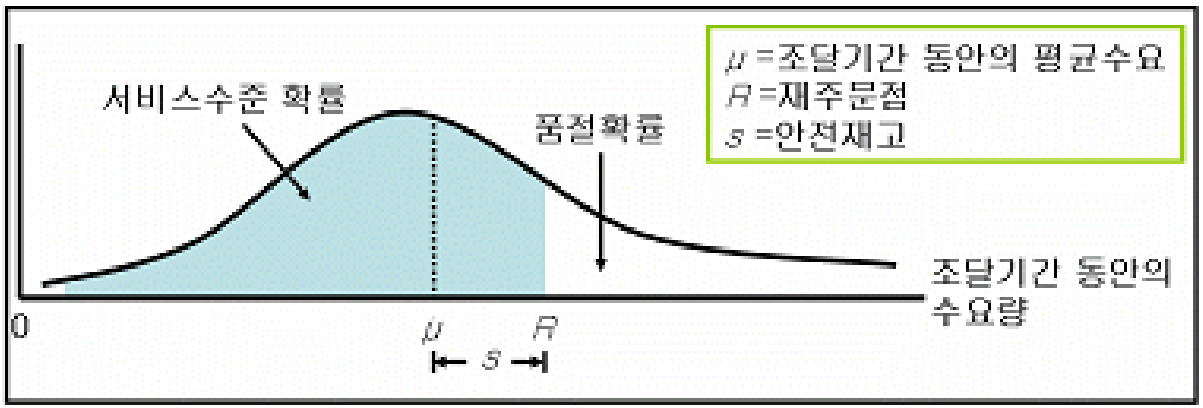
$$Q^* = \sqrt{\frac{2\,C_o D}{C_h}}\ , \qquad R = D \times L$$

③ EOQ모형의 민감도 분석

(2) 확률적 모형 : 안전재고를 고려한 고정 주문량 모형,
<도표 17-6>

* risk & uncertainty : variations in demand & lead time
*absorbed by provision for safety stock (buffer stock)

* desired service level (1-α) :
재고로부터 바로 충족되는 고객수요의 백분율 (서비스수준)
α = stockout probability(품절확률)



$\overline{D}$ = 연간 평균 수요율

d = (조달기간에 사용한 단위와 동일단위 기간당) 수요량, d~($\overline{d}$, σ_d^2)

X = 조달기간(L)동안의 수요량, X ~(μ , σ^2), $\mu = \overline{d}\,L$, $\sigma^2 = \sigma_d^2\,L$

EOQ : $Q^* = \sqrt{\frac{2\,C_o\overline{D}}{C_h}}$

ROP : $R = \mu + S = \overline{d} \times L + S$

X가 정규분포이면, $R = \mu + z_\alpha\sigma = \overline{d} \times L + z_\alpha\sigma_d\sqrt{L}$

* Application : two bin system

(2) 고정주문량모형의 재고회전율 (pp.566-567)

<4>고정 기간 모형 (pp.564-567)

(1) 확정적 모형

수요와 조달기간이 일정하므로 EOQ모형과 정확히 일치

$$T^* = \sqrt{\frac{2\,C_o}{D\,C_h}} \quad , \quad M^* = Q^* + DL = \sqrt{\frac{2\,C_o D}{C_h}} + DL$$

(2) 확률적 모형 : 안전재고를 고려한 고정 기간 모형, <도표 17-7>

$$T^* = \sqrt{\frac{2\,C_o}{\bar{D}\,C_h}} \quad , \quad M^* = \bar{d} \times (T^* + L) + z_\alpha \sigma_d \sqrt{T^* + L}$$

<5> Quantity discount : pp.568-570, <도표 17-8>

$$TC_i(Q) = C_iD + C_o\frac{D}{Q} + IC_i\frac{Q}{2}$$

Algorithm : p.568

<6> ABC 재고관리 (pp.568-570)

1950, GE, Dickie, Control the vital few

(참고) Pareto's law : Major part of an activity is accomplished by minority

(1) Criteria

- Annual dollar usage

  (Annual dollar volume = annual usage × unit purchase cost)

- Scarcity of material
- Storage requirement

(2) Classification of monetary value

(Criteria에 의해 각 item 분류)

Divide into 3 classes according to dollar volume

	inventory items	dollar volume
A : high value items	15~20 %	75~80 %
B : medium value items	20~25 %	10~15 %
C : low value items	60~65 %	5~10 %

(3) Control based on the ABC classification (중요도 group별로 degree of control 결정)

<7> 단일기간재고모형 (Single period inventory model) (pp.551-555)

MP = 한계이익(marginal profit), 즉 최종단위가 팔렸을 때 얻을 수 있는 이익
Cu (Cost per unit of demand underestimated)

ML = 한계손실(marginal loss), 즉 최종단위가 팔리지 않았을 때 발생하는 손실
Co (Cost per unit of demand overestimated)

$$p \geq \frac{ML}{MP+ML}$$ 인 최대 Q를 주문

여기서 P = 최종단위가 팔릴 확률

(예) 어느 대학생은 크리스마스시즌에 팔 크리스마스트리용 전나무를 주문하고자 함. 전나무 한 단위의 구입원가는 5,000원, 판가는 10,000원임. 시즌 중에 팔리지 않은 전나무 땔감으로 단위당 1,000원씩 받고 시장상인에게 넘김. 이 대학생은 지난 수년간 계속해서 크리스마스트리용 전나무를 팔았으므로 과거의 자료로부터 다음과 같은 수요의 확률분포를 얻었음. 얼마를 주문해야 할 것인가?

수요량	확률
15	0.1
16	0.1
17	0.2
18	0.3
19	0.2
20	0.1

(예)신문팔이문제(p.551)

<8> Miscellaneous Systems

① Optional replenishment system

② Two-Bin System

③ One-Bin System

<9> Inventory Accuracy and Cycle Counting

① Inventory accuracy refers to how well the inventory records agree with physical count

② Cycle Counting is a physical inventory-taking technique in which inventory is counted on a frequent basis rather than once or twice a year