“Logistics of pharmaceuticals in hospitals”

EAHP Academy Seminar 14-16 May, 2010, Riga Latvia
ACPE UNIVERSAL ACTIVITY NUMBER (UAN):0475-0000-10-019-L04-P

Saturday, 15 May 2010:

Supply Chain and economic Indicators

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“Logistics of Pharmaceuticals in Hospitals”

Disclosure of Relevant Financial Relationships

The following content contains information about healthcare product or services.

Regarding the healthcare products or services that will be discussed in the content, I have had no financial relationship in any amount in the last 12 months with the manufacturers of the products or providers of the services.

signed: Klaus-Michael Fortmann

EAHP Academy Seminar 2010, Riga, Latvia: "Logistics of pharma-ceuticals in hospitals"

Supply Chain and Economic Indicators - Overview -

Saturday, 15 May 2010

09.00 – 10.30	Fundamentals Logistic tools
10.30 – 11.00	Coffee Break: hotel lobby
11.00 – 12.30	Logistic tools
12.30 – 14.00	Lunch
14.00 – 15.30	Storage systems on wards Storage condition monitoring
15.30 - 16.00	Coffee Break: hotel lobby
16.00 - 18.00	Storage models Results and discussion
19.15	Academy Dinner & Social Activity (meet in hotel lobby at 19.00 for departure)

Supply Chain and Economic Indicators

- *Fundamentals*
- *Logistic tools*

Supply Chain and Economic Indicators - Fundamentals -

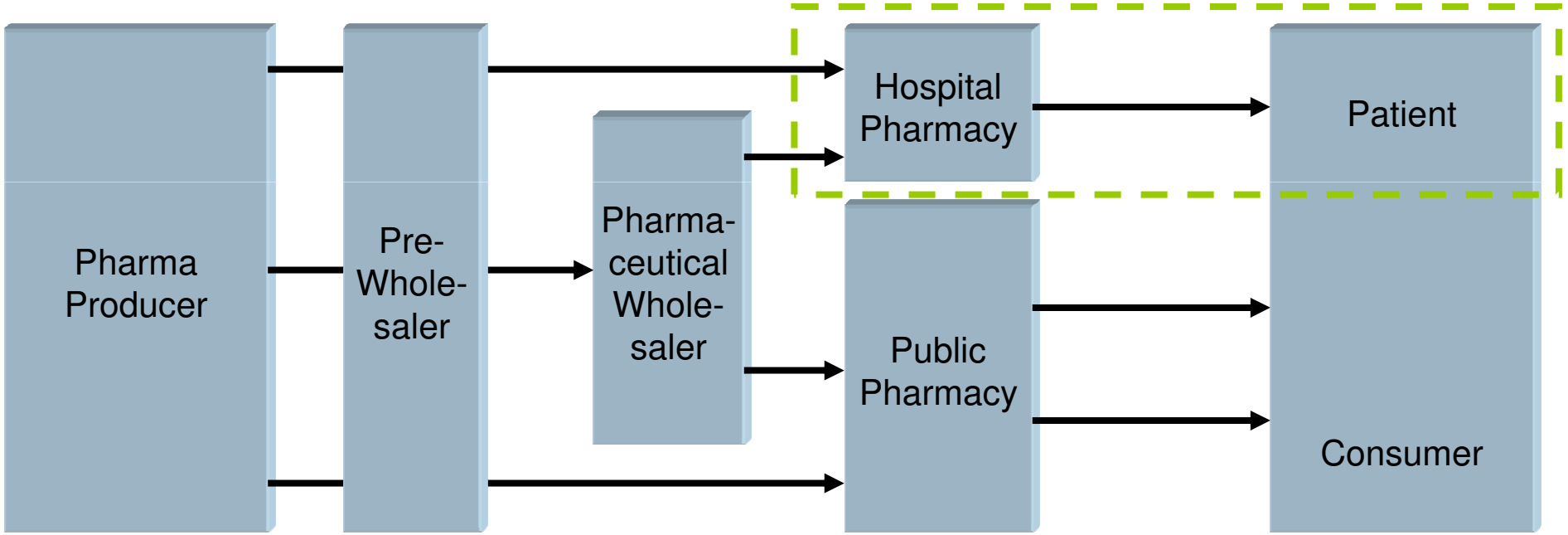
Educational Goals

- Understanding the supply chain
- Knowledge of methods to avoid counterfeits along the supply chain
- Knowledge of the definition of logistics (phases, activities)
- Knowlegde of the „6 Rights" of logistics (5 Rights of drug provision)
- Knowledge of main logistcs costs
- Knowledge of logistics service components
- Understanding the „available stock"
- Able to draw the „Ideal Model" of order point planning
- Knowledge of consumption models
- Understanding the method „exponential smoothing"

Supply Chain and Economic Indicators - Fundamentals -

Supply Chain of Drugs

our main focus



source: associated with: Thormann, P. et al.: Der pharmazeutische Großhandel: Fit für einen veränderlichen Markt, Hannover, Berlin 2007, p. 11, citation found in : Nora Meyer: Management der Arzneimittel-Supply Chain, Berlin 2008, p.49

Supply Chain and Economic Indicators - Fundamentals -

Challenge of the Future: Combat counterfeit drugs along SC

Examples of security systems for securing traceability:

- **2D Barcodes, e.g. Datamatrix code**

- **RFID, Radio Frequency Identification**
  expanded memory →
  possible to safeguard authentication,
  Stored information: company prefix, article number, unique serial number, locked by the pharmaceuticals manufacturer with a specific code

- **Variable security printing**
  each label provided with a unique randomly selected code, code stored in a database. All affected parties in the supply chain are able to read off and verify this code against the database

Source: Nordvalls (www.nordvalls.se) on http://www.ngpharma.eu.com/article/Solutions-to-combat-counterfeit-drugs/

Supply Chain and Economic Indicators - Fundamentals -

Tracking & Tracing is Normal in other Fields of Distribution

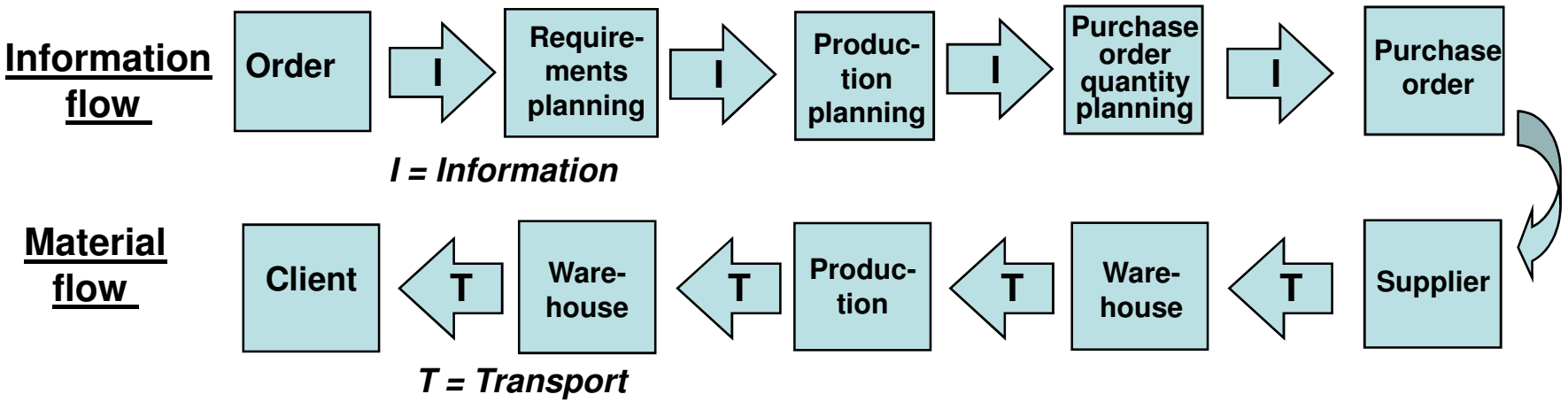
Supply Chain and Economic Indicators - Fundamentals -

General Definition of Logistics

Logistics is defined as the integrated planning, realising, usage and control of

- **all kinds of transport processes,**
- **the storage of goods and**
- **the corresponding information processes**

within companies and between companies.



Supply Chain and Economic Indicators - Fundamentals -

Main Aim of Logistics: Optimisation the Efficiency of Logistics

Efficiency of Logistics = Output/Input Ratio of the Logistics System

System Input:

Valued Factor Input

- Costs of Inventory
- Costs of Storage
- Costs of Handling
- Costs of Control
- Costs of System
- Costs of Transp.

Logistics System:

Logistics of a Company

Personnel and Equip-ment in the Areas

- Procurement Logist.
- In-house Logistics
- Distribution Logist.
- Reverse Logistics

System Output:

The 6 "R" of Logistics

- Right Product
- Right Place
- Right Quantity
- Right Time
- Right Quality
- Right Costs

*)

Called „Phases of logistics" (= Phases of material flow)

*)Variant: The 5 rights: the right patient, right medicine, right dose, right route and right time

Supply Chain and Economic Indicators - Fundamentals -

Components of Logistics Service

Delivery Time = Time between issue of order and availability for the client

Delivery Reliability (*on-time delivery performance*) = Percentage of keeping the guaranteed delivery time

Delivery Service Level = Percentage of articles directly deliverable from warehouse

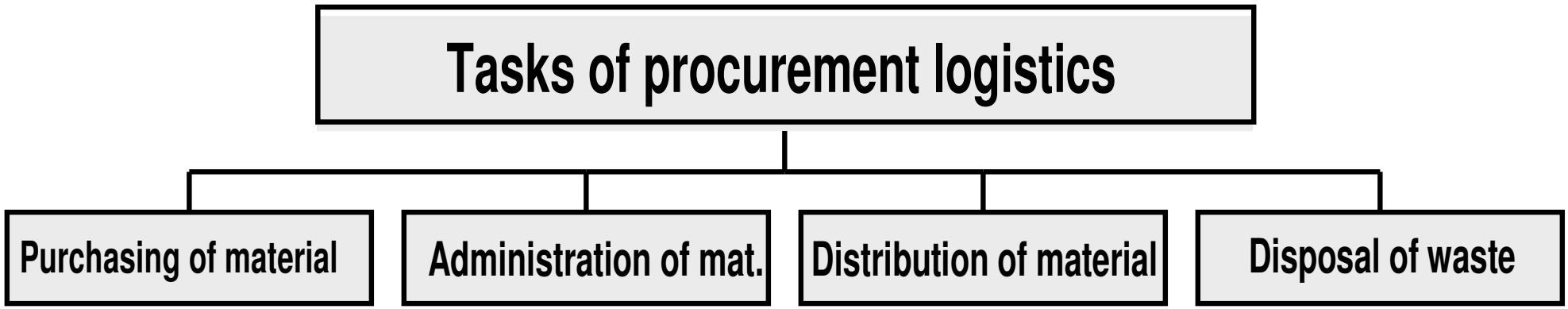
Quality of Delivery = Accuracy of delivery concerning type, quantity and quality of the delivered articles

Flexibility of Delivery = Possibility of consideration of special wishes of the clients concerning delivery time or delivery quantity

 Source: Associated with Christof Schulte: Logistik, 2.Edition, München 1995, p. 6

Supply Chain and Economic Indicators - Fundamentals -

Phase: Procurement Logistics



source: Oeldorf/Olfert: Materialwirtschaft

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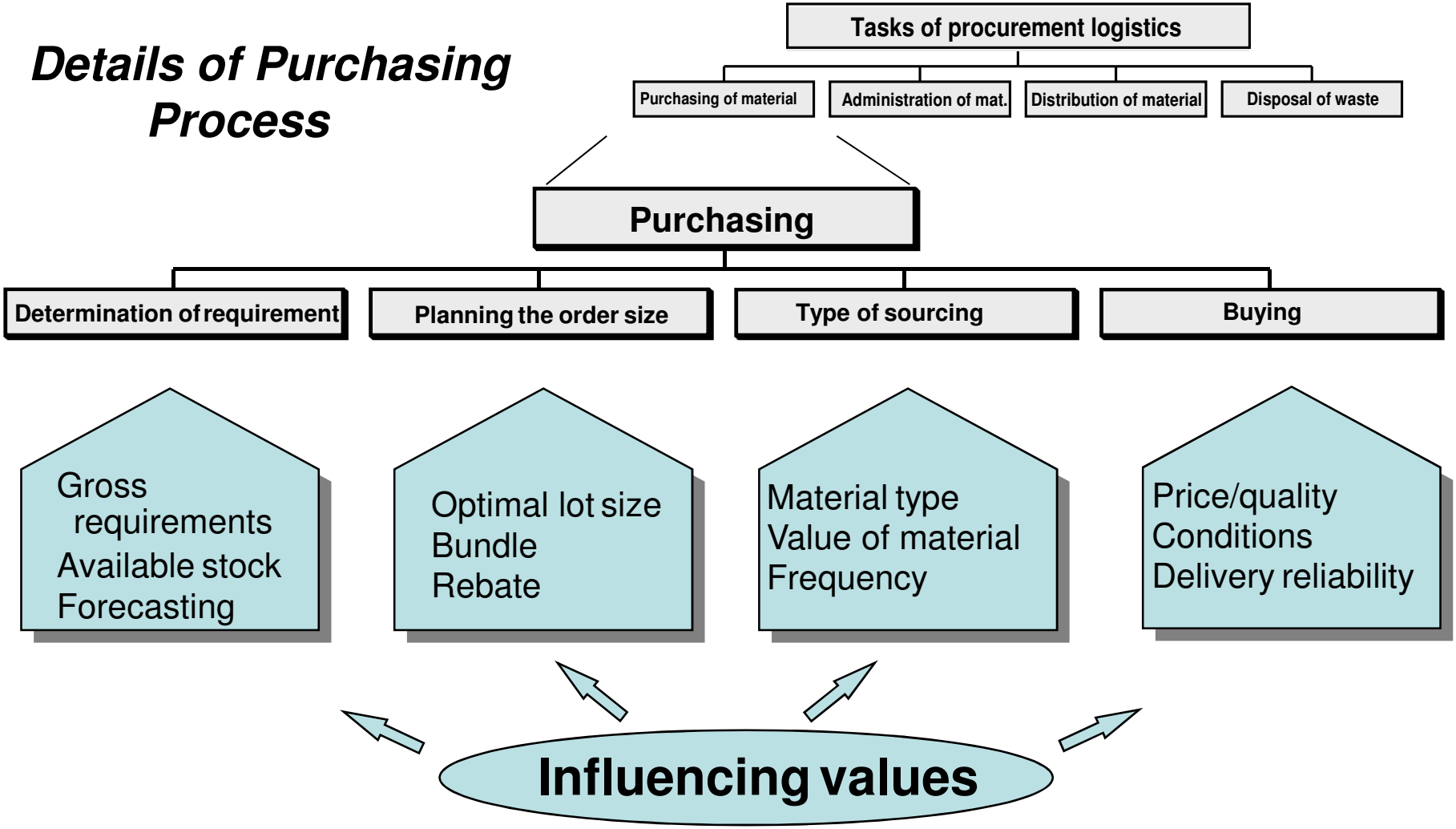
Supply Chain and Economic Indicators - Fundamentals -

Details of Purchasing Process



source: Oeldorf/Olfert: Materialwirtschaft

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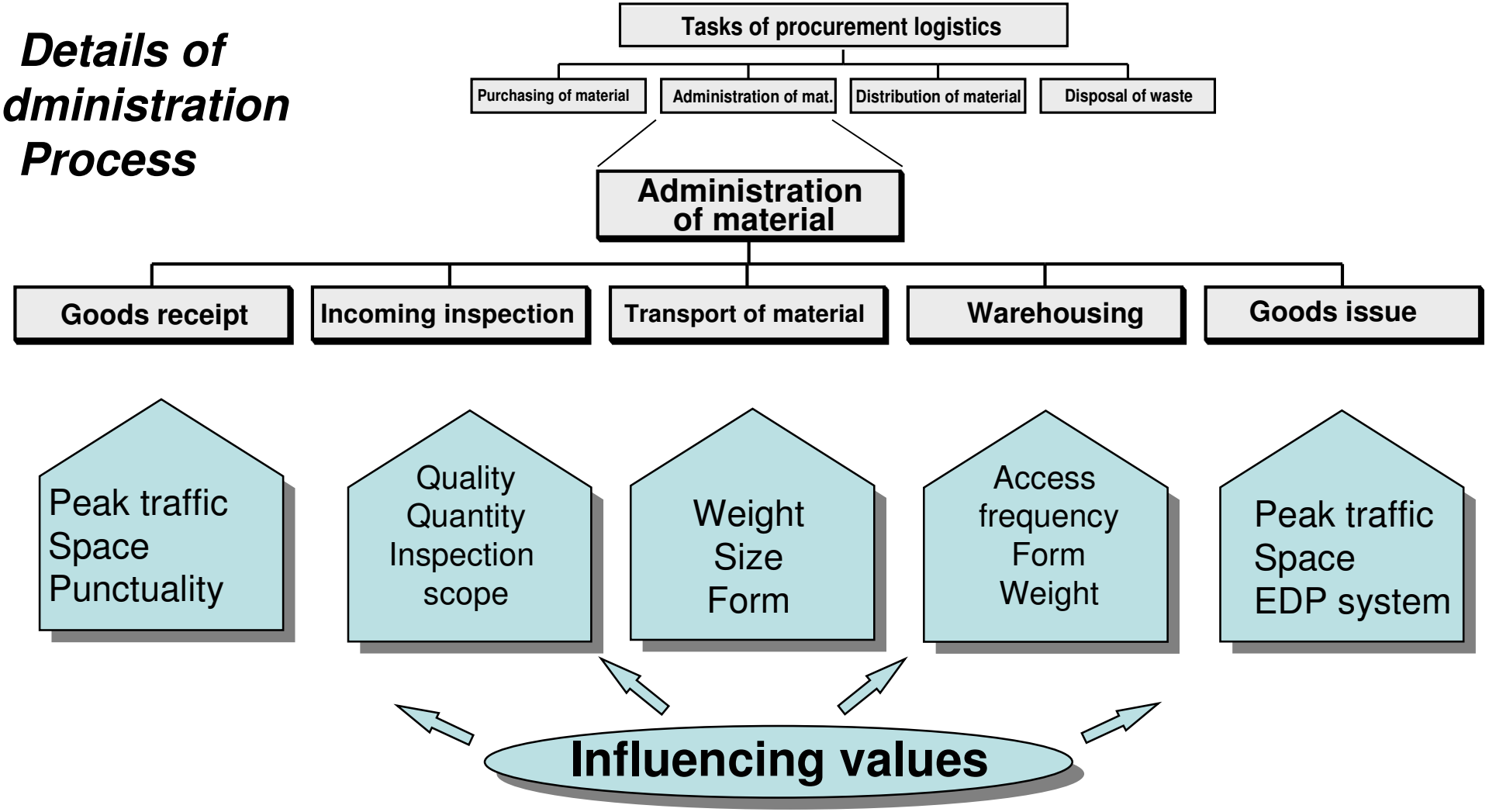
Supply Chain and Economic Indicators - Fundamentals -

Details of Administration Process



source: Oeldorf/Olfert: Materialwirtschaft

Supply Chain and Economic Indicators - Fundamentals -

Tasks of the Purchasing Process in a Hospital Pharmacy

- Checking the bought products
- Evaluation of suppliers
- External price comparision
- Negociation of prices and conditions
- Conclusion of contract
- Continuous revision of assortment
- Ordering
- Procurement of not-listed medicaments in special cases
- Ecological checking: packing, disposal

Details on the next slide

source: http://www.blak.de/2/apotheke/kh-apotheke_logistik.shtml (Bayrische Landesapothekenkammer)

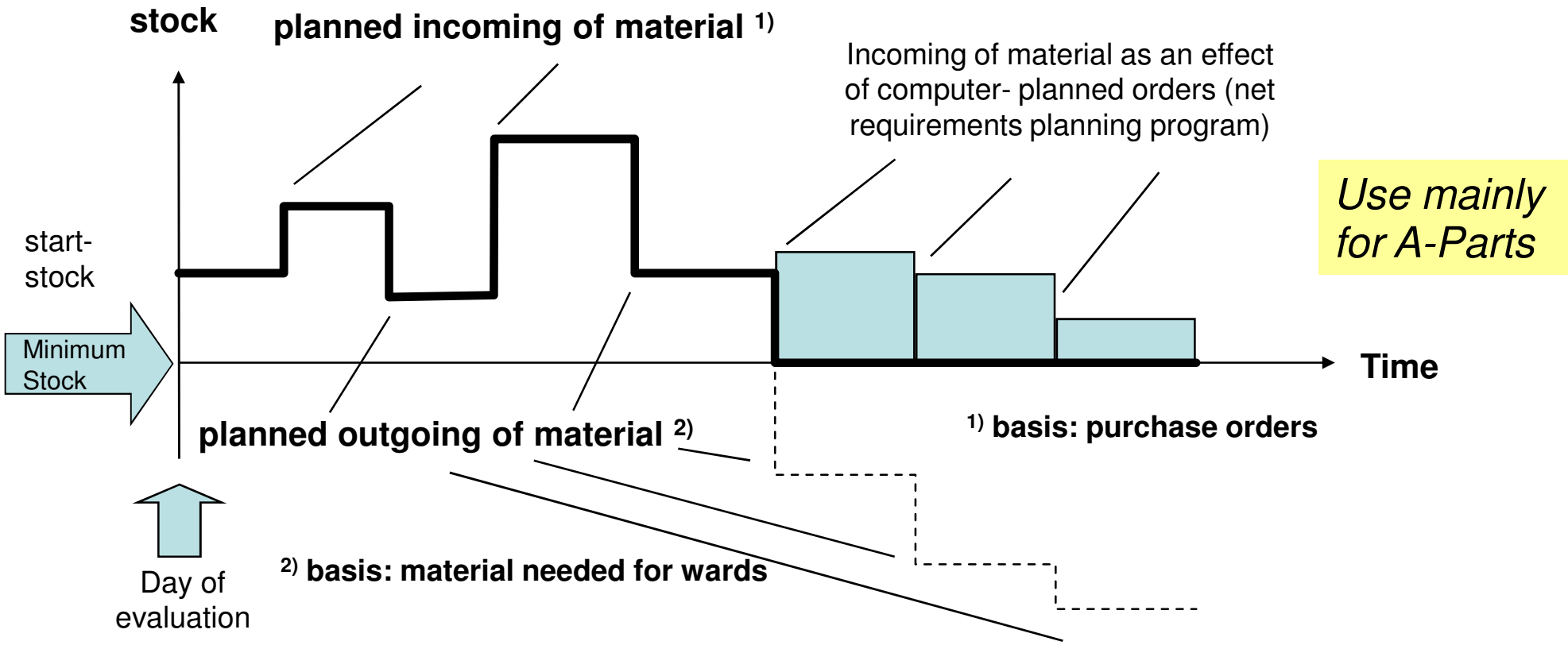
Supply Chain and Economic Indicators - Logistic Tools -

Value Benefit Analysis for Suppliers as Part of the Buying Process

Suppliers / Criteria	Weight	Supplier Miller		Supplier Mayor		Supplier Smitt	
	1....5	Points 1...5	PxG	Points 1...5	PxG	Points 1...5	PxG
Product Quality	5	3	15	4	20	5	25
Price	2	5	10	4	8	2	4
Delivery Time	4	4	16	2	8	1	4
Fulfillment of Contract	1	2	2	3	3	5	5
Delivery Date Reliability	4	2	8	3	12	5	20
Quantity Reliability	2	1	2	5	10	3	6
Sum			**53**		**61**		**64**
Rank			**III.**		**II.**		**I.**

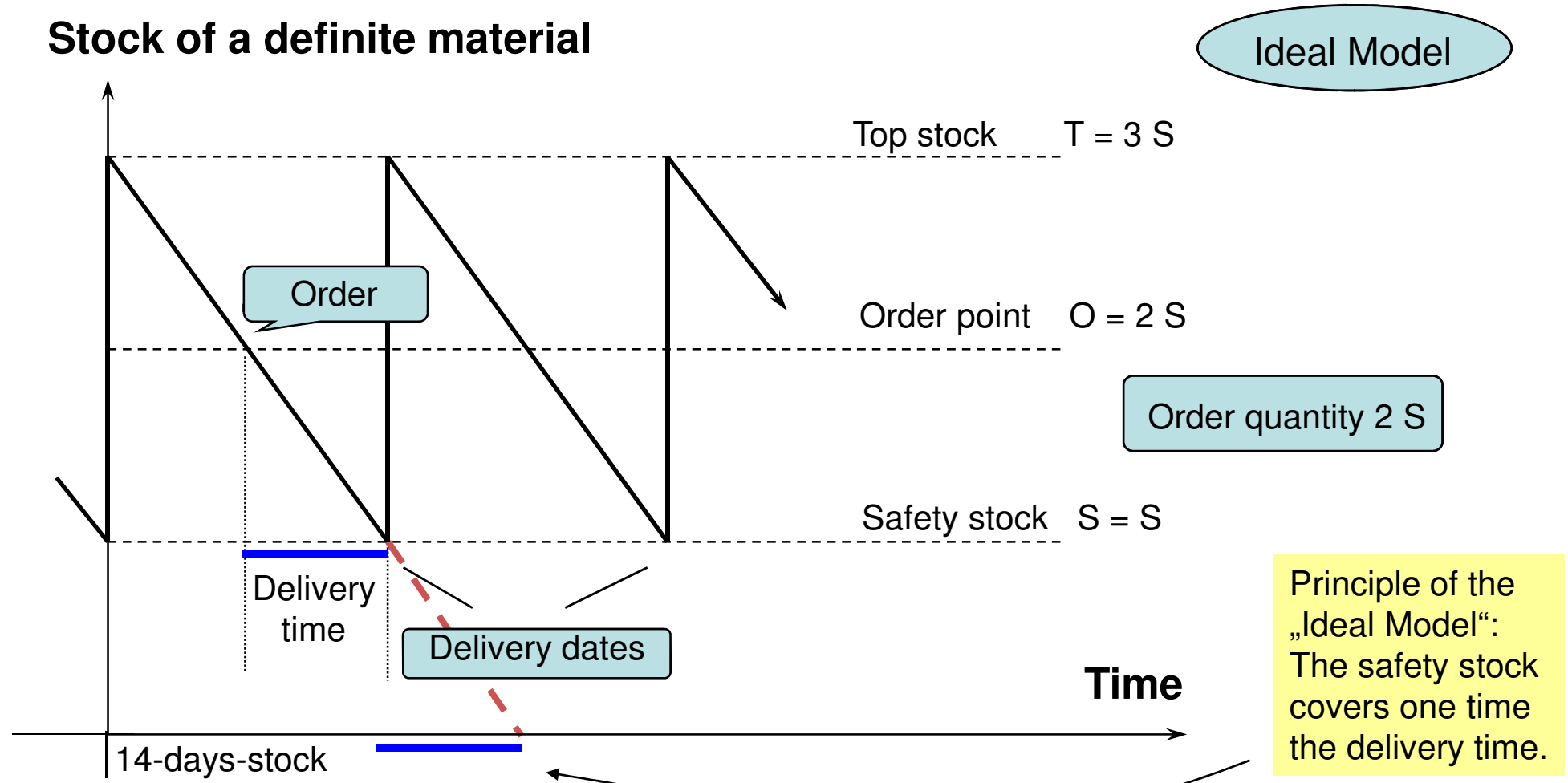
Supply Chain and economic Indicators - Logistic Tools -

Calculation of Material-Availability in the Future by Means of a Simulation of the Function „Stock over Time", Dependent on Events



Supply Chain and economic Indicators - Logistic Tools -

The Order Point System



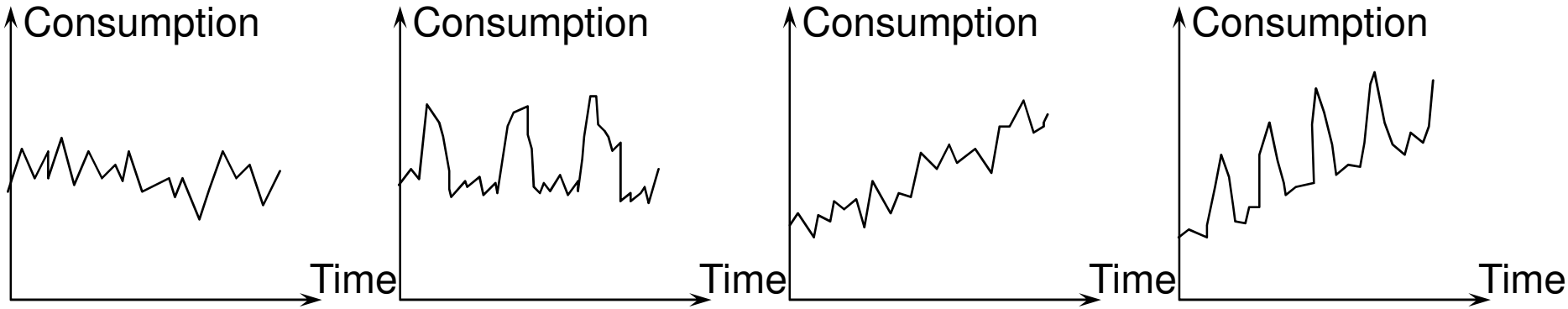
Principle of the „Ideal Model": The safety stock covers one time the delivery time.

Source: Associated with Oeldorf/Olfert: Materialwirtschaft
loinbd08.ppt

Supply Chain and Economic Indicators - Logistic Tools -

Stochastic Requirements Planning: Types of Models for Consumption

The stochastic requirements planning normally is used with lower-value parts (C-Parts) and is based on the consumption in the past.



Pure constant-model

Season- constant-model

Pure trend-model

Season- trend-model

Source: Associated with Oeldorf/Olfert: Materialwirtschaft; REFA: Planung und Steuerung, Teil 2
loinmf18.ppt

Supply Chain and Economic Indicators - Logistic Tools -

Stochastic Requirements Planning: Forecast Methods

Moving average value = Average consumption over x past periods; at the beginning of each new period the oldest one is cancelled; suitable for the pure constant model

Weighted moving average value: Each period-consumption corresponds with weight factors: the oldest one receive the lowest weight; suitable for the pure constant model

Regression analysis = Used for the forecast with trend-type function; linear case: y=a+bt ; non-linear: polynomal of n-th order

Exponential smoothing: Most important stochastic method; the new forecast is built from the old one to which is added the with α weighted difference between the old actual value and the old forecast value; suitable for the pure constant model; with the exponential smooting of second order it is possible to take into account trend functions of the past-consumption values

For season models are suitable mathematic combinations of the above models.

Source: Associated with Oeldorf/Olfert: Materialwirtschaft
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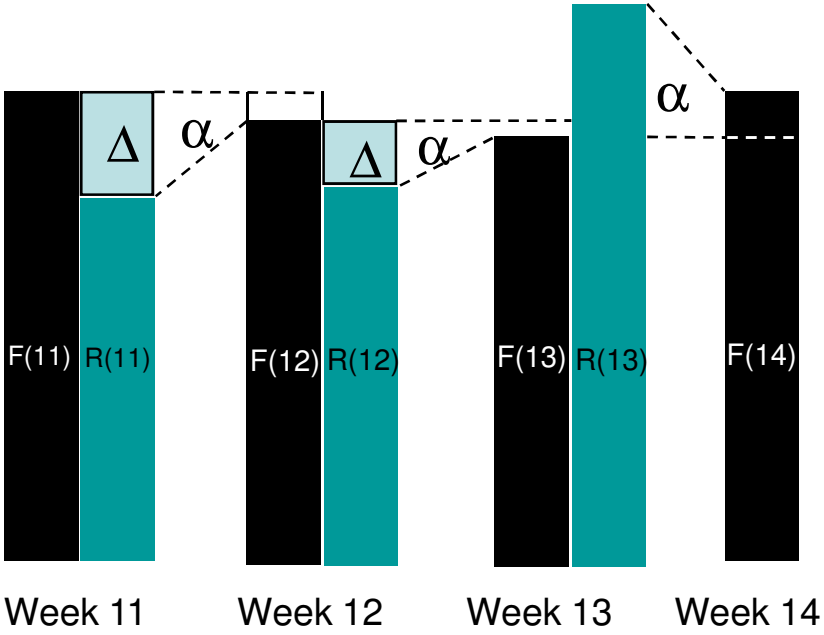
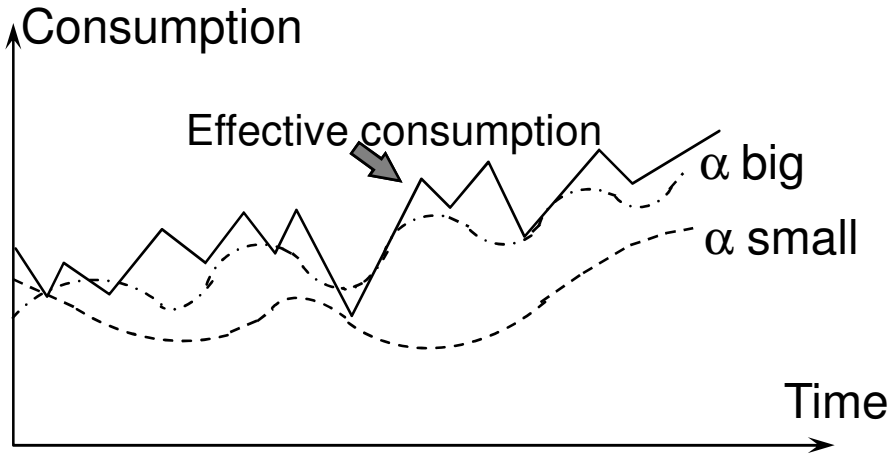
Supply Chain and Economic Indicators - Logistic Tools -

Stochastic Requirements Planning: Exponential Smoothing





$$F_{t+1} = F_t + \alpha(R_t - F_t)$$
$$\alpha = 0{,}1 \ldots 0{,}3$$

F_{t+1}: new forecast
F_t : old forecast
R_t : real consumption of the old period
α : smoothing factor

α is an experience factor

Advantage:
Low calculating amount: Only the data of the month before are necessary (the total past is involved in the values of the earlier months).; Influence of the newest values is stronger than the effect of elder ones.

Source: Associated with Oeldorf/Olfert: Materialwirtschaft; Kernler: PPS der 3. Generation
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Supply Chain and Economic Indicators - Fundamentals -

Repetition

- Difference between supply chain management and logistics?
- Partners of SC of pharmaceuticals?
- Definition of logistics (phases, activities)?
- 6 Rights" of logistics (5 Rights of drug provision)?
- Type of logistcs costs?
- Logistics service components?
- Explain the „available stock"
- Draw the „Ideal Model" of order point planning
  given: 2 weeks delivery time, consumption per week: 100 pieces
- Consumption models?
- Calculation of forecast F_{15} using the „exponential smoothing"
- given alpha= 0,3 F_{14}=200 R_{14}=180

Supply Chain and Economic Indicators

- **Logistic tools**

Supply Chain and Economic Indicators
- Logistic Tools -

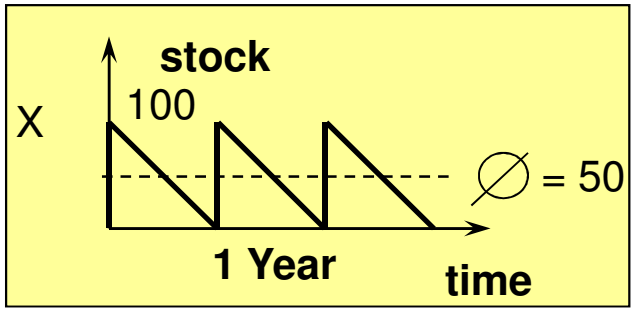
Educational Goals

- Understand the Andler formula
- How to calculate an ABC analysis (method, advantages)
- How to calculate a XYZ analysis (method, advantages)
- Knowledge of using the ABC/XYZ analysis
- Method of material flow analysis
- Knowledge of important rules for designing the material flow

Supply Chain and Economic Indicators - Logistic Tools -

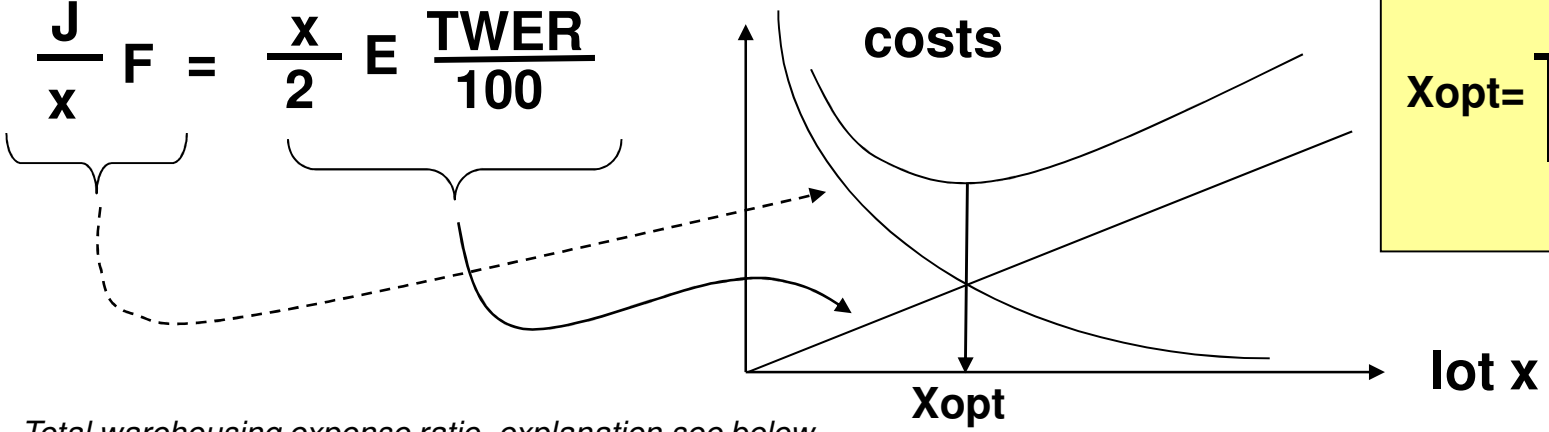
Simplified Derivation of the Andler Formula

J: annual requirement of bought-in material
F: fixed costs of the purchase process for one orderline
E: price per piece
TWER: costs of all storage activities as percentage from bounded capital



The half of the lot x is equal to the average stock (assumption: linear consumption).
So the average stock value is equal to x/2 * E. The costs of average stock is x/2*E*TWER[%]/100.
The minimum value of the sum of both types of costs can be found at the point of intersection.
Both functions will be equated, so we find Xopt, the optimal lot size.

$$\frac{J}{x} F = \frac{x}{2} E \frac{TWER}{100}$$



$$Xopt = \sqrt{\frac{200 \bullet J \bullet F}{E \bullet TWER[\%]}}$$

TWER = Total warehousing expense ratio, explanation see below

Supply Chain and Economic Indicators - Logistic Tools -

Optimal Order Quantity Formula, Developped by ANDLER :

$$\text{Optimal Order Quantity (pieces, unit)} = \sqrt{\frac{200 \times J \times F}{E \times TWER\ [\%]}}$$

J: annual requirement of bought-in material
F: fixed costs of the purchase process for one orderline
E: delivered price per piece (unit)
TWER: Costs of all storage activities [%]

Similarly is valid for in-house-products:

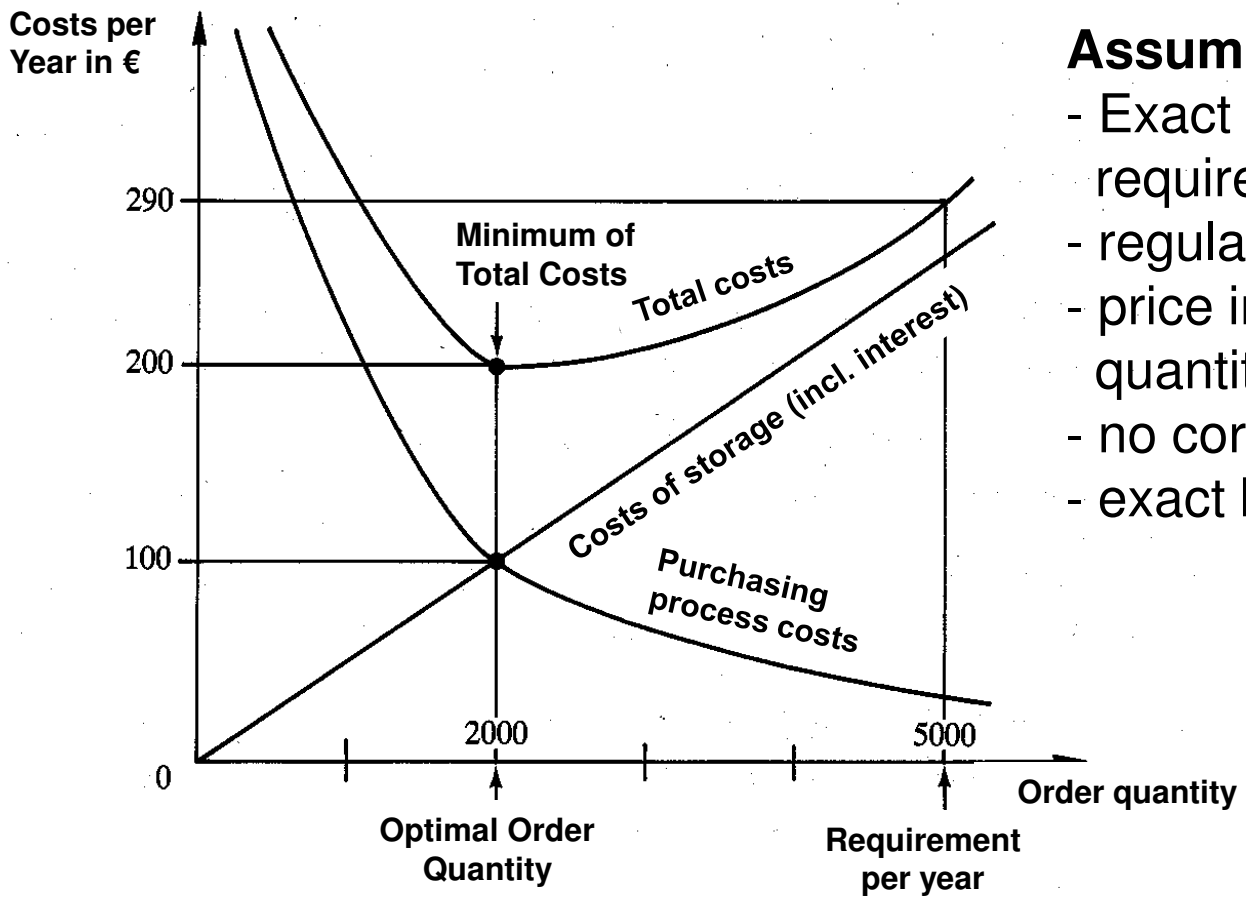
$$\text{Economic Lot Quantity (pieces, unit)} = \sqrt{\frac{200 \times J \times SC}{MC \times TWER\ [\%]}}$$

J: annual requirement of in-house material
SC: costs of the set-up process at the production machine: once per lot
MC: manufacturing costs for the considered in-house part
TWER: Costs of all storage activities [%]

TWER = Total warehousing expense ratio, explanation see below

Supply Chain and Economic Indicators - Logistic Tools -

Graphical Interpretation of the ANDLER Formula



Assumptions for the Validity:

- Exact knowledge of the requirement per year
- regular consumption
- price independent of the lot quantity
- no corresponding parts
- exact knowledge of costs

loinmf28.ppt Source: Chr.Schulte: Logistik

Supply Chain and Economic Indicators - Logistic Tools -

ABC Analysis

Main question: Which bought-in products correspond with the most expenses?

1) Build a list of articles and expenses

article	annual expenses in Euro
product 1	23.478,00
product 2	304.536,00
product 3	45.676,00
product 4	1.207,00
product 5	33.426,00
product 6	2.234,00
product 7	87.689,00
product 8	77.589,00
product 9	234.234,00
product 10	123.321,00
product 11	678.654,00
product 12	3.456,00
product 13	5.432,00

2) Sort the list by decreasing expenses

3) Accumulate the expenses

4) Classify the articles

article	annual expenses in Euro	accumulated expenses	percentage from total	class
product 11	678.654,00	678.654,00	41,87	A
product 2	304.536,00	983.190,00	60,66	A
product 9	234.234,00	1.217.424,00	75,11	A
product 10	123.321,00	1.340.745,00	82,71	B
product 7	87.689,00	1.428.434,00	88,12	B
product 8	77.589,00	1.506.023,00	92,91	B
product 3	45.676,00	1.551.699,00	95,73	C
product 5	33.426,00	1.585.125,00	97,79	C
product 1	23.478,00	1.608.603,00	99,24	C
product 13	5.432,00	1.614.035,00	99,57	C
product 12	3.456,00	1.617.491,00	99,79	C
product 6	2.234,00	1.619.725,00	99,93	C
product 4	1.207,00	1.620.932,00	100,00	C
sum	1.620.932,00			

A <= 80 %

B > 80 % <= 95 %

C > 95 % <= 100 %

Supply Chain and Economic Indicators - Logistic Tools -

ABC Analysis

What are the consquences?

3 from 13 articles are A-products → 23,1 %

3 from 13 articles are B-products →23,1 % *(casually the same value as above)*

7 from 13 articles are C-products → 53,8 %

article	annual expenses in Euro	accumulated expenses	percentage from total	class
product 11	678.654,00	678.654,00	41,87	A
product 2	304.536,00	983.190,00	60,66	A
product 9	234.234,00	1.217.424,00	75,11	A
product 10	123.321,00	1.340.745,00	82,71	B
product 7	87.689,00	1.428.434,00	88,12	B
product 8	77.589,00	1.506.023,00	92,91	B
product 3	45.676,00	1.551.699,00	95,73	C
product 5	33.426,00	1.585.125,00	97,79	C
product 1	23.478,00	1.608.603,00	99,24	C
product 13	5.432,00	1.614.035,00	99,57	C
product 12	3.456,00	1.617.491,00	99,79	C
product 6	2.234,00	1.619.725,00	99,93	C
product 4	1.207,00	1.620.932,00	100,00	C

The knowlege of the A-parts is a good basis for negociations with the suppliers; necessary is a perfect procurement planning

The purchasing process for C-parts must be rationalized because they represent only 5 % of the procurement volume.

Supply Chain and Economic Indicators - Logistic Tools -

XYZ Analysis: A Method for Analyzing the Fluctuation in Consumption, Necessary for a Good Procurement Decision

Definition:

X constant consumption
Y stronger fluctuations in consumption
Z completely irregular consumption

Coefficient of Variation

$$COV = \frac{1}{\bar{x}} \sqrt{\frac{1}{n} \sum_{i=1}^{i=n} (x_i - \bar{x})^2} * 100[\%]$$

Steps for Realizing a XYZ Analysis

a) calculate the coefficient of variation (COV) per article along a predefined number of periods
b) Sort the list by increasing COV
c) Graphical interpretation

Example:

Consumption of an article in month....

May	June	July	August
800	1.100	900	1.200

Class Limits:

for X: <= 10 %
for Y: <= 25 %
for Z: the rest

Calculation of COV

Average	$(800-1000)^2$	$(1100-1000)^2$	$(900-1000)^2$	$(1200-1000)^2$
1.000	40.000	10.000	10.000	40.000
	Sum of squares	**Sum / 4**	**Square root**	**COV [%]**
	100.000	25.000	158,114	**15,81**

Y-part

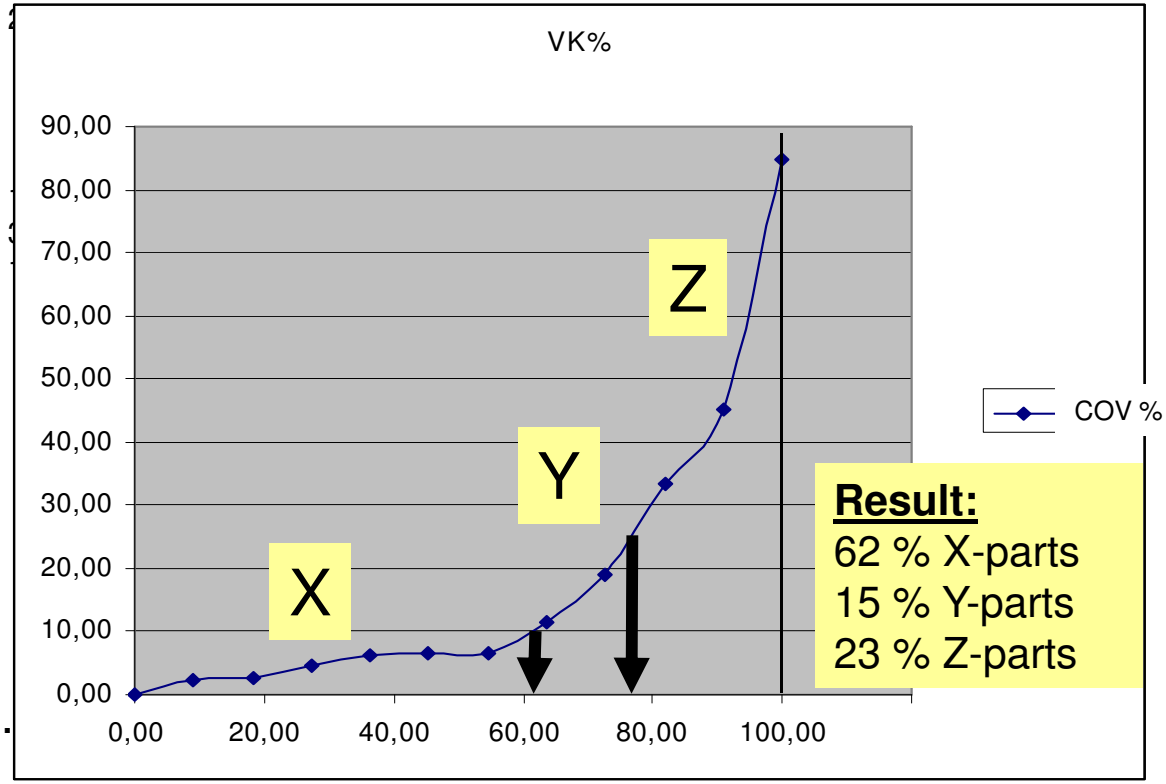
source: according to: Rolf Grap: Produktion und Beschaffung, München 1998, S. 230

Supply Chain and Economic Indicators - Logistic Tools -

Example of a XYZ-Analyse Including a Graphical Interpretation

Article	No.	A%	COV%		Consumption per month 1	2	3	4	5	6	7	8	9	10	11	12
		0,00	0,00													
976	1	9,09	2,28		8987	8998	8765	8438	8698	9001	8987	8675	8453	8564	8867	8732
4532	2	18,18	2,75		5543	5556	5567	5678	5432	5364	5867	5675	5879	5647	5435	5534
1231	3	27,27	4,49		311	312	334	323	345	334	345	344	332	324	347	365
7869	4	36,36	6,38	X	2345	2322										2314
4536	5	45,45	6,38		123	122										131
5647	6	54,55	6,44		355	345										387
6754	7	63,64	11,40	Y	10	11										11
4812	8	72,73	19,00		200	213										322
4356	9	81,82	33,44		2342	1213										3345
4567	10	90,91	45,07	Z	2213	2456										5678
4711	11	100,00	84,62		1123	12234										3345

Hint:
The graphically shown results are not represented by real articles in the table above, because there are only 11 values. In bigger tables are many points along the curve, so they may nearly match real points.

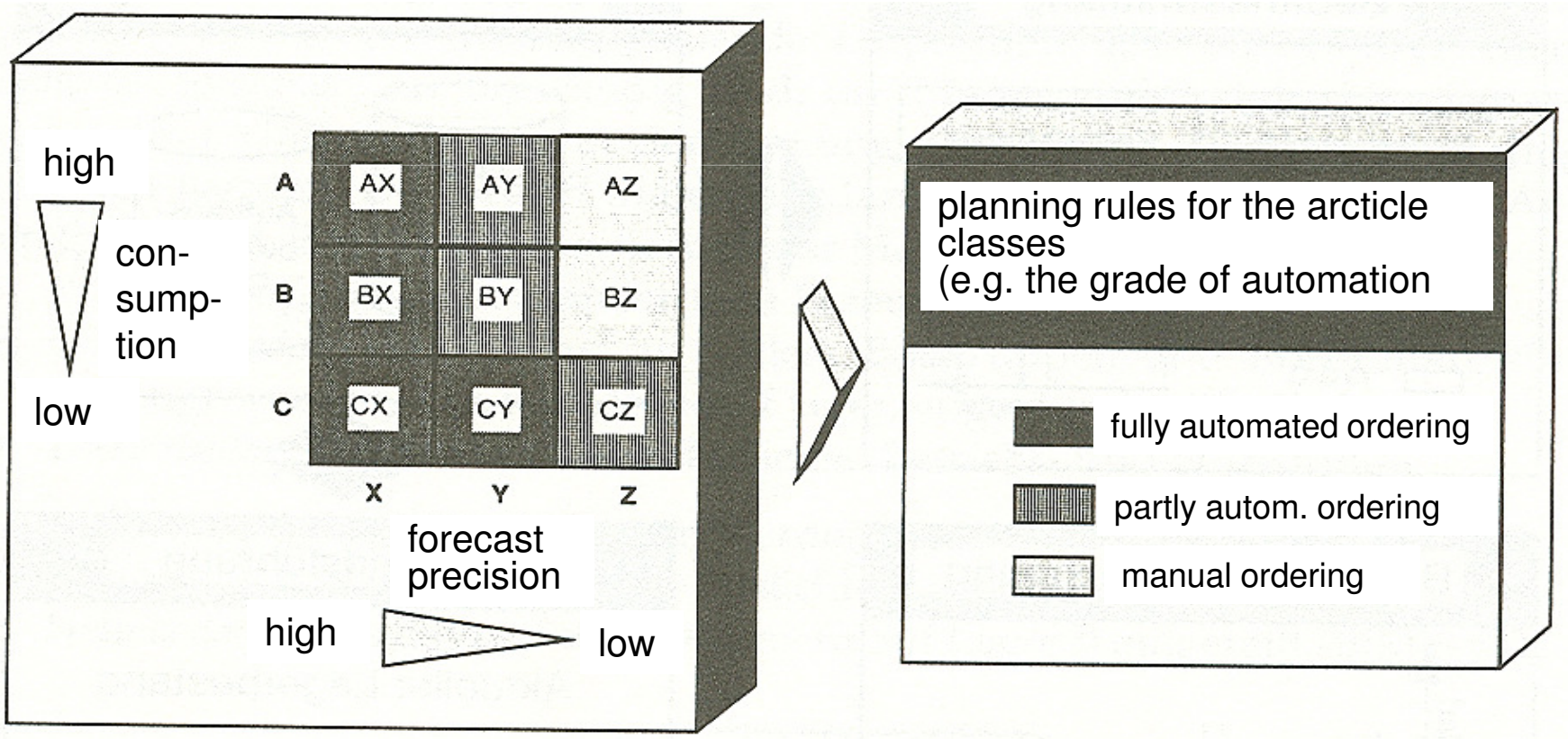


Result:
62 % X-parts
15 % Y-parts
23 % Z-parts

Supply Chain and Economic Indicators - Logistic Tools -

Influence of ABC / XYZ Classification

The combination ABC/XYZ leads to rules for requirement planning



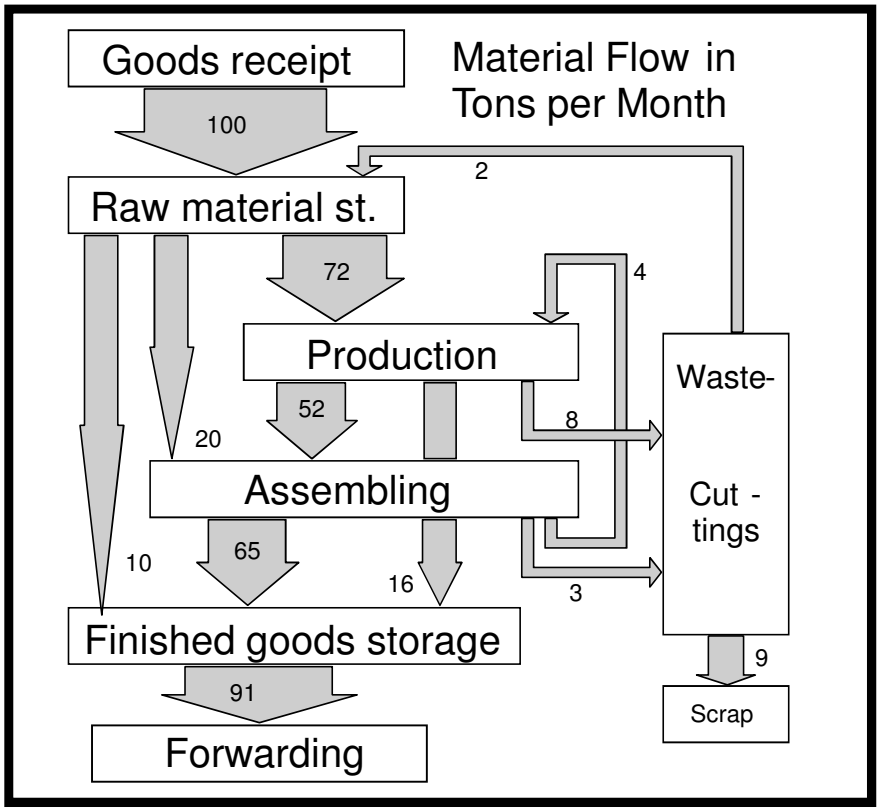
Quelle: Rolf Grap: Produktion und Beschaffung, München 1998, S. 231

Supply Chain and Economic Indicators - Logistic Tools -

Priciples for Optimizing the Material Flow in a Hospital Pharmacy Analogous to the Methods Used in Industry

Transport Matrix and Sankey-Diagramm[1]

From \ To	Raw material storage	Production	Assembling	Finished goods stor.	Waste, cuttings	Forwarding	Scrap	Sum
Goods receipt	100							100
Raw material storage		72	20	10				102
Production			52	16	8			76
Assembling		4		65	3			72
Finished goods storage						91		91
Waste, cuttings	2						9	11
Sum	102	76	72	91	11	91	9	



Sources: Chr.Schulte: Logistik (there: Kettner, Aggteleky, Nestler)

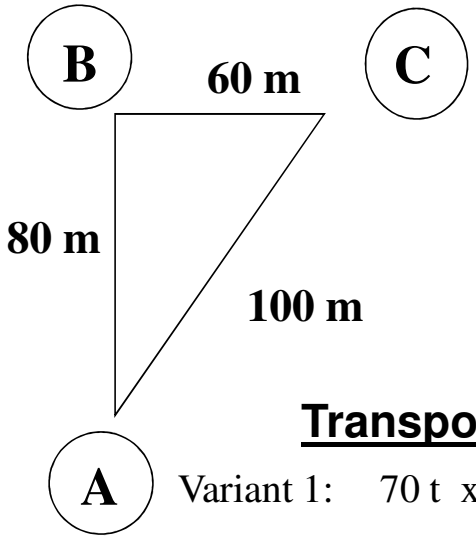
1) H.R.Sankey (1853-1921), Irish engineer

Supply Chain and Economic Indicators - Logistic Tools -

Priciples for Optimizing the Material Flow in a Hospital Pharmacy Analogous to the Methods Used in Industry

The Transportation Work depends on the Allocation of the Machines

Distances between the locations of the production facilities



Tons per month between the Production machines

To / From	2	3
1	70	40
2		50

Variations of allocation of the production machines to the production facilities

	A	B	C
V1	1	2	3
V2	3	1	2
V3	2	3	1

Transportation work fo the alternatives:

Variant 1: 70 t x 80 m + 40 t x 100 m + 50 t x 60 m = 12.600 tm

Variant 2: 70 t x 60 m + 40 t x 80 m + 50 t x 100 m = 12.400 tm **optimal**

Variant 3: 70 t x 100 m + 40 t x 60 m + 50 t x 80 m = 13.400 tm

Source: Fortmann/Kallweit: Logistics, Stuttgart 2007

Supply Chain and Economic Indicators - Logistic Tools -

Design Principles of Material Flow

- The design of material flow should be linear
- Clear structure in using of the available space
- Opposite transports should be avoided
- Avoid crossings in material flow

Supply Chain and Economic Indicators - Logistic Tools -

Repetition

- Calculate the optimal lot

  given: J=100 F=20 E=50 TWER=20 % Xopt =

- Build a ABC-Analysis

Article	Volume	Article	Volume decreased	Volume cumulated	% cumulated	class
4711	3000					
4812	1000					
4913	8000					
5014	10000					
5115	5000					

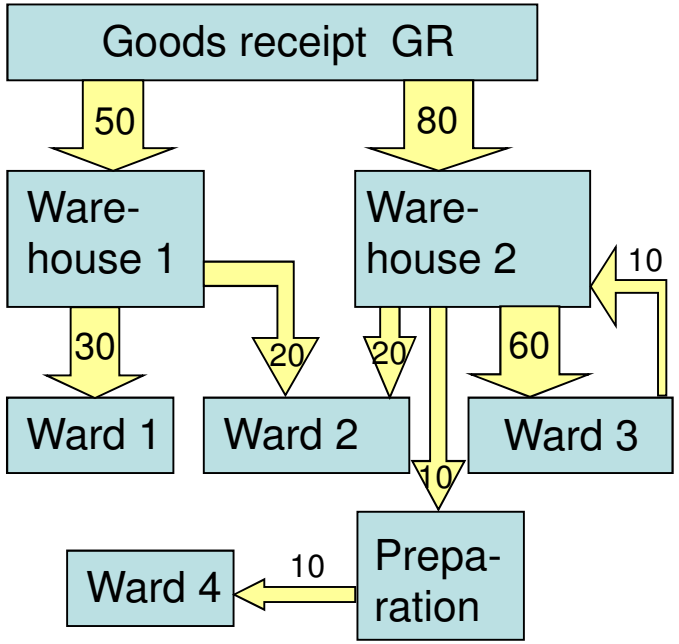
- Calculate a XYZ-Analysis

Consumption										COV=
May	June	July	Average Xa	$(May-Xa)^2$	$(June-Xa)^2$	$(July-Xa)^2$	Sum $(.....)^2$	Sum/3	SQUR(Sum/3)	SQUR/Xa
800	600	1000								

Supply Chain and Economic Indicators - Logistic Tools -

Repetition

Fill in the values of material flow quantities from the given drawing into the From/To-Matrix



From \ To	GR	Wh 1	Wh 2	Wrd 1	Wrd 2	Wrd 3	Wrd 4	Prep
GR								
Wh 1								
Wh 2								
Wrd 1								
Wrd 2								
Wrd 3								
Wrd 4								
Prep								

Supply Chain and Economic Indicators

- Storage systems on wards
- Storage condition monitoring

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Supply Chain and Economic Indicators - Storage On Wards / Stor. Cond. Mon.-

eahp european association of hospital pharmacists

Educational Goals

- Understanding the prinicple of module sytems
- Knowledge of functions of electronic cabinets
- Knowledge of GSP as part of GMP
- Methods of storage condition monitoring

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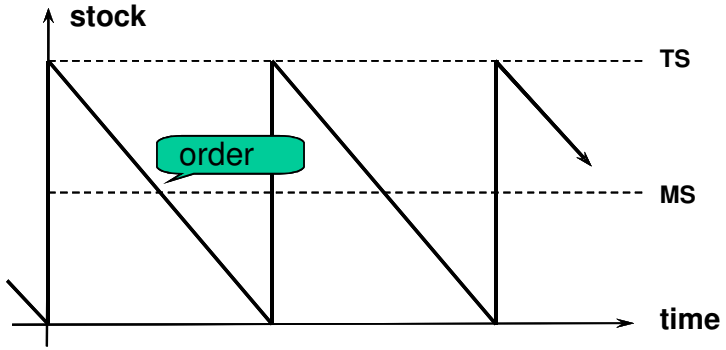
Supply Chain and economic Indicators - Storage Systems on Wards -

Module System



Organisation:
first in first out

The quantities within the baskets must be defined (minimum stock, top stock (=2 MS)

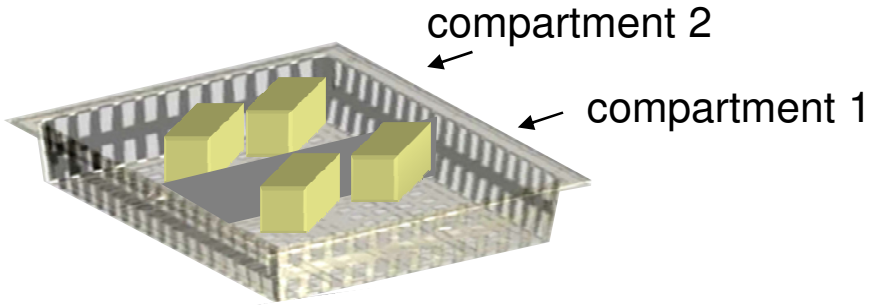
A barcode reader scans the requirement

Module system also within the several service trolleys

source: http://www.cli-ma.de/content/modulsystem/allgemeines.html; CliMa Clinic-Management Winfried Roßbauer Drosselweg 15 93359 Wildenberg

Supply Chain and economic Indicators - Storage Systems on Wards -

Module System



Prinicple: a defined quantity for a defined time at a defined location

Example:
a) Calculate the average requirement for 7 days
b) This 7-day-quantity is called minimum stock MS
c) This stock is twofold stored within the basket
e.g. the reserve has the same value MS

Rules:
- Begin withdrawing form compartment1,
- when empty, withdraw from comp. 2,
- never use articles from comp.2, when there is a rest in comp.1
- never rearrange articles from comp.2 to comp.1

source: http://www.cli-ma.de/content/modulsystem/allgemeines.html; CliMa Clinic-Management Winfried Roßbauer Drosselweg 15 93359 Wildenberg

Supply Chain and economic Indicators - Storage Systems on Wards -

Electronic Cabinet

OMNICELL Inc.

Controlled Substance Management

Share

Improve distribution and record keeping for controlled substance inventory

Omnicell's SecureVault™ system combines cabinet security with software that enables the pharmacy to trace and monitor the movement of controlled substances along all points in the distribution process. Every transaction is automatically recorded, ensuring a complete audit trail.

source: http://www.omnicell.com/Solutions/Central-Pharmacy-Automation/Pages/Controlled-Substance-Management.aspx

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Supply Chain and economic Indicators - Storage Systems on Wards -

Electronic Cabinet

PAR Secure can be used in conjunction with any of the following products to identify the patient or department to which the supplies are being dispensed: PAR Display, PAR Select, PAR Record PAR Replenish.
To gain access to secured supplies, the caregiver simply enters an access code. Upon opening the door, the user indicates supplies dispensed by touching the iTag associated with the item.

source: http://www.parexcellencesystems.com/main.asp

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Supply Chain and economic Indicators - Storage Systems on Wards -

Electronic Cabinet

The caregiver utilizes any PAR Excellence product to select the patient name, then enters a code to unlock the cabinet.

PAR Secure System

Then the caregiver touches the iTag or scans the Barcode for items dispensed from the cabinet or from those maintained outside the cabinet.

The information is downloaded when the probe is returned to the downloader.

Process steps

source: http://www.parexcellencesystems.com/main.asp

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Supply Chain and economic Indicators - Storage Systems on Wards -

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AcuDose-Rx

McKesson

Electronic Cabinet

Key Benefits

- Highest storage capacity of any cabinet on the market
- Specifically designed for maximum reliability and durability
- Modular software and hardware updates to extend investment
- Supports the ISMP recommended core processes
- Only cabinet with certified biometrics identification method—FastEntry™
- Most flexible and configurable cabinet system available today

Reliable, Safe, Fast and Efficient Medication Dispensing

AcuDose-Rx® is an automated medication dispensing cabinet solution that provides caregivers with fast, safe and secure access to patient medications. The system supports all hospital distribution models to streamline nursing workflow, improve inventory management, and strengthen compliance. Offering more capacity than any other cabinet available, AcuDose-Rx reduces stock outs and ensures medication availability for patients.

Video link: supply chain management between ward and hospital pharmacy

http://video.mckesson.com/services/player/bcpid10043455001?bclid=9203093001&bctid=8789317001

source:http://www.mckesson.com/static_files/McKesson.com/MPT/Documents/MAIFiles/AcuDose-RxSellSheet.pdf

Supply Chain and economic Indicators - Storage Condition Monitoring -

The WHO, WORLD HEALTH ORGANIZATION Defines Rules for Good Storage Practice Including Storage Condition Monitoring

„In order to maintain the original quality, every activity in the distribution of pharmaceutical products should be carried out according to the principles of good manufacturing practice (GMP), good storage practice (GSP) and good distribution practice (GDP)." [1)]

Good Storage Practices

„Good Storage Practices are that part of quality assurance that ensure that the quality of a pharmaceutical products is maintained through adequate control throughout the storage." [1)]

Focus here: GSP

1) Source: WORLD HEALTH ORGANIZATION, Working document QAS/04.068/Rev.2, „DISTRIBUTION PRACTICES (GDP) FOR PHARMACEUTICAL PRODUCTS" page 4 and 8

Supply Chain and economic Indicators - Storage Condition Monitoring -

GSP Good Storage Practices for Pharmaceuticals

Personnel

- qualified personnel to achieve pharmaceutical quality assurance objectives
- trained in relation to good storage practice, regulations, procedures and safety
- high levels of personal hygiene and sanitation
- wear suitable protective or working garments (special clothes)

Storage area

- only authorized persons
- sufficient capacity of storage areas
- adapted to ensure good storage conditions (clean, dry, acceptable temperature)
- provide, check, monitor and record special storage conditions (e.g. temperature, relative humidity), when these are obligatory

Source: WHO Technical Report Series, No. 908, 2003, Annex 9: „Guide to good storage practices for pharmaceuticals

Supply Chain and economic Indicators - Storage Condition Monitoring -

GSP Good Storage Practices for Pharmaceuticals

Storage area (continuation)

-clean areas, free from accumulated waste and vermin, written sanitation programme (frequency and methods of cleaning and pest control)
- receiving and dispatch bays free from influence of weather
- quarantine areas separate, clearly marked, only authorized personnel
- separate sampling areas for starting materials, avoid cross-contamination by means of adequate cleaning procedures
- separated and good identifyable area for segregated products (rejcted, expired, recalled, returned materials or products)
- dedicated areas with additional safety and security measures for high risky products (e.g. radioactive, high active, narcotics …)
- handling and distribution of materials and pharmaceuticals according to GMP (Good Manufacturing Practise)
- prevent contamination, mix-uups and cross-contamination
- assure the principle „first expiry/first out (FEFO)

Source: WHO Technical Report Series, No. 908, 2003, Annex 9: „Guide to good storage practices for pharmaceuticals

Supply Chain and economic Indicators - Storage Condition Monitoring -

GSP Good Storage Practices for Pharmaceuticals

Storage area (continuation)

- separate storage of rejected materials and pharmaceutical products
- narcotic drugs must be stored according to international conventions and national laws
- damaged items must be separated
- adequate lighting at all storage areas

Storage conditions and monitoring of storage conditions

- compliance with the labelling on pharmaceutical products and materials
- recording of temperature for later control
- periodically checking, calibration and documentation of the monitoring equipment
- storage of the recorded data more than 1 year after shelf-live

Source: WHO Technical Report Series, No. 908, 2003, Annex 9: „Guide to good storage practices for pharmaceuticals

Supply Chain and economic Indicators - Storage Condition Monitoring -

GSP Good Storage Practices for Pharmaceuticals

Documentation: written instructions and records

- instructions according to material flow, handling of expired stock and organization in case of product recall
- written information concerning storage conditions and retest dates
- storage of data about each delivery: goods, quality, quantity, supplier, batch number (of supplier and /or assigned), date of receipt, expiry date; storage duration of the data: shelf-life of the products plus 1 year
- storage of all data about receipts an issues, using the batch number

Labelling and containers

-storage of materials and pharmaceutical products in adapted containers (ensure quality, free from external influences)
- clear labelling: name of material, batch number, expiry date, retest date, storage conditions, reference to the pharmacopoeia

Source: WHO Technical Report Series, No. 908, 2003, Annex 9: „Guide to good storage practices for pharmaceuticals

Supply Chain and economic Indicators - Storage Condition Monitoring -

Examples for labelling

GSP Good Storage Practices for Pharmaceuticals

Normal storage conditions

-dry, well-ventilated, temperatures of 15–25°C or, depending on climatic conditions, up to 30 °C
- extraneous odours, other indications of contamination, and intense light must be excluded

Defined storage instructions

"Do not store over 30 °C" from +2 °C to +30°C
"Do not store over 25 °C" from +2 °C to +25°C
"Do not store over 15 °C" from +2 °C to +15°C
"Do not store over 8 °C" from +2 °C to +8°C
"Do not store below 8 °C" from +8 °C to +25°C
"Protect from moisture" no more than 60% relative humidity in normal storage conditions; to be provided to the patient in a moistureresistant container.
"Protect from light" to be provided to the patient in a light-resistant container.

Source: WHO Technical Report Series, No. 908, 2003, Annex 9: „Guide to good storage practices for pharmaceuticals

Supply Chain and economic Indicators - Storage Condition Monitoring -

Stability Storage/Testing

Stability storage and testing is required in order to assign expiration dating. We offer many temperature and humidity conditions for storage, both ICH and custom. A variety of light studies can be performed as well. Analysis of products at client specified time intervals are normally conducted. In some cases, samples are returned to a client for subsequent testing.

Walk-in and Reach-in Chambers
Storage Conditions
25° C/60% RH
30° C/65% RH
40° C/75% RH
5° C
-20° C
Freeze/Thaw
Photo Stability
Specialty conditions may be arranged:
40° C/Ambient
25° C/Low Humidity
50° C
Others

ICH
The International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH)
(http://www.ich.org/cache/compo/276-254-1.html)

source: http://www.rdlaboratories.com/

Supply Chain and economic Indicators - Storage Condition Monitoring -

Stability Chambers

Our state-of-the-art stability chambers offer continuous mapping with up to 26 fixed sensors to capture electronic data. Electronic calculation of MKT by an individual sensor or weighted average by multiple sensors at any time period may be selected.

Your stability studies are safe and secure with our alarm notification system. In the event of a set point failure all appropriate supervisory personnel are notified by e-mail and alarm monitoring services.

All maintenance and service is provided by qualified engineering support. Maintenance records and monitoring data can be viewed during an audit. To reduce down time from potential chamber failures all parts are inventoried on site.

The automated explosive gas venting system is designed to prevent damage from gas build-up and eliminate product or client liability due to hazardous product leakage from alcohol based products, unusual gases, aerosol products, etc.

Stability Chamber Features Include:

Storage – ICH

source: http://www.rdlaboratories.com/

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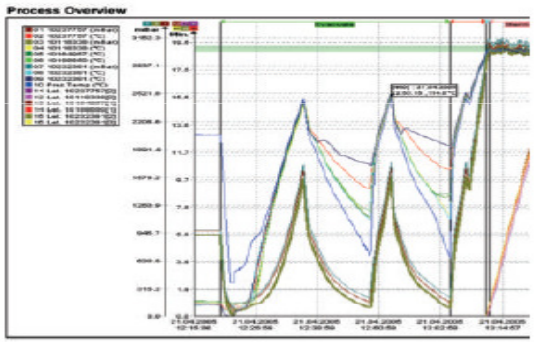
Supply Chain and economic Indicators - Storage Condition Monitoring -

PC based controlling process control

Only 3 Easy Steps ... ebro® validation systems

Setup 1	Evaluate 2	Report 3



Quick and easy validation

ebro® Winlog validation system is a combination of high accuracy wireless measurement technology and powerful programming and reporting tools.

The system consists of:

EBI series Data Loggers:
Wireless sensors to measure and record process conditions (temperature, rH, pressure, time)

USB Interface:
To provide simultaneous readout of up to 8 loggers at once. Additional interfaces can be connected to increase productivity.

Winlog.pharm Software:
Easy-to-use software for programming, evaluation, calibration and report generation

http://www.ebro.com/en/downloads/30_catalogs.php

Supply Chain and economic Indicators - Storage Condition Monitoring -

Automatic functions of Winlog.pharm:

Automatic report generation
The Software automatically generates clear, precise reports for setup and validation. The reports can be adapted to the specific needs of the user and the data can be exported in Excel for further evaluation.

Automatic user-defined calculation
Statistical calculations such as lethality, difference, fluctuation and variance are pre-programmed into the system. The user can freely select the calculations thar are relevant to the specifc validation study.

Automatic recognition of process cycles
The powerful cycle detective makes it easy to generate reports, as critical process cyles are recognized automatically.

Automatic completion of validation processes
The software database allows validations to be evaluated according to national and international standards.

Creation of user-specific templates for specific devices and thermal processes
The Explorer-similar interface makes it easier to create, select, archive and view the different devices. Frequently used validation configurations can be saved. Re-validation is made easier by calling up a saved configuration from the data base.

Documentation templates SOP, IQ/OQ tailored to the needs of the pharmaceutical industry
DKD (NIST) Validation Standard FDA 21 CFR Part 11 compliant

source: http://www.ebro.de/en/products/software/winlogpharm.php

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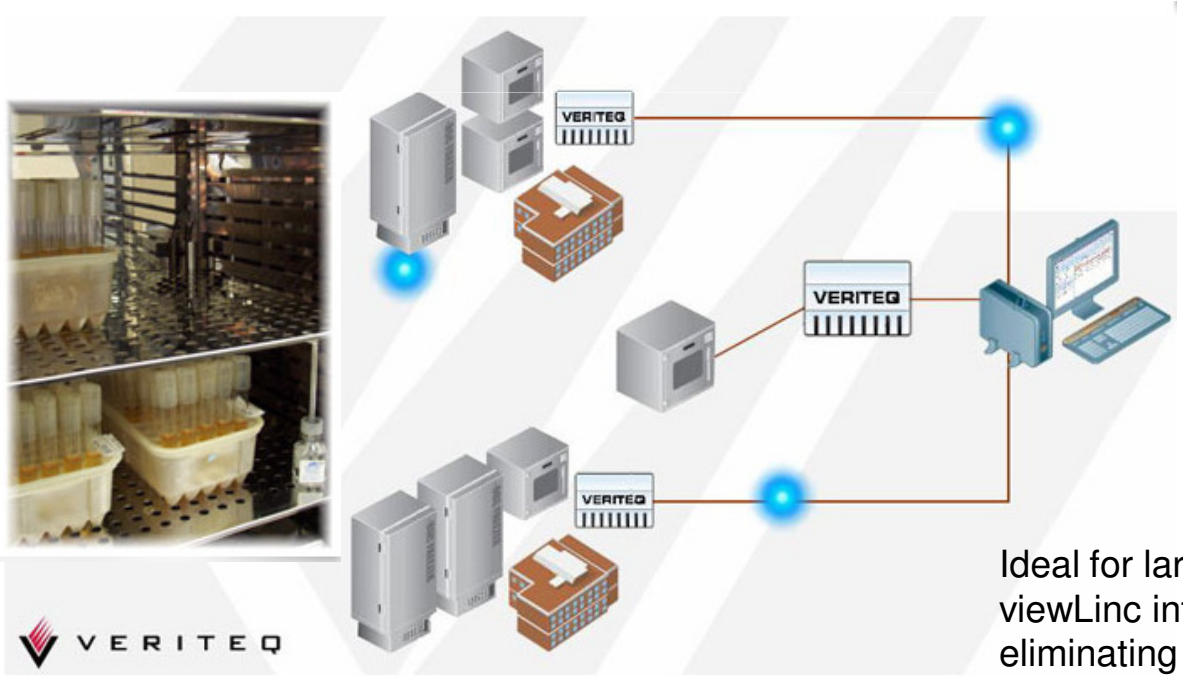
Supply Chain and economic Indicators - Storage Condition Monitoring -

Validatable Relative Humidity & Temperature Data Loggers

Veriteq's VL 2000 series loggers are fully validatable and designed for regulated industries/pharmaceutical applications — with NIST-traceable, ISO/IEC 17025 calibration, cGMP/FDA compliant measurement and redundant recording of temperature and humidity. All data are recorded in real-time and maintained in a secure format for later review and reporting

PC
phone
eMail
SMS
pager



viewLinc™ Monitoring, Alarming & Reporting

For monitoring with alarming, real-time and historical data trending
Compliant with the requirements of all major regulatory bodies, including **FDA (Part 11), CBER, ISO 17025, the Joint Commission,** and **AATB**

Ideal for large-scale systems and standalone applications, viewLinc integrates with your existing infrastructure, eliminating the cost of installing and maintaining a dedicated network. Connect with your existing Ethernet, PoE, WiFi or combination.

http://www.veriteq.com/validation-data-loggers/validation-humidity-specs.htm

Supply Chain and Economic Indicators

- Storage models
- Results and discussion

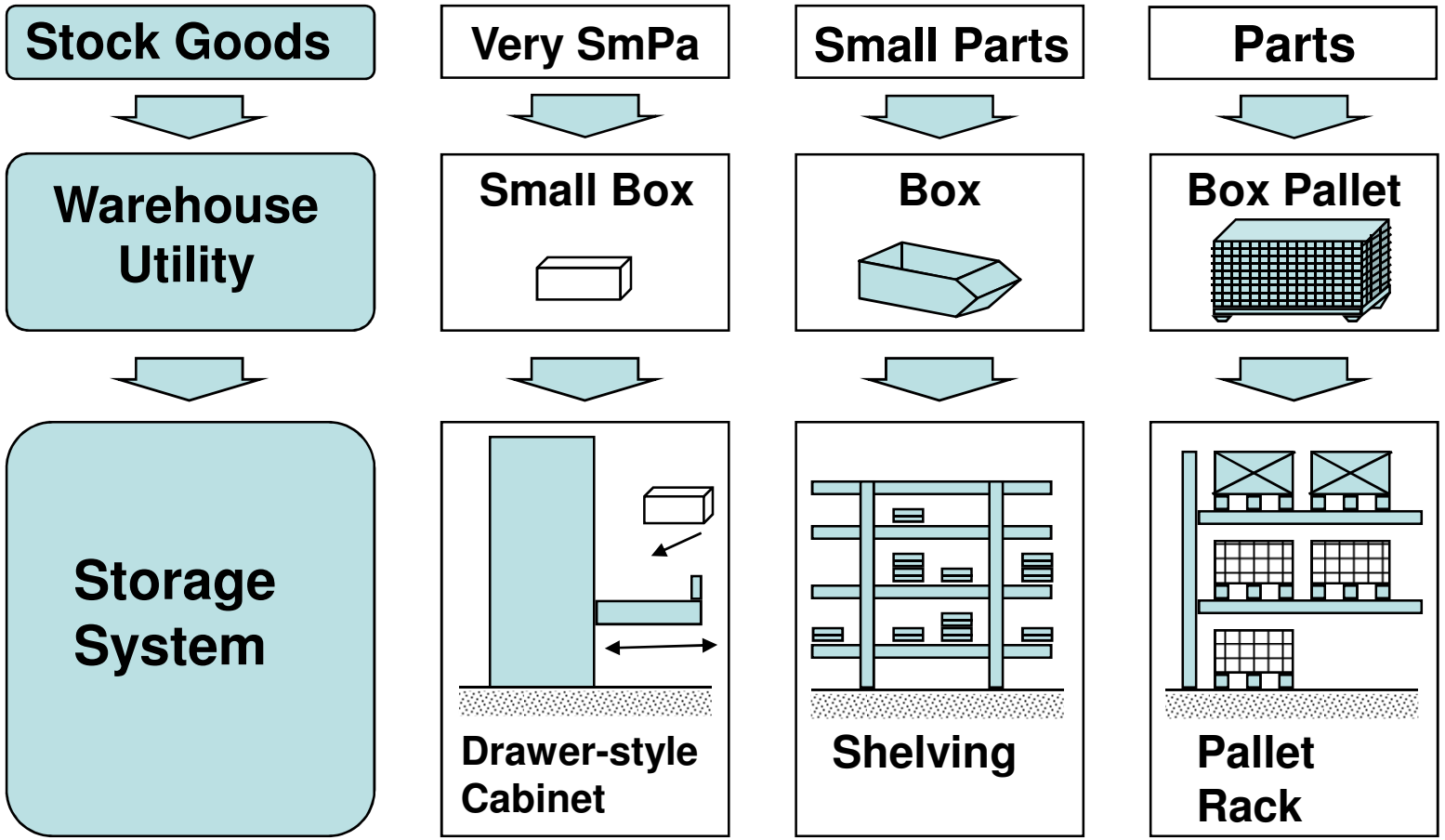
Supply Chain and Economic Indicators - Storage Models / KPIs -

Educational Goals

- Understanding the order to select the suitable storage system
- Knowledge of storage principles
- Knowledge of types of racks
- Knowlegde about advantages of stock centralisation
- Ability tu use the „square root law"
- Knowledge of paternoster warehouse
- Understanding pick to light principle
- Knowledge about paperless order picking
- Understandig the batch flow method
- Knowledge about the advantages and problems of Unit Doses
- Ability to calculate KPIs and the several kinds of average stock
- Understanding the KPI-report for a hospital pharmacy

Supply Chain and economic Indicators - Storage Models -

Selection Criteria for the suitable Storage System



 Source: Associated with: Zeitschrift Materialfluß: Lagerplanung (Sonderpublikation), Verlag Moderne Industrie

Supply Chain and economic Indicators - Storage Models -

Storage Principles

Random storage, chaotic storage: no fixed places for articles
- needs a good and secure organisation (normally computer aided)
- advantage: saves place in warehouse
- risk: big efforts for inventory when information about articles<->bins is lost

Fixed storage bin principle: each article has ist own, fixed place
- advantage: with increasing experience, the warehouse worker finds articles very quick
- disadvantage: a fixed, but emty bin cannot be used by another article

Alphabetic order:
- advantage: each person can find articles quickly without experience
- disadvantage: when names of articles change, they must be rearranged

Order by API (active pharmaceutical ingredient):
- advantage: name-changes do not affect the storage order
- disadvantage: physicans, nurses and pharmacists must learn a new principle [1)]

1) Details: http://www.medicalorder.de/uploads/media/KH_Pharmazie_Lagerung_Wirkst.pdf

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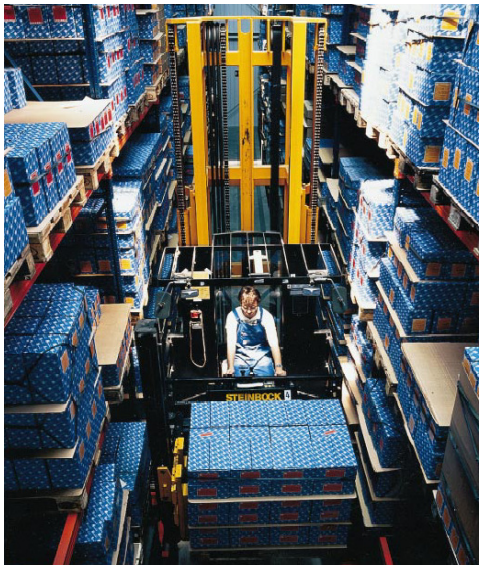
Supply Chain and economic Indicators - Storage Models -

Examples

Shelving

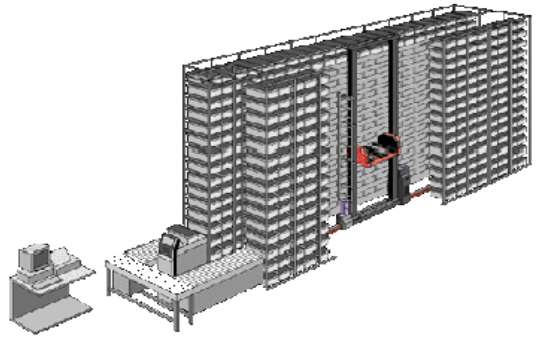
Gravity flow rack

Drawer style cabinet



Pallet rack

Pallet rack



Fully automated small-parts warehouse „Miniload warehouse"

Supply Chain and economic Indicators - Storage Models -

Advantages of a Central Warehouse

Advantages of central Storage versus decentral Storage:

- Stock lower than the sum of decentral stock
- Minimum stock lower than the sum of minimum stock decentral
- Lower capital lockup
- Better use of room
- Higher turnover: therefore lower perishableness
- Personnel placement more economic
- Use of storage devices more efficient

Source: Oeldorf/Olfert: Materialwirtschaft
loingl15.ppt

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Supply Chain and economic Indicators - Storage Models -

Decentral Stock versus Central Stock

Warehouse 1

Stock Article A: 300 pieces

Warehouse 2

Stock Article A: 400 pieces

Warehouse 3

Stock Article A: 500 pieces

Re-

storage

1200 Pieces - 707 Pieces = 493 Pieces is equivalent to 41 % Reduction of Stock, when centralized

Central Warehouse

Stock Article A:

$$\sqrt{300^2+400^2+500^2}$$

= 707 Pieces

General Conditions:

- Optimal disposition of Stock and further supplies
- Same turnover decentral and central
- Same assortment decentral and central

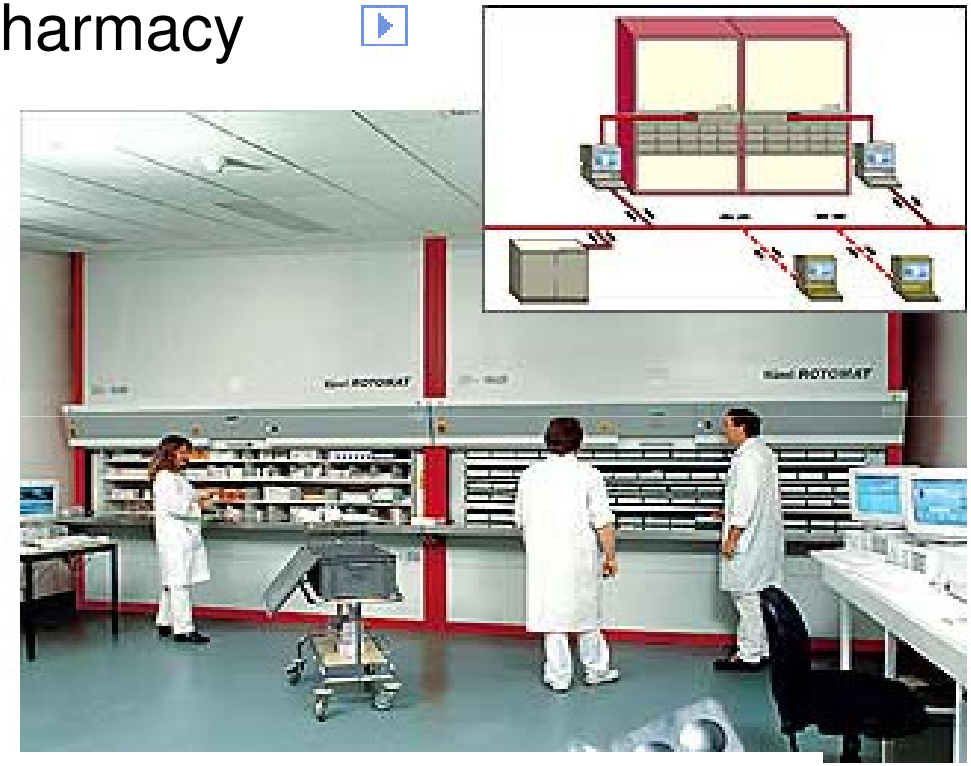
Additional correction factor, when more technical performance is installed in the central warehouse than in the decentral locations:
0,7 bis 0,8 (that means for example: 0,7x707 pieces)

Sources: Gudehus, Tim: Logistik 1, p. 308, Berlin, Heidelberg, New York, 2000 , there: Maister, D.H.,(1976), Centralisation of Inventories and the „Square Root Law", International Journal of Physical Distribution, Vol. 6, No.3, p.126 ff.
lohdgt35a.ppt

Supply Chain and economic Indicators - Storage Models -

Storage Example Central Pharmacy

EDP controlled central pharmacy in 2 ROTOMAT Lifts (vertical paternoster principle.
Advantage: permanent overview about total stock with low time amount for withdrawing and filling.
The HÄNEL Software administrates the entire pharmacy and controls the two ROTOMAT Lifts.
The Software is connected to the Hospital Information System, so all kinds of data exchange are possible



Advantages

- More than 60% space saving in comparision with conventional storage
- considerable saving of working hours by means of simply and quick operation
- permanent stock overview
- better organization of drug issue
- protection and security for the stored drugs

source: http://www.haenel.de/pc/ie/de/kontakt/index.htm

Supply Chain and economic Indicators - Storage Models -

Advantages of Paperless Order Picking

- productivity higher
- personnel costs lower
- reducing of mix-up of articles
- reducing of control effort
- short order picking time
- better keeping of delivery dates
- lower stock level within the pick order area
- no costs for printing and distribution of order picking papers
- optimizing the order picking route
- better use of room rsp. area
- lower stress for the personnel

Quelle: Chr. Schulte: Logistik, 2. Aufl., München 1995, S. 124

Supply Chain and economic Indicators - Storage Models -

Pick-by-Light-Order picking

Gravity flow rack first in first out principle

The picking person goes to the compartment with light on and picks the quantity, shown in the display.
Then she must push the button; the computer program then reduces the stock.

source: Wolfgang Gerold, KAV Wien, Erstes Deutsches Unit-Dose-Symposium, Kassel, 21.10.2004 Vortrag „Unit-Dose-Projekt KAV Wien - Apothekenpartnerschaften"

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Supply Chain and economic Indicators - Storage Models -

AXON System in the Stauferklinik Mutlangen

Batch oriented order picking

5 Hospitals
1300 Beds

Manual order picking, using PDA

source: Dr. Ulrich Proff http://www.axon-mv.com/Pages/Kontakt.html

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Supply Chain and economic Indicators - Storage Models -

Batch Flow System

Company: P@P Systems GmbH
Schafhofstraße 10
D 90411 Nürnberg

Left can be seen the control unit with the WiFi access point, in front are the con-tainer for the wards, in back-ground the gravity flow racks

The PDA leads the employee to the picking points

Linear sorter, filling the ward containers

Data for order picking

Data for actualizing the stock

Connection to SAP-System

source: http://www.klinikum-konstanz.de/einrichtungen/apotheke/batchflow.html

http://www.pp-systeme.com/index.html

Supply Chain and economic Indicators - Storage Models -

Fully automated Order picking in Lukas Hospital Neuss (near Düsseld.)

- automated handling of drugs and medical products in containers for several wards
- contains up to 80.000 drug parcels, maximum 2.500 per hour,
- about 1.000 different drugs, partly with high turnover
- exactly Cooled warehouse area included

filling the order picking automat

exterior view

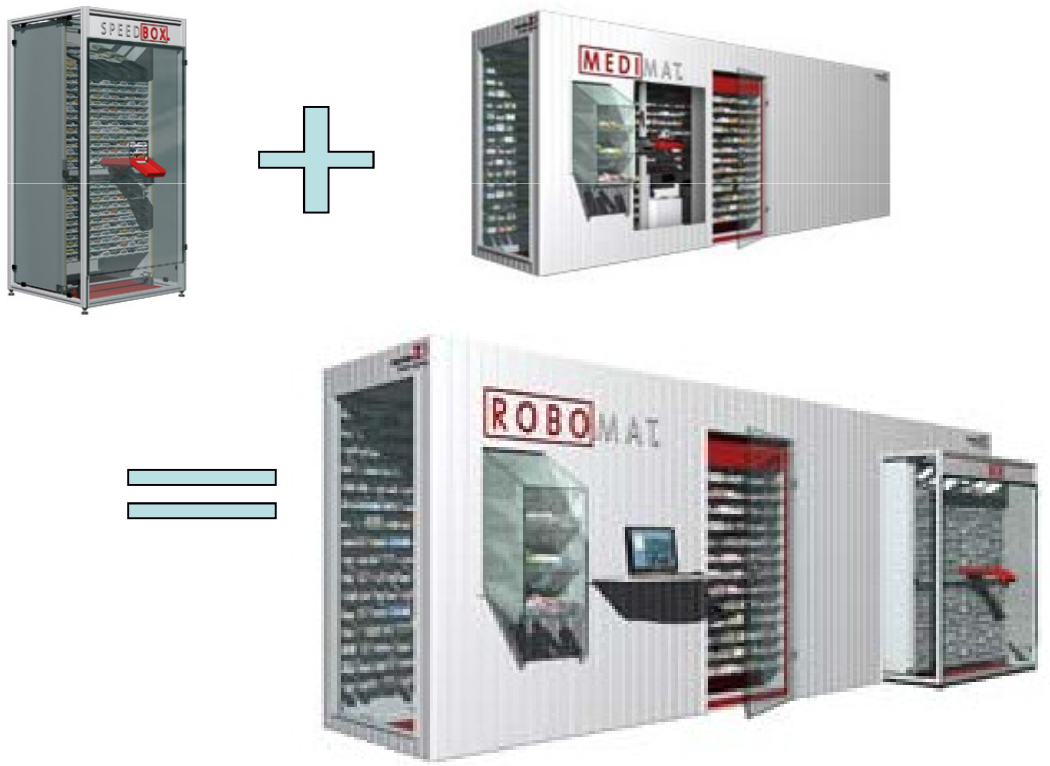
interior view with cooled area

Städtische Kliniken Neuss · Lukaskrankenhaus GmbH · Preussenstr. 84 · 41464 Neuss · Telefon: 0 21 31 / 8 88-0 · Telefax: 0 21 31 / 8 88-79 99 E-Mail: information@lukasneuss.de

source: http://www.lukasneuss.de/Einrichtungen/Zentrale_Apotheke/Logistik/body_logistik.html

Supply Chain and economic Indicators - Storage Models -

Parcel Oriented Order Picking Solutions



Technische Daten ROBOMAT®	
Maße ROBOMAT®	
Höhe:	1,95 m bis 2,95m
Länge:	4,0 m bis 13,0 m
Breite:	1,30 m
Kapazität:	ca. 3.200 Packungen (bei sortenreinen Kanälen) pro Meter Regal
Leistung	
Auslagerung:	1200 Pack/h
Einlagerung:	330 Pack/h manuell
	150 Pack/h autom.
Personaleinsatz	Mit vollautomatischer Scannung ca. 1 Sekunde pro Packung Mit manueller Scannung ca. 3 Sekunden pro Packung

source:http://www.mach4.de/produkte/robomat.html

Supply Chain and economic Indicators - Storage Models -

Characteristics of THERIAK [1] and Unit Dose Principle

- Cross interaction between drugs are avoided
- allergic reaction are avoided using anamnesis data
- dosis is adapted to patient weight
- avoiduing of kidney damage
- Theriak is connected via interface to the HIS Hospital Information System
- Stockage of Unit Doses in the pharmacy only 3-5 days
- Providing security is givenn by using redundant technique
- for short term demand (the patient comes in the afternoon) exists a ward stockage of Unit Doses, e.g. 20 sachets (each contaning 1 pill)
- Sachets are continuous scanner-controlled
- Non-used sachets are restored to the pharmacy warehouse
- Application of drugs in the right order by means of patient tag

1) THERIAK TMM prescription software; runs independant from producer of the unit dose system
source: http://cis-healthcare.com/Theriak/introduction.aspx

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Supply Chain and economic Indicators - Storage Models -

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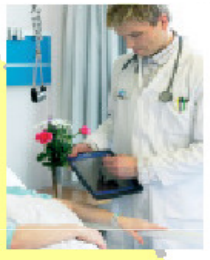
UNIT DOSE for Pills, Capsulas, Dragées, Phials

Patient bracelet

Barcoding

Prescription



THERIAK TMM Prescription Software

Giving

Unit Dose decentral

UNIT-DOSE= closed-loop process of drug logistics

Unit Dose

Controlling/Optimizing

Not used drugs can be restored

Order Picking

Packaging/Storage

„Drugnest"

swisslog

www.swisslog.com

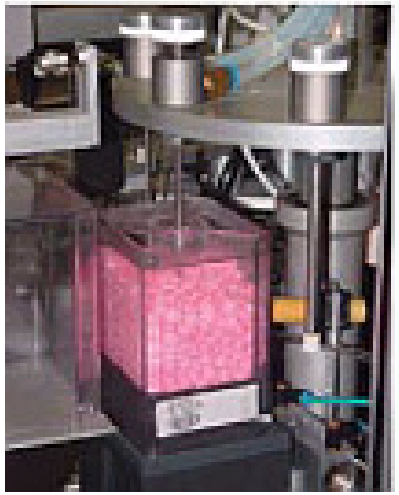
source: Stefan W. Müller, Geschäftsführer swisslog, Erstes Deutsches Unit-Dose-Symposium, Kassel, 21.10.2004 Vortrag „ Eröffnung, Grußwort und Schlusswort zum Symposium "

Supply Chain and economic Indicators - Storage Models -

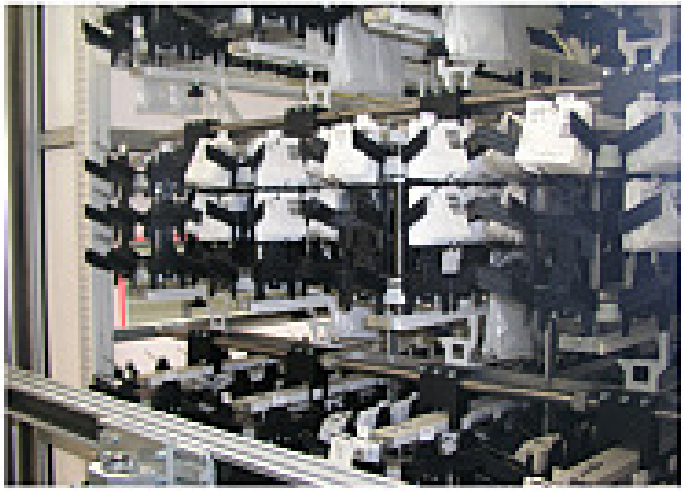
UNIT DOSE mit Swisslog

Cutting of
blister packs

Bulk drugs



Drug nest



Collecting the
Unit Doses
for one patient

source: Jürgen van Gessel, Chefapotheker im St.Elisabeth KH Oberhausen, Erstes Deutsches Unit-Dose-Symposium, Kassel, 21.10.2004
Vortrag „ THERIAK Therapy Management "

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Supply Chain and economic Indicators - Storage Models -

BAXTER FDS 330 (Fast Dispensing System) „Krankenhaus der Barmherzigen Brüder" Linz, Austria

Characteristics:
- Administration of single pills
- No blister package
- Cross contamination possible
- Pills must be de-blistered

source: http://www.friedrich-ebert-krankenhaus.de /leistungen/apotheke/unser_team.html

Advantages of Unit Dose

- The patient is able to control his drug
- Fully controlled and documented way of drugs
- Less medication errors
- Less manual work on wards
- More time for patients
- Mor transparency and standardizaztion of drug prescription
- Medication profiles are visible via networking, especially important in case of emergency
- Reduction of drug consumption
- Lower stockage on wards
- Exact consumption control concerning cost units
- Less theft
- Less effort for inventory on wards
- Easier calculation of costs concerning DRGs

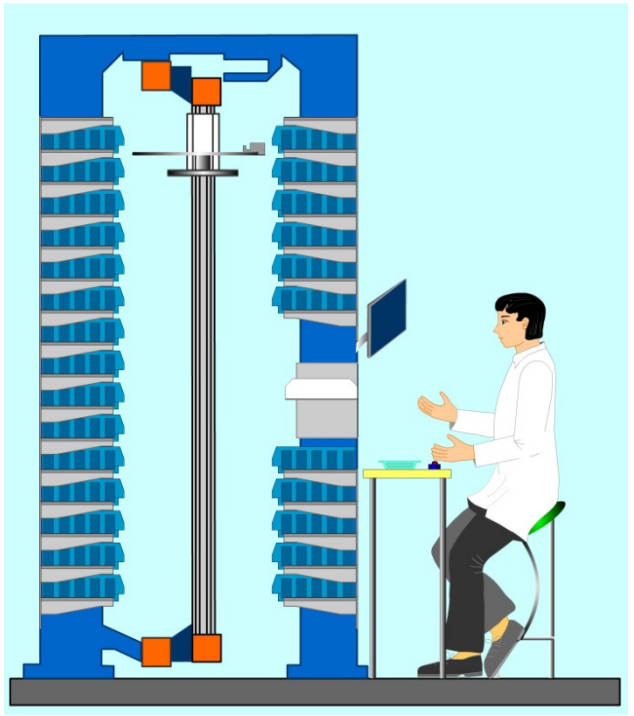
source: Mag. Gunda Gittler on http://www.barmherzige-brueder.at/bblinz/apotheke/fds.htm

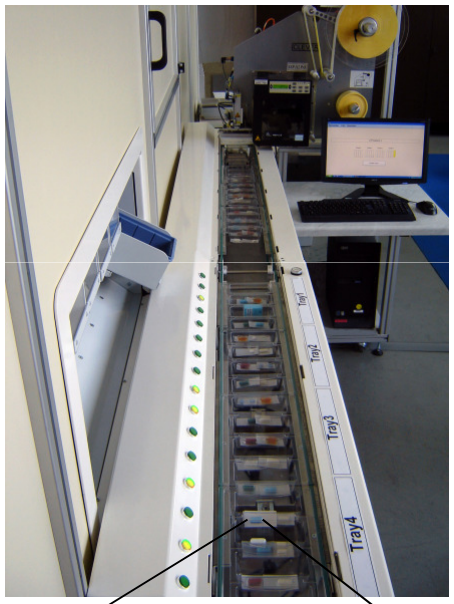
Supply Chain and economic Indicators - Storage Models -

Partially manual Unit Dose System

Pentapack HP500
Blister-Machine

P@P Unit Dose Machine





Patient tray

Soruce: http://www.pentapackna.com/product.html

source:Company: P@P Systems GmbH Schafhofstraße 10 D 90411 Nürnberg

Reduction of Medication Errors Using UNIT DOSE

Based on worldwide studies

Number of patients per year		70.000	
Medication error quota with longer lay time		3%	*
No. of patients affected by medication errors		2.100	
Prolongation of lay time in days		2	
Costs per day /Patient in EURO		500	
Total costs per year, based on medication errors		**2.100.000**	**EURO**

*) studies in Norway say up to 10%

source: Stefan Grosch, SWISSLOG: Economy of Pillpick

Supply Chain and economic Indicators - Economic Indicators -

eahp european association of hospital pharmacists

„Logistics Performance Measurement"

= part of logistics controlling by means of

Key Performance Indicators (KPIs)

Supply Chain and economic Indicators - Economic Indicators -

The most important KPIs within Procurement Logistics

$$\text{Purchase performance} = \frac{\text{total order value p.a. in EUR}}{\text{costs of the purchasing department p.a. in EUR}}$$

This KPI valuates the performance of the purchasing departement; it indicates, which order value was realised per 1 EUR costs of the purchasing department. It is difficult to manipulate this KPI. Example: ***50:1***

$$\text{Costs per order item} = \frac{\text{costs of the purchasing department p.a. in EUR}}{\text{number of order item p.a.}}$$

This KPI is necessary for the ANDLER-formula

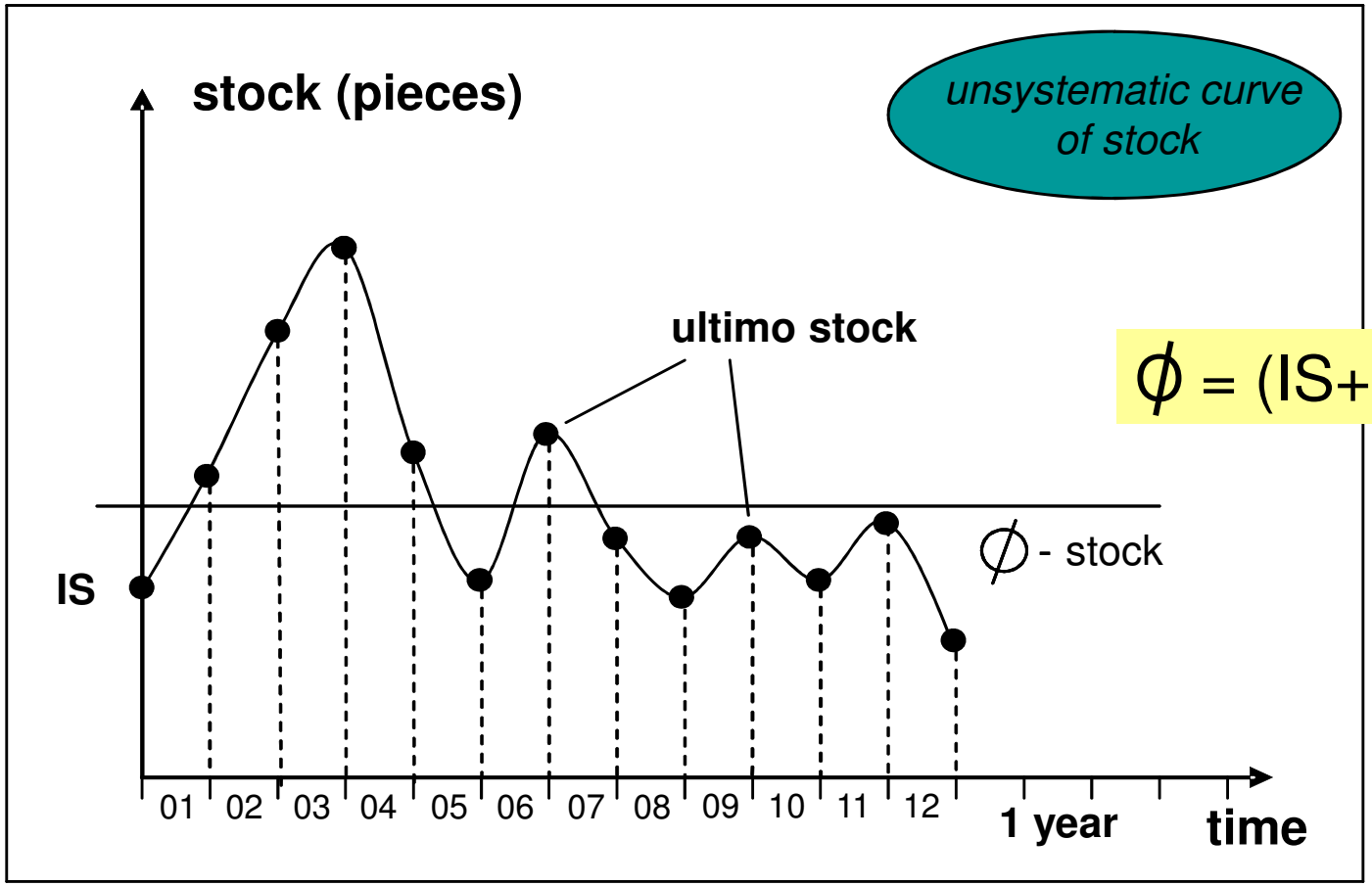
$$\text{Purchase success} = \text{sum of price deviations / sum of planned prices} \times 100\ [\%]$$

A negative value indicates a negotiation success because the paid prices were lower than the planned prices.

Sources: Chr.Schulte: Logistik; Praxishandbuch für den Materialwirtschaftsleiter, WEKA-Fachverlag, Augsburg 1996; Abels et al.: Wie gut ist Ihre Logistik ?, Verlag TÜV Rheinl, Köln ´94t

Supply Chain and economic Indicators
- Economic Indicators -

Calculation of the average stock Version 1

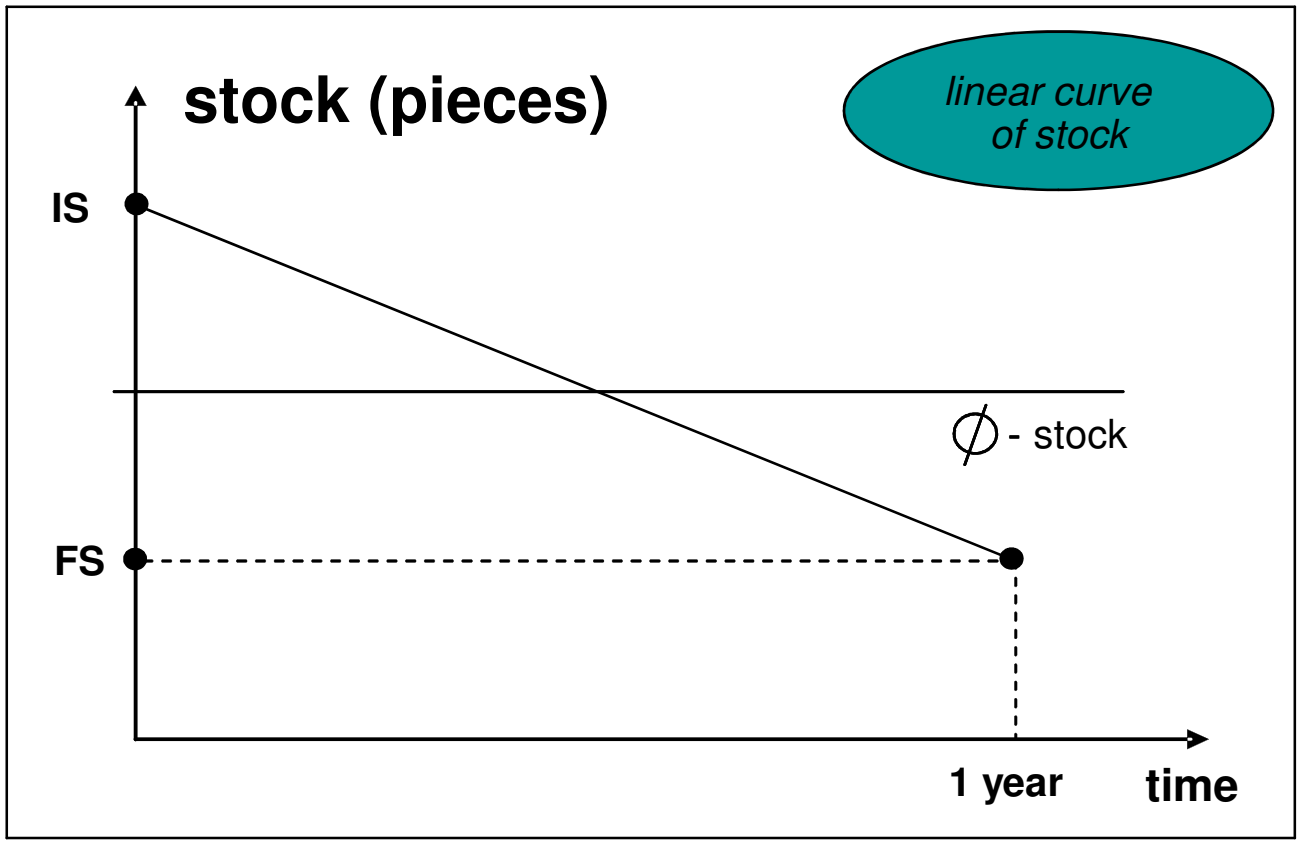


$$\emptyset = (IS+12US)/13$$

IS=initial stock
US=ultimo stock

Supply Chain and economic Indicators - Economic Indicators -

Calculation of the average stock Version 2

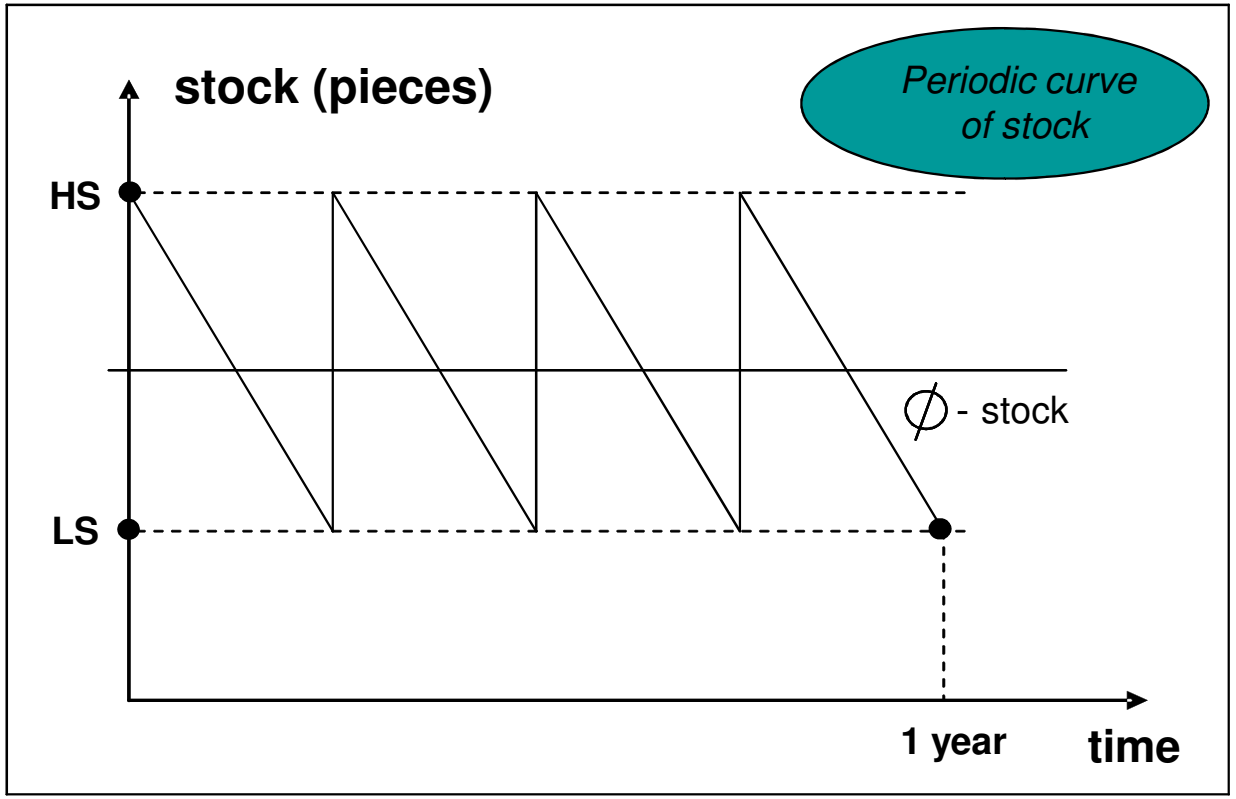


$\phi = (IS+FS)/2$

IS=initial stock
FS=final stock

Supply Chain and economic Indicators
- Economic Indicators -

Calculation of the average stock Version 3



$\emptyset = (LS+HS)/2$

Supply Chain and economic Indicators - Economic Indicators -

The most important KPIs for warehousing

Average stock = (start stock + 12 ultimo stocks) / 13

Warehouse expense ratio (WER) = $\frac{\text{total costs of warehousing p.a.}}{\text{average stock (capital lockup)}}$ x 100 [%]

The costs of warehousing do not contain the interest costs of the capital lockup.

Total warehousing expense ratio (TWER) = WER + interest for capital lockup

This KPI is necessary for the ANDLER-formula; normal value range: 15 – 25 %

Sources: Chr.Schulte: Logistik; Praxishandbuch für den Materialwirtschaftsleiter, WEKA-Fachverlag, Augsburg 1996; Abels et al.: Wie gut ist Ihre Logistik ?, Verlag TÜV Rheinl, Köln ´94t

Supply Chain and economic Indicators - Economic Indicators -

The most important KPIs for warehousing

Inventory turnover = warehouse sales p.a. (pieces rsp. value) / average stock (pieces rsp. value)

The inventory turnover is one of the mostly used KPI.
The average turnover over the full assortment must be built only via values!

Range of inventory in months = 12 months / inventory turnover

The range of inventory tells us, how long the average stock meets the normal demand without replenishment. The average range must be built using the average turnover.

Sources: Chr.Schulte: Logistik; Praxishandbuch für den Materialwirtschaftsleiter, WEKA-Fachverlag, Augsburg 1996; Abels et al.: Wie gut ist Ihre Logistik ?, Verlag TÜV Rheinl, Köln ´94t

Supply Chain and economic Indicators - Economic Indicators -

The most important KPIs for warehousing an logistics

$$\text{Delivery service level} = \frac{\text{directly delivered number of pieces of an article}}{\text{demand of the customer}} \times 100\ [\%]$$

Average delivery service level: sales realised / wished sales * 100 [%]

Logistics cost rate = costs of logistics / sales x 100 [%]

Costs of logistics = depend on the definition, what logistics is: planning of materials, purchasing, goods receipt, included quality control, warehousing, in-house transport, External transport, order picking, packaging, shipping, logistics-IT-system, order processing, production planning and control (PPC) etc.

Sources: Chr.Schulte: Logistik; Praxishandbuch für den Materialwirtschaftsleiter, WEKA-Fachverlag, Augsburg 1996; Abels et al.: Wie gut ist Ihre Logistik ?, Verlag TÜV Rheinl, Köln ´94t

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Supply Chain and economic Indicators - Economic Indicators -

The most important KPIs for warehousing an logistics

$$\text{Pick-Rate} = \frac{\text{number of picked colli}}{\text{man hours}} \quad [\text{ pieces per hour }]$$

Delivery Time = time between issue of order and disposability for the client

$$\textit{Delivery reliability} = \frac{\text{number of on-time delivered positions}}{\text{total number of delivery positions}} \times 100\ [\%]$$

Sources: Chr.Schulte: Logistik; Praxishandbuch für den Materialwirtschaftsleiter, WEKA-Fachverlag, Augsburg 1996; Abels et al.: Wie gut ist Ihre Logistik ?, Verlag TÜV Rheinl, Köln ´94t

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Supply Chain and economic Indicators - Economic Indicators -

Most Important Key Performance Indicators in a Hospital Pharmacy

General Data		Key Performance Indicator	KPI	Remark
Sales volume in €	5.000.000	turnover per sqm	8.333	
thereof for drugs	3.000.000			
number of provided hospitals	3			
number of beds	1.100	turnover per bed	4.545	
number of DRG cases	30.000	turnover per DRG case	167	*DRG-relevant*
personnel (full time) incl. chief	12	turnover per person	416.667	
thereof procurement	2	percentage	16,7	
thereof goods receipt	0,5	percentage	4,2	
thereof warehousing	1	percentage	8,3	
thereof order picking	3	percentage	25,0	
thereof goods issue	0,5	percentage	4,2	
thereof inventory control	1	percentage	8,3	
thereof preparation	2	percentage	16,7	
thereof transport to wards	1	percentage	8,3	
total area in square meters sqm	600			
Numbers of articles				
numb. of active pharmac. ingredients	700	number of APIs per bed	0,64	*decreases by help of standardization*
number of article numbers for drugs	2.000	number of drugs per bed	1,82	*decreases by help of standardization*
numb. of art. numb. for medical products	4.000	number of medical products per bed	3,64	*decreases by help of standardization*

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Supply Chain and economic Indicators - Economic Indicators -

Data for warehousing			Key Performance Indicator	KPI	Remark
average stock in €	600.000		Inventory turnover (IT)	8,33	
			Range of inventory (RI) in weeks	6,24	*RI=52/IT*
depreciation	20.000		percentage of turnover %	0,40	
theft	10.000		percentage of turnover %	0,20	*Theft*
storage area in sqm	300		stock per sqm in €	2.000,00	
thereof drugs	120				
personal capacity in warehouse	1				
full cost per person	35.000				
warehouserent in €/sqm per month	10				
room costs for warehousing	36.000		warehouse expense ratio WER %	11,83	*(room costs+personnel costs)/capital lockup*
interest for capital lockup in %	6		total WER in %	17,83	*TWER=WER + interest*
Date for procurement					
office area in sqm	40				
number of order item p.a.	40.000		costs per order item ="F" in Andler formula	2,62	*purchas.+goods receipt+invoice contr.+office rent*
thereof drugs	30.000		order item quota	1.667	*order items per employee per month*
thereof medicalproducts	8.000		total order item performance	3.333	*total order items per month*
miscellaneous	2.000				
person.capac. Procurement	2,0				
pers.cap.Sampling goods receipt	0,2				
person.capac. goods receipt entry Buchu	0,2				
person.capac. invoice control	0,1				
full cost per person p.a.	40.000				
office rent in €/sqm per month	10				
room costs office procurement	4.800		€ per year		

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Supply Chain and economic Indicators - Economic Indicators -

Examples for optimal lot			Key Performance Indicator	KPI		Remark
number of pills ***Paracetamol*** p.a.	70.000		in Andler formula called "J"			
number of order items p.a.	5		lot quantity actual	14.000		
price per piece in €	0,01		in Andler formula called "E"	14.342		*Andler formula = SQRT((200*J*F)/(E*TWER))*
number of ***Ti-Mesh*** p.a.	77					
number of order items p.a.	5		lot quantity actual	15		*The optimal lot size is 5 or 6 but never 15!*
price per piece at 6	85		optimal lot	5		*Andler formula = SQRT((200*J*F)/(E*TWER))*
price per piece at 60	72		optimal lot	6		*Andler formula = SQRT((200*J*F)/(E*TWER))*
Procurement performance						
Planned budget	4.900.000		purchase success in %	-2,08		*minus indicates: better than planned*
as-is volume	4.800.000		purchase performance	60	:1	*for 1 € effort was made a purchase turnover of 60 €*
thereof over master agreement	2.000.000		master agreement quota in %	42		*easier purchasing process*
number of delivery notes p.a.	12.000					
numer of working days	250					
av.number of items per deliv. note	5		number of goods receipt items per day	240		*productivity of goods receipt*
delivery time form producer in hours	24					
delivery time from wholesaler in h	4					
deliv. time taxi from public pharmacy	1					
Order picking performance						
number of order picking items p.a.	250.000		WA-Positionen per Tag	1.000		*productivity of order picking*
pers.capacity (incl. goods issue+control)	3,5		pick rate in picks per man-hour	41		*productivity of order picking*
full costs per person p.a. in €	35.000		costs per goods issue item in €	0,49		
number of man-hours per day	7					

Supply Chain and Economic Indicators - Storage Models / KPIs -

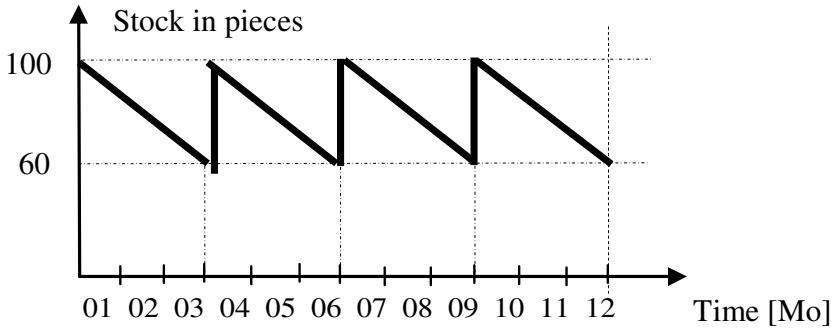
Repetition

- Declare the steps to find the suitable storage system
- Explain advantages and disadvantages of several storage principles
- Explain some types of racks; what is the main advantage of a gravity flow rack?
- Calculate the central stock
  given: in decentral warehouse: W1 300 pieces, W2 400, W3 500
- Give some examples, where the paternoster principle can be found
- Explain the pick to light principle
- Explain some advatages of paperless order picking
- Explain the advantages of batch flow method
- What are advantages and problems of Unit Doses?
- Ability to calculate KPIs and the several kinds of average stock
- Understanding the KPI-report for a hospital pharmacy

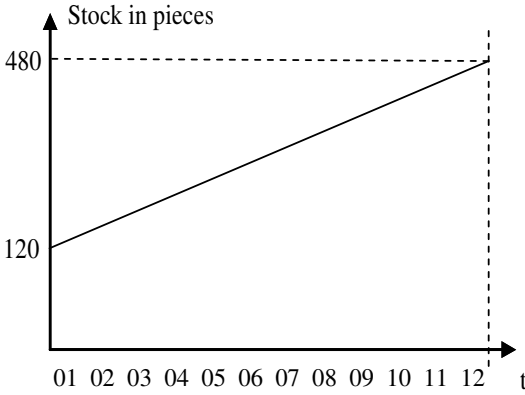
Supply Chain and Economic Indicators - Storage Models / KPIs -

Repetition

- Given is the following stock curve for one year: Please calculate the inventory turnover



- Given are the following stock curves, each for one year. Calculate in all cases the average stock!



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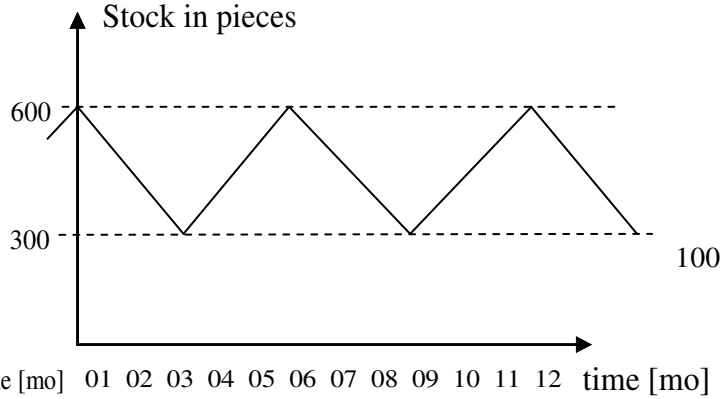

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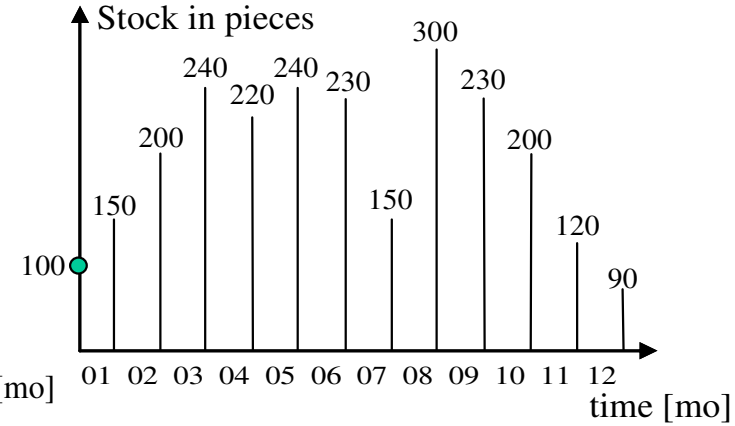

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