MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

LOGISTICS

Guidelines to practical tasks, laboratory works and independent work

of Bachelor's (first) degree students
of speciality 073 "Management"
of the educational program "Logistics"

Kharkiv
S. Kuznets KhNUE
2023

UDC 005.932(072.034)
L85

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Затверджено на засіданні кафедри менеджменту, логістики та інновацій.
Протокол № 10 від 12.01.2023 р.

Самостійне електронне текстове мережеве видання

Logistics [Electronic resource] : guidelines to practical tasks, laboratory works and independent work of Bachelor's (first) degree students of speciality 073 "Management" of the educational program "Logistics" / compiled by T. Kolodizieva. – Kharkiv : S. Kuznets KhNUE, 2023. – 47 p. (English)

L85

Tasks for practical, laboratory classes and independent work of students on the academic discipline, guidelines and the order of doing the tasks are offered.

For Bachelor's (first) degree students of speciality 073 "Management" of the educational program "Logistics".

UDC 005.932(072.034)

Introduction

The educational discipline "Logistics" is aimed at the formation of modern theoretical knowledge and practical skills in using the principles and techniques of logistics in the general system of company management.

The goal is achieved through acquisition of deep theoretical knowledge of concepts, strategies and tactics of logistics; mastering of the methodological tools of development and implementation of the tasks of logistics; mastering the skills of logistics thinking and developing proposals for improvement of logistics systems and their operation; learning the characteristics of formation and developing knowledge of the enterprise personnel in the logistics flow management; acquisition of skills necessary for assessment of the economic impact of the implementation of logistics solutions.

The subject of the academic discipline is the general patterns of development of logistics systems, characteristics and trends in management and optimization of material flow.

The object of the academic discipline is the planning, control and management of transportation, warehousing, storage and other operations, inventory logistics, streamlining of commodity circulation, the economic efficiency of logistics. The guidelines are aimed at students' mastering the following general and special competences:

the ability to identify and describe the characteristics of organizations;

the ability to analyse the results of the organization's activities, compare them with factors of external and internal influence environment;

the ability to determine the organization's functional areas and connections between them;

the ability to form a complex program increasing the company competitiveness on the national and international markets from the point of view of logistics as a new paradigm of entrepreneurial activity;

the ability to carry out organizational, technological, technical and information support of basic functions' logistics. The ability to manage logistics activities of enterprises in the spheres of production, stocks, warehousing, procurement, sales, transportation and freight processing;

knowledge and understanding of the subject area and understanding of professional activity;

the ability to effectively analyse and integrate the logistics concept into international activity, to analyse the conceptual bases and define the main

categories of international logistics, to apply the optimization factor in the delivery of goods in international communication. The ability to choose the optimal mode of transport in international communication, to make effective decisions in the process of international logistics activity.

The guidelines are aimed at obtaining the following learning outcomes of students:

the ability to describe the content of the functional areas of the organization;

the ability to demonstrate organizational design skills;

the ability to use the principles and methods of logistics in the general enterprise management system for cost reduction and optimization of logistics flows and processes of organizations;

the ability to apply a logistic approach to the management of organizations' resources and to ensure their higher competitiveness; demonstrate the skills in optimizing the organizational and technological aspects of the main functions of logistics using communication and information support;

the ability to apply the optimization factor in the delivery of goods in international communication, to choose the optimal mode of transport in international communication, analyse international agreements, analyse risks in international logistics.

Content module 1
Conceptual fundamentals of logistics

Theme 1. Logistics as an instrument of the market economy

Practical lesson 1. The impact of logistics on the enterprise performance

Guidelines to tasks 1 – 4

As an expensive function, logistics has an impact on an organization's overall financial performance. We will start with the effects on the return on assets (ROA).

The return on assets is defined as the pre-tax profit earned by an organization, divided by the value of the assets employed:

Return on assets = profits earned / assets employed. (1.1)

This gives a measure of how well available resources are used and, in general, the higher the value, the better the organization's performance. Assets are usually described as current (cash, accounts receivable, stocks, and so on) or fixed (property, plant, equipment, and so on). Improving the flow of materials reduces the amount of stock. This clearly lowers current assets, but we can argue that it also reduces fixed assets and increases profit. This argument is illustrated in Fig. 1.1.

● *Current assets.* More efficient logistics reduces the current assets through lower stock levels. Reducing the investment in stock can also free up cash for other more productive purposes and reduce the need for borrowing.

● *Fixed assets.* Fixed assets include property, plant and equipment. Logistics is a heavy user of these resources, and the warehouses, transport fleets, materials handling equipment and other facilities needed to move materials through the supply chain form a major part of fixed assets.

● *Sales*. By making a more attractive product, or making it more readily available, logistics can increase sales and give higher market share.

● *Profit margin.* More efficient logistics gives lower operating costs, and this in turn leads to higher profit margins.

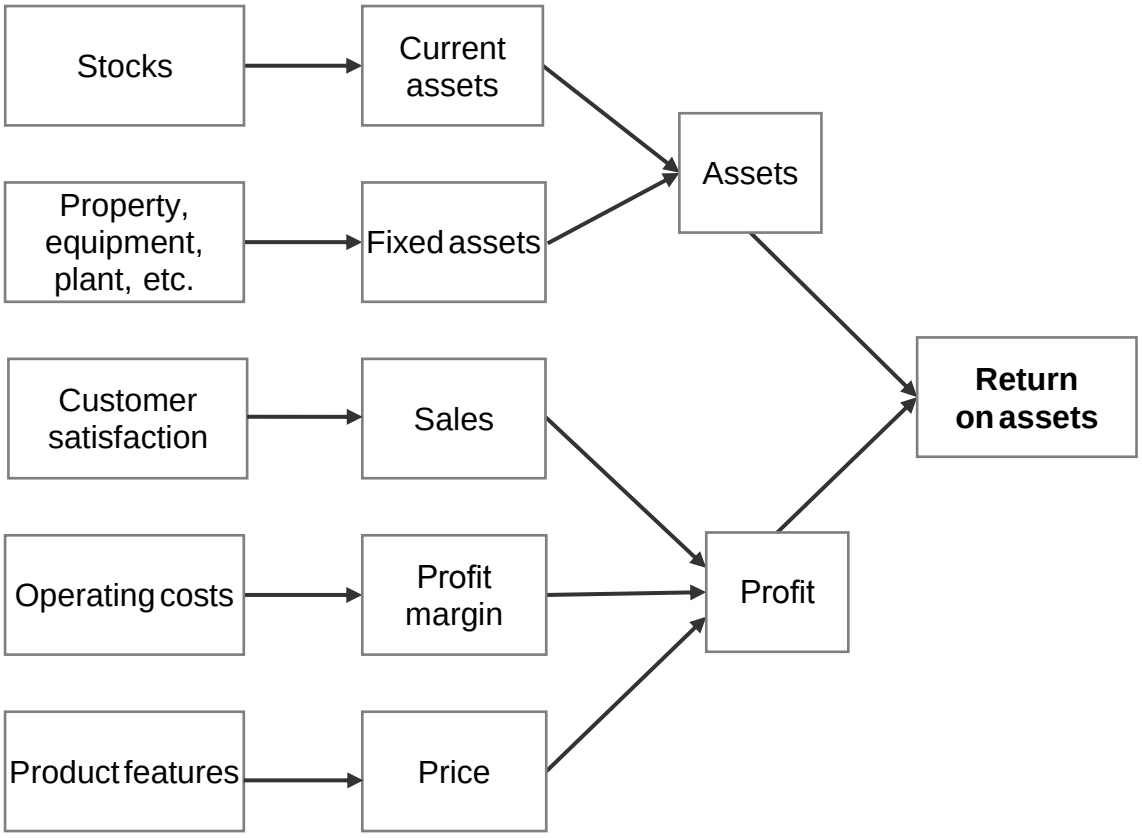


Fig. 1.1. **The influence of logistics on ROA**

Task 1. J. Mitchell currently has sales of £10 million a year, with a stock level of 25 % of sales. Annual holding cost for the stock is 20 % of value. Operating costs (excluding the cost of stocks) are £7.5 million a year and other assets are valued at £20 million. What is the current return on assets? How does this change if stock levels are reduced to 20 % of sales?

Task 2. JL Francisco & Partners run a wholesale fruit business around Rio del Plata. In normal circumstances the company makes a gross profit of 5 % of sales. A consultant's report has recently suggested that 22 % of their operating costs are due to logistics, and that improved efficiency might reduce this by 10 %. How much extra profit would this generate? If they do not improve logistics, how much would sales have to rise to get the same increase in profit?

Task 3. The firm "Fruits wholesale" is engaged in wholesale business with fruit. The firm's gross profit averages 6.5 % of sales. In 2019, the company's sales amounted to 1 670 640 USD. Analysis of the company's financial activities showed that logistics accounts for 20.7 % of operating costs. Analysts in a detailed analysis of the structure of logistics costs came to the conclusion

that higher efficiency of the organization of work at the firm will reduce these costs by 8.5 %.

The following questions arise: "What additional profit will allow the company to receive the measure proposed by analysts, i.e. the specified reduction in logistics costs?" and "If the firm's management does not approve the analysts' proposal, how much will they need to increase sales in monetary terms to achieve the same increase in profits?"

Task 4. In 2019 the firm had sales of 1 670 640 USD. Usually, to eliminate all kinds of risks, the company forms a level of fruit stocks on average equal to 20 % of sales. The annual cost of storing fruit in stock is 18 % of its value, operating costs amount to 1 562 048.4 USD, and the value of other assets is estimated at 3 200 000 USD.

Having such data on the economic and financial activities of the firm, determine the current value of return on assets and determine how it will change if the level of inventories is reduced by 6 %, i.e. up to 14 % of sales.

Theme 2. The concept and methodology of the integrated logistics

Laboratory work 1. Differentiation of the range of stocks by the method of the ABC analysis. Differentiation of the range of stocks by the method of the XYZ-analysis

Guidelines

The ABC analysis is derived from the term "The Pareto Principle" named after an Italian economist Vilfredo Pareto, also called 80/20 rule. This principle suggests that 80 % of the total output is generated only by 20 % of the valuable efforts.

When it comes to stock or inventory management, the ABC analysis typically segregates inventory into three categories based on its revenue and control measures required:

A is 20 % of items with 80 % of total revenue and hence asks for tight control;

B is 30 % items with 15 % revenue;

C is 50 % of the things with least 5 % revenue and hence treated as most liberal.

Any particular company's numbers may be different but have a similar distinguishable pattern. This analysis aims to draw managers' attention to the critical few (A-items) rather than the trivial many (C-items) and focus their inventory control efforts on those particular items where it will have the most significant effect.

As a purchasing manager, understanding your sales over a certain period will help you evaluate and segregate which product belongs in which category, i.e., A, B, or C. This will also assist the purchase manager in analysing what to buy, and in what quantity.

Category A is the smallest, always reserved for the biggest money-makers. It represents the highest quality, most valuable products, and customers that you have. Such products will contribute heavily to the overall profit without costing much when it comes to the seller's resources.

Category B products are less critical than category A products and more critical than category C products. So stay in the middle. This category, in particular, holds the potential to either get moved into category A if the sales are good, or can even slip down to category C.

Category C items are marginally valuable. These products will help you to continually run your business, with a fixed and steady income, but don't individually contribute much value to either the seller or to the business.

ABC analysis can also be performed for the customer or client base to understand the market and strategize your business plans. An ABC analysis example for customers can be based on four primary metrics: revenue potential, support costs, sales revenue, and contribution margin.

The ABC analysis – how to do:

1. Make a list of part numbers.
2. Determine the total quantity used over some period of time.
3. Obtain the cost for each part.
4. Calculate the usage $-value for each part by multiplying the quantity and the cost.
5. Sort the list from high to low $.
6. Calculate the total usage $-value for all items.
7. Calculate each item's percent of the total usage $-value.
8. Select the percentage cut-offs for each ABC group.

Graphic interpretation of the ABC analysis is given in Fig. 2.1.

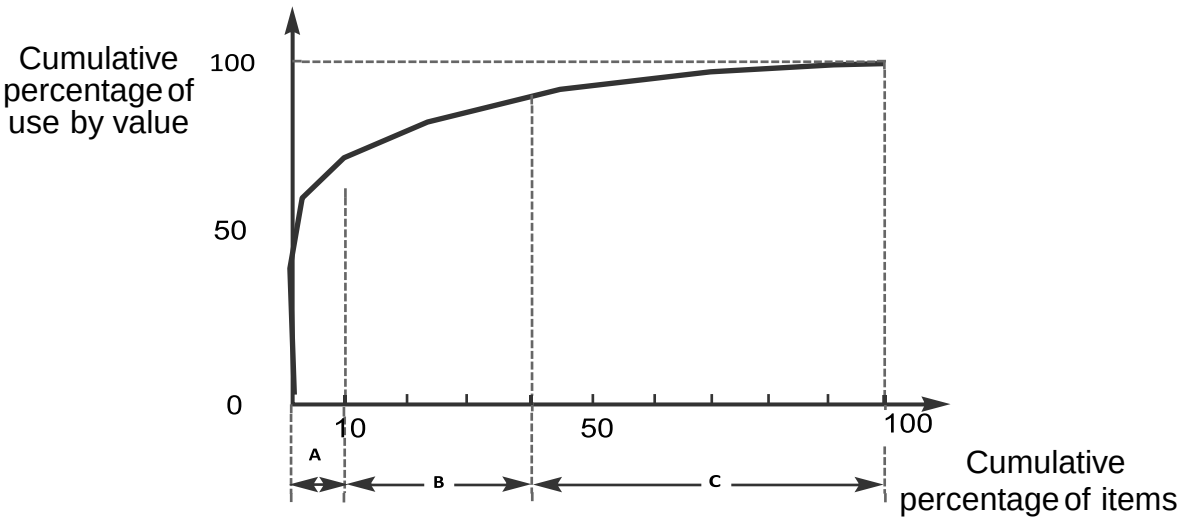


Fig. 2.1. **The graphic interpretation of the ABC analysis** [2]

The XYZ analysis is a way to classify inventory items according to variability of their demand. The variability of demand for an inventory item can be expressed as a variation coefficient.

X is very little variation: X items are characterised by steady turnover over time. Future demand can be reliably forecast. The variation coefficient is from 0 to 10 %.

Y is some variation: Although demand for Y items is not steady, variability in demand can be predicted to an extent. This is usually because demand fluctuations are caused by known factors, such as seasonality, product life cycles, competitor action or economic factors. It's more difficult to forecast demand accurately. The variation coefficient is from 10 to 25 %.

Z is the greatest variation: Demand for Z items can fluctuate strongly or occur sporadically. There is no trend or predictable causal factors, making reliable demand forecasting impossible. The variation coefficient is more than 25 %.

The steps for classifying items based on the degree of demand volatility are:

1. Determine the items to be included in the analysis.
2. Calculate the variation coefficient for each item.
3. Sort the items by increasing the variation coefficient and accumulate.
4. Agree and set the boundaries between the cumulative variation coefficients.

The ABC dimension is usually based on value (margin or revenue) or volume of sales, whereas the XYZ dimension looks at the forecastability of the demand, i.e. how hard is it to predict future sales from the variability previous sales? The use of segmentation allows for different forecasting procedures to be applied to different segments of ABC – XYZ, moving away from the "one size fits all" mentality to forecasting (Fig. 2.2). This can drive better forecast accuracy once the optimal forecast profiles have been assigned based on the segmentation.

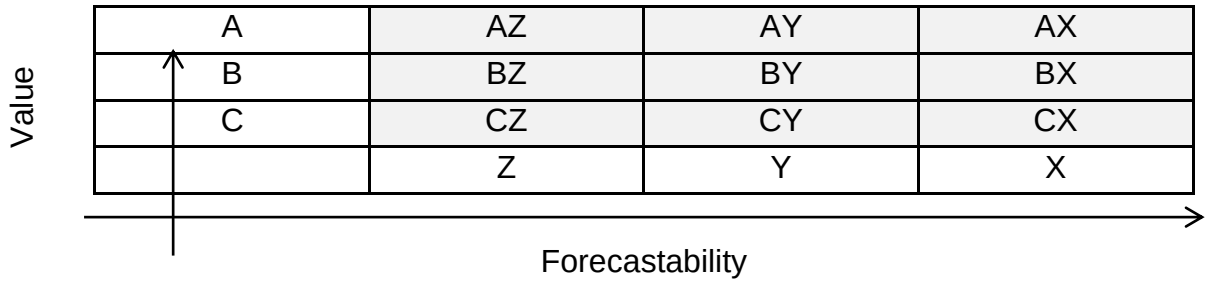


Fig. 2.2. **The matrix of the ABC – XYZ analysis**

Task 1. Conduct the ABC analysis and the XYZ analysis of products based on the data in Table 2.1. The results of the analysis should be listed in Tables 2.2 and 2.3. Provide graphic interpretation of the ABC analysis, the XYZ analysis, the matrix of the ABC – XYZ analysis. Draw conclusions.

Table 2.1

Data

Product	Annual consumption (in units per item)	Price per unit	Annual consumption value	Coefficient of variation, %
1	2	3	4	5
1	1.480	6.10		15
2	1.680	0.15		30
3	10.120	0.20		6
4	3.520	0.40		7
5	3.830	9.50		20
6	4.368	0.25		38
7	4.180	0.45		36
8	3.590	0.90		39

Table 2.1 (the end)

1	2	3	4	5
9	4.820	0.70		18
10	6.000	0.02		5
11	1.900	1.01		6
12	2.980	4.20		8
13	1.050	0.30		9
14	1.100	0.44		2
15	7.1	3.16		15
16	4.700	0.38		21

Table 2.2

The ABC analysis

Product	Annual consumption (in units per item)	Annual consumption value	Share of each item in the total annual consumption value, %	Cumulative share of each item in the total annual consumption value, %	Coefficient of variation, %	Product group ABC	Product group XYZ

Table 2.3

The XYZ analysis

Product	Annual consumption	Coefficient of variation, %	Share of each item in the total annual consumption, %	Cumulative share of each item in the total annual consumption, %	Product group XYZ

Theme 3. The objects of the logistics management and logistics operations

Practical lesson 2. Characteristics of logistics flows. Determining the optimal order size

Guidelines to tasks 1 – 2

The economic order quantity (EOQ) was developed early last century and has remained a dominant theme for the control of independent demand systems. It remains the best way of tackling a wide range of inventory problems. It is flexible and easy to use, and gives good guidelines for a wide range of circumstances.

Imagine a single item, held in stock to meet a constant demand of D per unit time. Assume that unit cost (U), reorder cost (R) and holding cost (H) are all known exactly, while the shortage cost is so high that all demands must be met and no shortages are allowed. The item is bought in batches from a supplier who delivers after a constant lead time. We want to find the best order quantity, Q, and always place orders of this size. There is no point in carrying spare stock, so we time orders to arrive just as existing stock runs out. Then we get a series of stock cycles, with the saw-tooth pattern shown in Fig. 3.1.

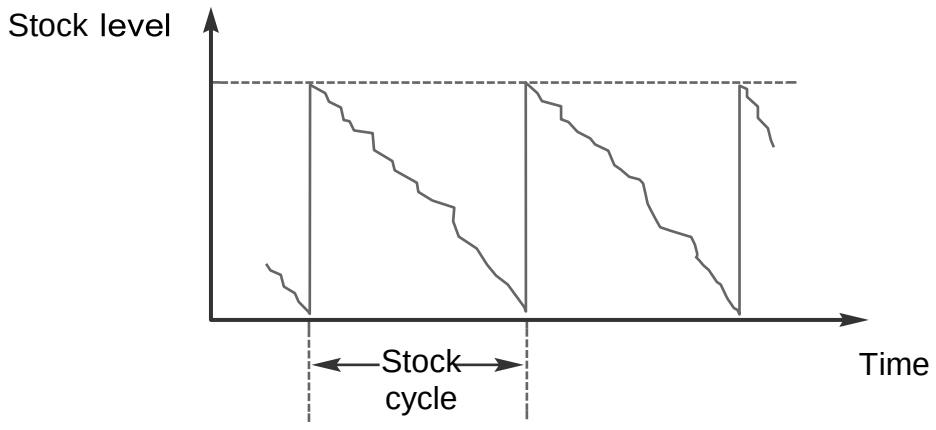


Fig. 3.1. **A repeated pattern of stock cycles**

At some point an order of size Q arrives. This is used at a constant rate, D, until no stock is left. We can find the total cost for the cycle by adding the four components of cost – unit, reorder, holding and shortage. No shortages are allowed, so we can ignore this cost, and the cost of buying the item is constant regardless of the ordering policy, so we can also leave the unit cost out of the calculations. Then we can show that the cost per unit time is:

$$C = \text{total reorder costs} + \text{total holding costs} = RD/Q + HQ/2. \qquad (3.1)$$

If we plot these two parts separately against Q, we get the results shown in Fig. 3.2.

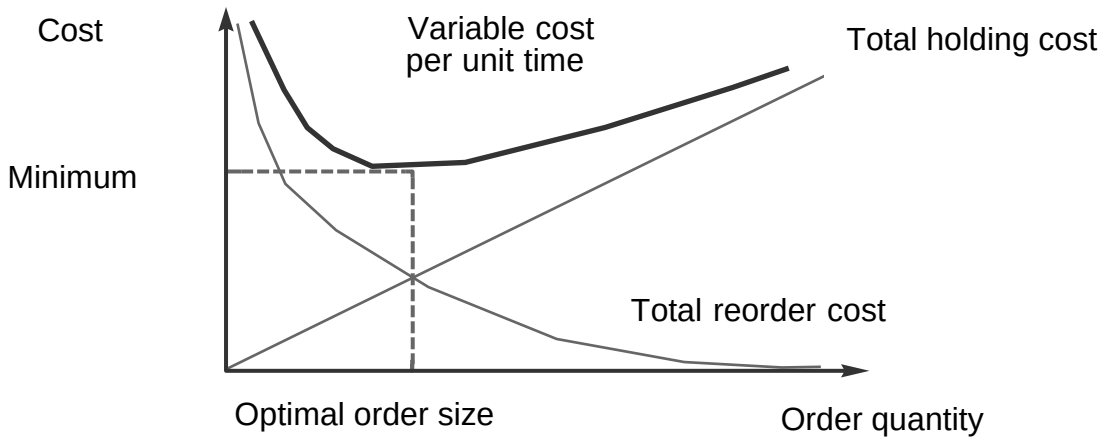


Fig. 3.2. **Variation of cost with the order size**

From this graph you can see that:

1) the total holding cost rises linearly with the order size;

2) the total reorder cost falls as the order quantity increases;

3) large infrequent orders give high total holding costs and low total reorder costs;

4) small frequent orders give low total holding costs and high total reorder costs;

5) adding the two costs gives a total cost curve that is an asymmetric 'U' shape with a distinct minimum;

6) this minimum cost shows the optimal order size – which is the economic order quantity, EOQ.

A standard analysis shows that the economic order quantity is found from the following equation:

$$Q = \sqrt{\frac{2RD}{H}}. \qquad (3.2)$$

where D is demand;

R is reorder cost;

H is holding cost.

Task 1. John Pritchard buys stationery for Penwynn Motors. The demand for printed forms is constant at 20 boxes a month. Each box of forms costs £50, the cost of processing an order and arranging delivery is £60, and holding cost is £18 a box a year. What are the economic order quantity, cycle length and costs?

Task 2. The maintenance department of a large hospital uses about 816 cases of liquid cleanser annually. Ordering costs are $12, carrying costs are $4 per case a year and the new price schedule indicates that orders of less than 50 cases will cost $20 per case, 50 to 79 cases will cost $18 per case, 80 to 99 cases will cost $17 per cases and larger orders will cost $16 per case (Table 3.1) [2]. Determine:

a) the common minimum point for EOQ;

b) the total cost if the feasible minimum point is on the lowest price range, that is the optimal order quantity;

c) the total cost if the feasible minimum point is in any other price range.

Table 3.1

Data

Range	Price
1 to 49	20
50 to 79	18
80 to 99	17
100 or more	16

Theme 4. Logistics activity and logistics functions

Laboratory work 2. Choice of suppliers

Guidelines

Rank the three suppliers you are given, identifying the preferred supplier Instructions:

1. Consider the following three suppliers.
2. Identify most important criteria for supplier selection.
3. Assign weight to each criterion in terms of importance.
4. Multiply the score of each criterion by the specific weight of this criterion and calculate the weighted score.
5. Find the sum of the weighted scores for each supplier.
6. Rank each of the three suppliers based on the criteria and justify the reasons for the preferred supplier.

Task 1. The supplier selection process is a critical activity within the operations of a company. Once the outsourcing decision is taken, a process aimed at the analysis and choice of the appropriate suppliers begins.

Suppose that you are a Procurement Analyst in a large company. You have been asked to create a proposal to the Chief Procurement Officer identifying the best supplier to outsource, for a 3-year period, a complex part of your company's value chain. Your company operates in a mature market where the qualifying and winning factors are quality and time to customer respectively.

Based on the information included in Table 4.1, address the following questions:

What supplier would you select?

What is the rationale for your choice?

What supplier would you select if your company's factors changed to price and quality? Would yours choice change?

Table 4.1

Supplier data

Supplier	Price	Quality	Delivery	Others
A	90	90	95	Overseas supplier (transport lead time is 3 weeks)
B	105	100	100	Supplier facing financial issues
C	85	85	95	Proximity supplier (transport lead time is 3 hours)

Note. Figures are expressed in % as follows:
Price: price quoted by supplier vs outsourcing company target price.
Quality: parts accepted vs. parts delivered.
Delivery: parts delivered on time vs parts delivered.

Theme 5. Logistics management in the general management

Practical lesson 3

Guidelines

If you have a number of jobs waiting to use a single piece of equipment, the total processing time is fixed regardless of the order in which the jobs are scheduled (providing the set-up time for each job is constant, regardless of the job that was done previously). But the order of taking jobs does change other measures of performance. You can see this in the following four scheduling rules.

1. *First come, first served.* This is the most obvious scheduling rule and simply takes jobs in the order they arrive. It assumes no priority, no urgency, or any other measure of relative importance. Its drawback is that urgent jobs may be delayed while less urgent ones are being processed.

2. *Most urgent job first.* This rule assigns an importance, or urgency, to each job and they are processed in order of decreasing urgency. Emergency departments in hospitals, for example, treat those who are most seriously in need first. The benefit of this rule is that more important jobs have higher priority. Unfortunately, jobs that have low priority may be stuck at the end of a queue for a very long time.

3. *Shortest job first.* A useful objective is to minimise the average time spent in the system, where:

Time in the system = processing time + waiting time. (5.1)

If a job needs one day of processing but it waits in the queue for four days, its time in the system is five days. Taking the jobs in order of increasing duration minimises the average time spent in the system. It allows those jobs that can be done quickly to move on through the system, while longer jobs are left until later. The disadvantage is that long jobs can spend a long time waiting.

4. *Earliest due date first.* This sorts jobs into order of delivery date, and the ones that are due earliest are processed first. This has the benefit of minimising the maximum lateness of jobs, but again some jobs may wait a long time.

Task 1. Zambrucci Transport has to schedule the following six jobs for a heavy lift crane (Table 5.1). How can it design a reasonable schedule?

Table 5.1

Initial data

Jobs	A	B	C	D	E	F
Duration in days	12	8	4	16	2	10
Target completion (days from now)	12	40	44	48	4	20

Tasks for independent work

Test tasks

1. The dimension of the material flow is a fraction, in the numerator of which is the unit of measurement of:

a) time;

b) cargo;

c) distance;

d) no right answers.

2. Material flows are subdivided into single-assortment and multi-assortment based on:

a) quantity;

b) natural material composition;

c) the specific weight of the cargoes;

d) the degree of compatibility.

3. The global tasks of logistics do not include:

a) achieving the maximum effect with a minimum of costs in an unstable market environment;

b) modelling of logistics systems and conditions for their reliable functioning;

c) an increase in supply stocks;

d) there is no correct answer.

4. What is a logistics system in logistics:

a) a complex organizationally completed economic system, which consists of elements-links, interconnected in a single process of managing material and related flows, and the tasks of these links have different functional purposes;

b) a set of actions aimed at the production of finished products or services demanded by the consumer at a certain time;

c) a complex set of functional elements (links) interconnected in a single process of production and sale of finished products to the end consumer;

d) complex organizationally completed (structured) economic system that consists of elements interconnected in a single process of managing material and related flows, and the tasks of the functioning of these links are combined by internal and (or) external goals;

e) an organizationally completed economic system that solves problems of optimization of the material flow movement at the macrological level;

f) there is no correct answer?

5. The ABC analysis depends on the:

a) quality of materials;

b) cost of materials;

c) annual consumption value of materials;

d) quantity of materials used.

6. Logistics is primarily:

a) a military term;

b) an economic term;

c) a math term;

d) a philosophy term.

7. Which "right" is superfluous:

a) right product;

b) right quantity;

c) right quality;

d) right weight;

e) right time;

f) right place;

g) right customer;

h) right cost?

8. Formation of all types of support (infrastructure development) for the movement of flows in specific conditions. This principle of modern logistics concept is named:

a) specificity;

b) constructiveness;

c) reliability;

d) complexity.

9. Which flows are of greatest interest for the logistics of the economic sphere:

a) material, transport, energy;

b) energy, money, information;

c) material, information and financial;

d) information, human, military?

10. The logistic process that involves determining the quantity of product and accompanying service that customers will require at some point in the future is:

a) order processing;

b) logistics communications;

c) demand forecasting;
d) procurement.

11. What is the origin of the word "logistics":
a) it all began in Greece with the word "logos";
b) it was first borrowed from French as *logistique*, meaning "art of calculating";
c) answers a) and b) are correct;
d) no right answers?

12. All the parts and sub-parts are arranged in such a manner that output of the whole (achieved through coordination amongst subsystems) is more than the total of the output of individual parts. This component of a system approach is named:
a) sub-system;
b) synergy;
c) system boundary;
d) feedback.

13. What criterion is used when we distinguish systems:
• the transport sub-system;
• the stock management sub-system;
• the warehouse management sub-system;
• the packaging sub-system;
• the order realization subsystem;
• the consumer services subsystem:
a) the functional criterion;
b) the structural-decision functional criterion;
c) the content and structural criterion;
d) the efficiency criterion?

14. The material flow that is not in the time interval, but at a certain time is considered as:
a) finished products;
b) raw materials;
c) inventory;
d) no right answers.

15. What is a logistics chain:

a) the path of goods and information from a creator to an end user that enables any business to turn products into sales;

b) a prerequisite for acquisition and retaining of customers as it helps companies to deliver their goods;

c) answers a) and b) are correct;

d) the system a business uses to move goods from their raw state through production and to customers?

16. Information flow is:

a) messages circulating in the logistics system;

b) messages circulating between the logistics system and external environment;

c) messages required for managing, analysing and controlling logistics operations;

d) all answers are correct.

17. These teams are ongoing teams with specific continuing goals. They are:

a) task teams;

b) work teams;

c) no right answer.

Content module 2
Functional-basic division of logistics

Theme 6. Logistics approach to management of material flows in manufacturing

Laboratory work 3. Planning of material needs in the MRP-1 system

Guidelines to tasks 1 – 2

Material requirements planning (MRP) uses the master schedule, along with other relevant information, to plan the supply of materials. It is used for dependent demand.

The MRP procedure has the following steps (Fig. 6.1):

Step 1. Use the master schedule to find the gross requirements of level 0 items.

Step 2. Subtract any stock on hand and orders arriving to give the net requirements for level 0 items. Then schedule production, with starting times to meet these net requirements.

Step 3. Take the next level. Use the bill of materials to translate the net requirements from the last level into gross requirements for this level.

Step 4. Take each material in turn and:

subtract the stock on hand and scheduled deliveries to find the materials needed;

use the lead time and any other relevant information to give the size and timing of these orders.

Then, if there are more levels of materials, go back to step 3.

Step 5. Finalise the timetable, adding any specific adjustments.

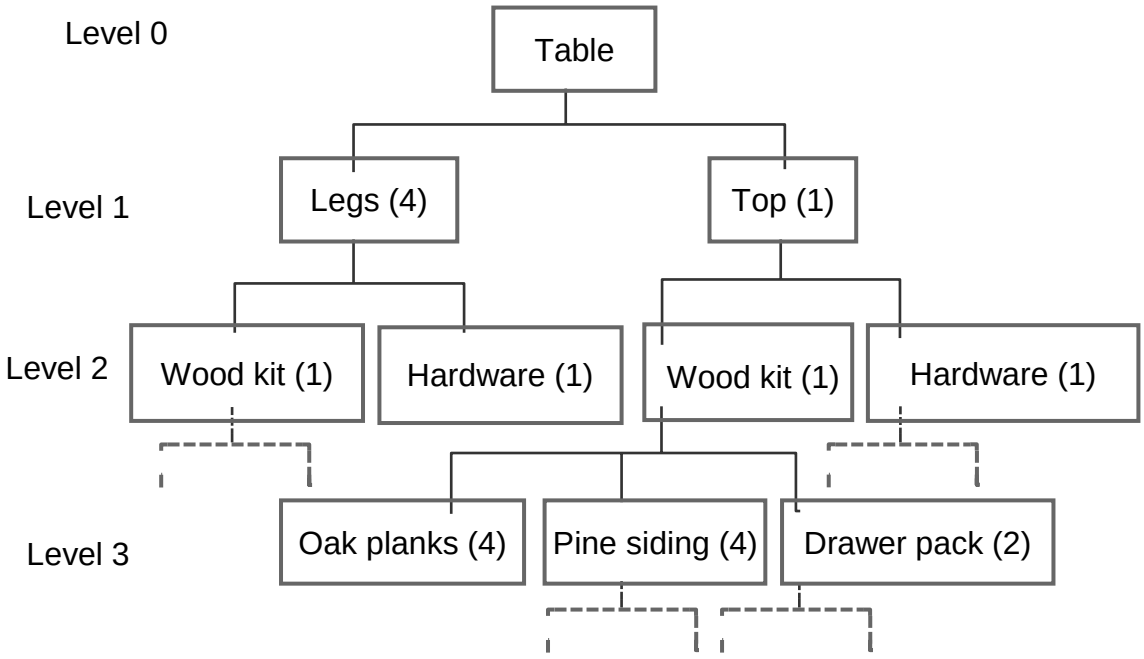


Fig. 6.1. **Part of a bill of materials for a table**

The orders give the following production schedule for finished tables – shown as the gross requirements for level 0 items. Subtracting the current stock of finished tables gives the net requirements. Then allowing a week for assembly gives the start times (Tables 6.1 – 6.3).

Table 6.1

Level 0 – kitchen tables

Week	1	2	3	4	5	6	7
Gross requirements							
Opening stock							
Net requirements							
Start assembly							
Scheduled completion							

The scheduled completion shows the number of units that become available in a week, which is the number started the lead time earlier.

We have already described the bill of materials for this example as the first two levels in Fig. 6.1. We can use this, together with the assembly plans, to find gross requirements for level 1 items – which are legs and tops.

Table 6.2

Level 1 – legs

Week	1	2	3	4	5	6	7
Gross requirements							
Opening stock							
Net requirements							
Place order							
Scheduled completion							

Table 6.3

Level 1 – tops

Week	1	2	3	4	5	6	7
Gross requirements							
Opening stock							
Net requirements							
Place order							
Scheduled completion							

There are no more levels of materials, so we can finalise the timetable of events as:

week No.:

week No.:

week No.:

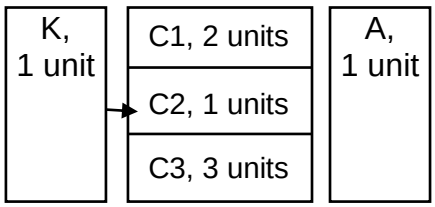
week No.:

Task 1. Semple-Brown assemble kitchen tables using bought-in parts of four legs and a top. These have lead times of two and three weeks respectively, and assembly takes a week. The company receive orders for 20 tables to be delivered in week 5 of a planning period and 40 tables in week 7. It has current stocks of 2 complete tables, 40 legs and 22 tops. When should it order parts?

Task 2. A company belongs to the type of enterprises with a significant scope of supply, due to its multinomenclature. The assembly shop of this enterprise carries out assembly of automobile units (A) from components of own and third-party production. The total manufacturing time of a unit is 10 days. To assemble the unit, it is necessary to make three units (C1, C2, C3) and order from another company a component K, which is used for assembling C2. Make a production schedule for the manufacture of 1 unit according to Table 6.4.

Table 6.4

Initial data

The scheme of assembly of the unit	Elements of the unit	Available stock, pcs	Pure need, pcs	Duration of the production period	
				days	transcript
	A	0		1	Assembly and delivery
	C1	1		5	Production
	C2	0		1	Production
	C3	1		1	Production
	K	0		4	Execution of the order

Practical lesson 4. Inventory management systems

Guidelines to tasks 1 – 2

The EOQ analysis uses a fixed order quantity for purchases, so an order of fixed size is placed whenever stock falls to a certain level. A heating plant may order 25,000 litres of oil whenever the amount in the tank falls to 2500 litres. Such systems need continuous monitoring of stock levels and are best suited to low, irregular demand for relatively expensive items. But there is an alternative periodic review approach, which orders varying amounts at regular intervals.

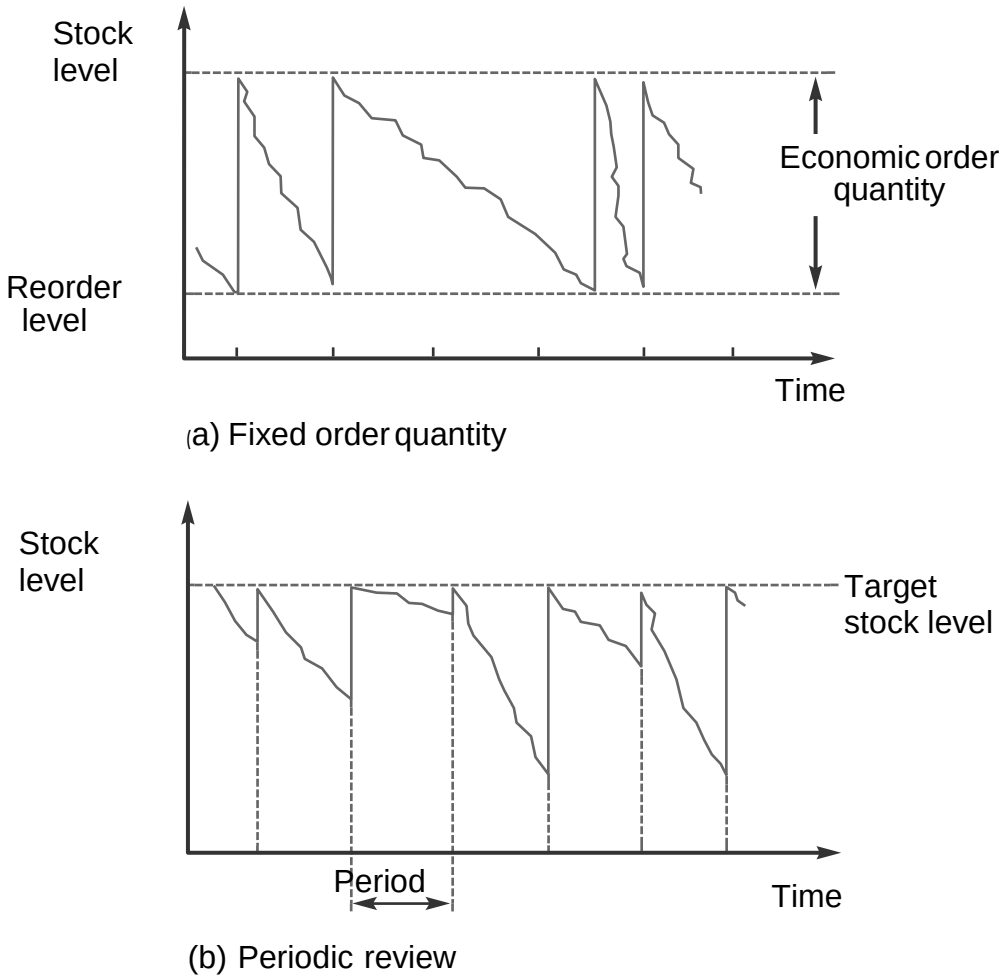


Fig. 6.2. **Alternative approaches to ordering** [2]

A supermarket may refill its shelves every evening to replace whatever it sold during the day. The operating cost of this system is generally lower and it is better suited to high, regular demand of low value items (see Fig. 6.2).

If the demand is constant, these two systems are the same, but differences appear when demand varies. We can show this by extending the last analysis, and looking at a periodic review system where demand is normally distributed. Then we are looking for answers to two questions. First, how long should the interval between orders be? This can be any convenient time, and organisations typically place orders at the end of every week, or every morning, or at the end of a month. If there is no obvious cycle, we might aim for a certain number of orders a year or some average order size. One approach is to calculate an economic order quantity, and then find the period that gives orders of about this size. This decision is largely a matter for management judgement.

Second, what is the target stock level? The system works by looking at the stock on hand when an order is due, and ordering an amount that brings this up to a target stock level.

$$\text{Order quantity} = \text{target stock level} - \text{stock on hand}. \quad (6.1)$$

At the end of a month a company might have ten units remaining of an item with a target stock level of 40, so it orders 30 more units.

We can find the target stock level by extending our previous analyses. Suppose the lead time is constant at L. When an order is placed, the stock on hand plus this order must last until the next order arrives:

$$\text{Next order arrives after a time} = \text{order interval (T)} + \text{lead time (L)}. \quad (6.2)$$

Supermarkets traditionally use periodic review, and with EDI you can imagine a store where the tills pass messages every night to replenish products that were used during the day. But the system becomes more responsive and reduces stock levels if it sends messages, say, two or three times a day. Suppliers consolidate these orders and send deliveries as often as necessary.

Task 1. The need of the JSC "LAZ" for purchased components per year is 2550 pcs. The number of working days per year is 220, the economic order quantity is 125 pcs.; delivery time is 10 days, possible delivery delay is 2 days. Determine the parameters of the fixed order quantity system. Provide a graphical interpretation. Use Table 6.5.

Table 6.5

The initial data and calculation of indicators [2]

No.	Indicator	Calculation procedure	Values
1	Demand for purchased components per year, pcs.	2550	
2	Economic order quantity (EOQ), pcs.	125	
3	Lead time, days	10	
4	Possible delivery delay, days	2	
5	Demand rate, pcs / day	n.1 / 220	
6	Order spending time, days	n.2 / n.5	
7	Lead time demand, pcs.	n.3 × n.5	
8	Maximum demand during delivery time, pcs.	n.5 × (n.3 + n.4)	
9	Safety stock, pcs.	n.8 − n.7	
10	Reorder point, pcs.	n.9 + n.7	
11	Maximum inventory, pcs.	n.9 + n.2	
12	Term of inventory consumption to the reorder point, days	(n.11 − n.10) / / n.5	

Task 2. Calculate the parameters of the fixed period inventory system, if the annual demand of the wholesale store "Radekhivbud" for cement is 20,000 tons, the number of working days per year is 226, the economic order quantity is 1 800 tons, the lead time is 10 days, a possible delay of delivery is 2 days. Use Table 6.6.

Table 6.6

Initial data and calculation of indicators

No.	Indicator values	Calculation procedure	Values
1	2	3	4
1	Demand for cement per year, ton	20 000	
2	Time between orders, days	226 / (n.1 / 1800)	
3	Lead time, days	10	
4	Possible delivery delay, days	2	
5	Demand rate, ton / day	n.1 / 226	
6	Lead time demand, ton	n.3 × n.5	
7	Maximum demand during the lead time, ton	n.5 × (n.3 + n.4)	

Table 6.6 (the end)

1	2	3	4
8	Safety stock, ton	n.7 − n.6	
9	Maximum inventory, ton	n.8 + (n.2 × n.5)	
10	Order size, ton	n.9 − X* + n.6	

X* is the actual inventory balance at the time of inspection.

Provide a graphical interpretation of this fixed period inventory system.

Theme 7. Logistics approach to management of material flows in circulation

Laboratory work 4. Defining the boundaries of the market

Guidelines

In the process of selling goods in the market, each firm seeks to determine the rational boundaries of the market, where it will have advantages. Assuming that the quality of goods of different firms is the same, the boundaries of the market will directly depend on the cost of products and transportation costs, which in total constitute the selling price:

$$P = C + T \times R, \quad (7.1)$$

where P is the selling price of goods, UAH;

C is the cost of goods, UAH;

T is the company tariff for transportation, UAH / km;

R is the distance from the firm to the market boundary, km.

Define the market boundaries for firms A and B (Fig. 7.1).

The border of the market is a point determined by the condition of equality of the selling price:

$$P_A = P_B. \quad (7.2)$$

The selling price for firm A will be equal to:

$$P_A = C_A + T_A \times R_A. \quad (7.3)$$

The selling price for the company B will be equal to:

$$P_B = C_B + T_B \times R_B. \quad (7.4)$$

The distance between the firms R_{AB} = X km, then

$$R_B = R_{AB} - R_A = X - R_A.$$

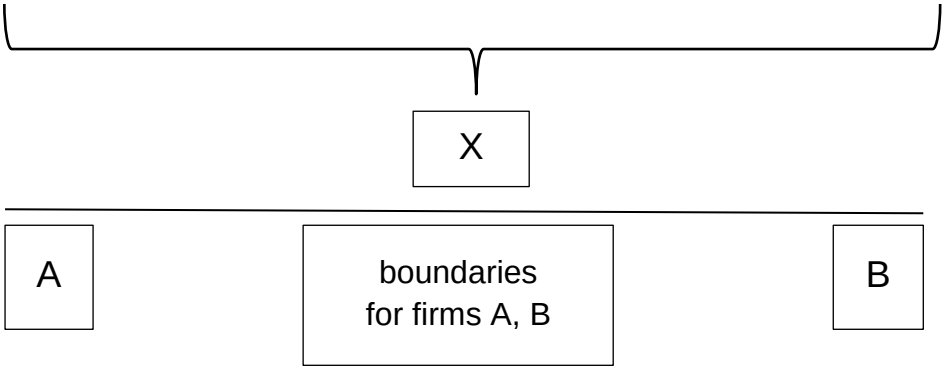


Fig. 7.1. **The distance between the firms A and B**

Substituting the values of (7.3) and (7.4) in equation (7.2), we obtain:

$$C_A + T_A \times R_A = C_B + T_B (R_{AB} - R_A). \quad (7.5)$$

That is, the market boundary for firm A passes at a distance from company A:

$$R_A = (C_B - C_A + T_B \times R_{AB}) / (T_A + T_B) \text{ km} \quad (7.6)$$

and at a distance R_B km from company B:

$$R_B = R_{AB} - R_A. \quad (7.7)$$

To expand the market, firm A decided to use a warehouse (W), located at a distance of Y km from the production plant Fig. 7.2. The costs associated with the operation of the warehouse are Z (CW) UAH per product unit.

$$P_W = (C_W + C_A) + T_W \times R_W. \quad (7.8)$$

$$R_W = R_{WB} - R_{B'}(6). \quad (7.9)$$

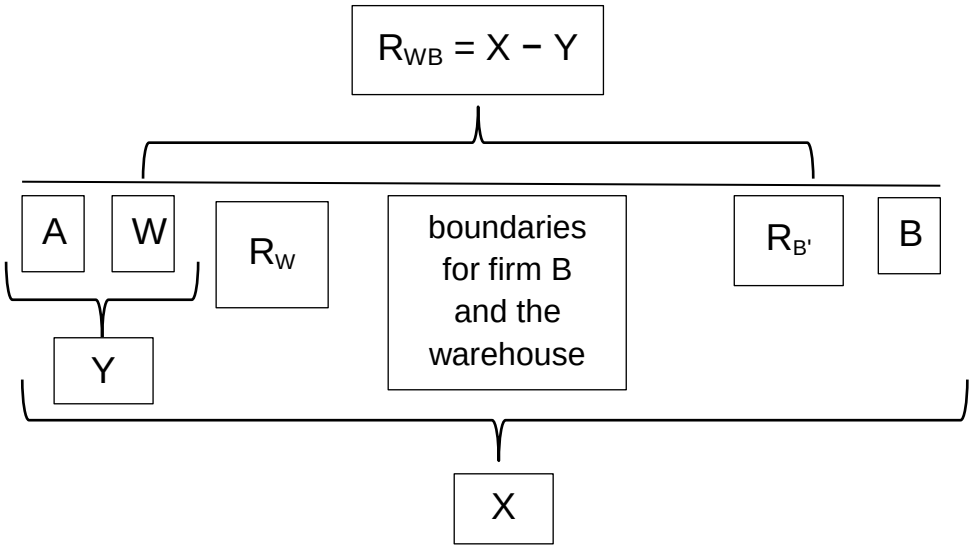


Fig. 7.2. **The distance between firm B and the warehouse** (developed by the author)

From the condition $P_W = P_B$ it follows:

$$(C_W + C_A) + T_W \times (R_{WB} - R_{B'}) = C_B + T_B \times R_{B'}. \quad (7.10)$$

Therefore:

$$R_{B'} = (C_W + C_A + T_W \times R_{WB} - C_B) / (T_B + T_W) \text{ km}, \quad (7.11)$$

$$R_W = R_{WB} - R_{B'} \text{ km}. \quad (7.12)$$

Therefore:

$$R_{A'} = R_{AW} + R_W \text{ km}. \quad (7.13)$$

The expansion of the market boundaries for firm A was:

$$S_A = R_{A'} - R_A \text{ km}. \quad (7.14)$$

The reduction of the market boundaries for firm B was:

$$S_B = R_B - S_A. \quad (7.15)$$

Task 1. Manufacturer A, producing tableware, is located at a distance of 550 km from company B, which sells similar products. Both companies set their production costs at 24 UAH, and the tariff for transporting products to outlets is 2.4 UAH / km per product unit. To expand the market, company A decided to use a warehouse located at a distance of 240 km from the production plant. The costs associated with the operation of the warehouse are 8 UAH per product unit. How will the use of the warehouse change the boundaries of the market for each firm?

Theme 8. Logistics approach to customer service

Practical lesson 5. Determination of the level of logistics service

Guidelines to tasks 1 – 2

The main criterion for evaluating the service system, both from the position of the supplier and the recipient of services, is the level of logistics service.

The level of logistics services is a quantitative characteristic of the correspondence between the actual values of the quality indicators and the quantity of logistics services to the optimal or theoretically possible values of these indicators.

The calculation of this indicator is performed according to the following formula:

$$ή = m / M, \quad (8.1)$$

where ή is the level of logistics service;

m is quantitative assessment of the theoretically possible volume of logistics services;

M is quantitative assessment of the volume of logistics services actually provided.

The level of service can also be assessed by comparing the time for the implementation of logistics services actually provided during the delivery process with the time that would have to be spent to provide the entire range of possible services in the process of the same delivery.

The calculation is made according to the following formula:

$$ή = \frac{\sum_1^n t_i}{\sum_1^N t_i}, \quad (8.2)$$

where n is the number of services that can theoretically be provided;

t_i is the actual number of services provided;

N is time to perform the i-th service.

Thus, $\sum_1^n t_i$ is the total time actually spent on the provision of services; $\sum_1^N t_i$ is the time that theoretically can be spent on the completed entire range of services.

Task 1. The retailer sells computer accessories. The total range of components for computers of this brand includes 20 types, of which 10 types are constantly available at the enterprise. Calculate the level of service of the enterprise.

Task 2. Table 8.1 gives a general list of services that a firm can provide in the process of selling its products, as well as the time required to provide each individual service. However, in fact, the company provides only services No. 1, 3, 7, 8, 10. Calculate the level of service of the enterprise.

Table 8.1

The list of services that the firm can potentially provide

Service number	The time required to provide the service, person × hour
1	5
2	2
3	9
4	3.5
5	0.5
6	6
7	4
8	7
9	1
10	8

Theme 9. Warehouses and transportation in logistics

Laboratory work 5. Determining the location of the distribution center

Guidelines to task 1

There are three basic alternatives for location. First, a facility can be located near to customers; this gives good customer service and low costs for transporting out to customers, but high cost for transporting in from suppliers. Second, it can be located near to suppliers; this moves products quickly into the supply chain, gives low costs for inward transportation, but high costs for outward transportation. Third, it can be located at some point between suppliers and customers, giving a compromise with reasonable service and lower costs (Fig. 9.1).

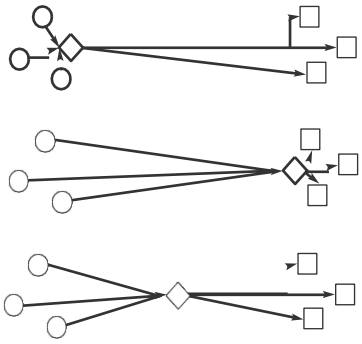


Fig. 9.1. **Alternative choices of location**

A simple way of finding the best compromise location calculates the centre of gravity of supply and demand. The co-ordinates of the centre of gravity are:

$$x_0 = \frac{\sum (x_i \times W_i)}{\sum W_i}; \tag{9.1}$$

$$y_0 = \frac{\sum (y_i \times W_i)}{\sum W_i}, \tag{9.2}$$

where x_0, y_0 are the coordinates of the centre of gravity which gives the facility location;

x_i, y_i are coordinates of each customer and supplier;

W_i is the expected customer demand, or expected supply from the supplier.

Task 1. Van Hendrick Industries is building a central logistics centre that will collect components from three suppliers, and send finished goods to six regional warehouses. The locations of these and the amounts supplied or demanded are shown in the Table 9.1. Where should they start looking for a site?

Table 9.1

The locations of the suppliers, regional warehouses and the amounts supplied or demanded

Location	X, Y coordinates	Supply or demand
Supplier 1	91.8	40
Supplier 2	93.35	60
Supplier 3	3.86	80
Warehouse 1	83.26	24
Warehouse 2	89.54	16
Warehouse 3	63.87	22
Warehouse 4	11.85	38
Warehouse 5	9.16	52
Warehouse 6	44.48	28

Guidelines to task 2

This is a single median problem, so we start with a matrix showing the minimum distances between each town, as shown in Fig. 9.2 [2]. This matrix also shows the weight to be moved in column B. If we take one column, say C, this shows the distance from a center located in AL to each other town. If we multiply this distance by the corresponding weight in column B, we get the weight-distance for each town. Then adding these down the column gives the total weight-distance for a logistics center in AL.

Repeating this calculation for each of the other towns allows us to compare the costs and to find the town which has the lowest total cost (Table 9.2) [2].

Table 9.2

Calculation to find the town which has the lowest total cost

	A	B	C	D	E	F	G	H	I	J
1										
2		Weight	AL	BE	CP	DI	EN	FR	GO	HT
3	AL									
4	BE									
5	CP									
6	DI									
7	EN									
8	FR									
9	GO									
10	HT									
11										
12	Totals									

Task 2. Van Ian Bruce delivers goods to eight towns, with locations and demands as shown in Fig. 9.2. He wants to find the location for a logistics centre that minimises the average delivery time to these towns. Where should he start looking?

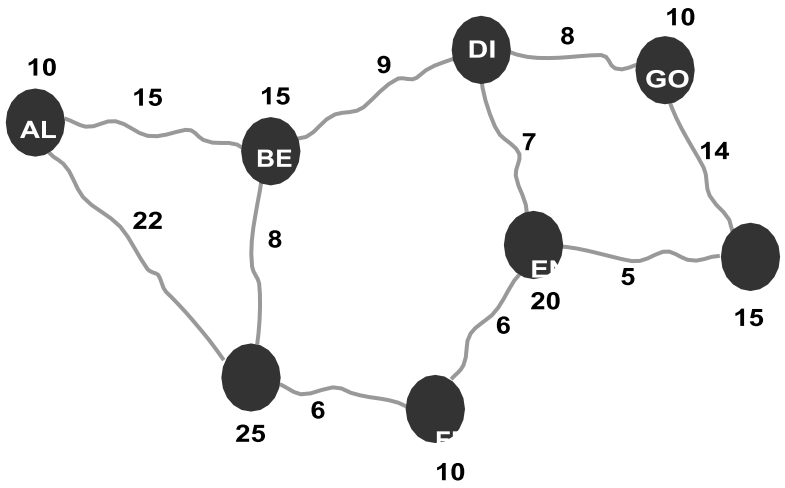


Fig. 9.2. **Towns, with locations and demands**

Guidelines to task 3

The criterion for choosing a distribution system is the criterion of the minimum reduced costs, i.e. costs reduced to a single annual measurement.

The value of these costs is determined by the following formula:

$$C_n = \sum CE_i + C / T, \quad (9.3)$$

where C_n is reduced costs of the option;

i is cost items (i = 1 ... m);

m is the number of cost items taken into account;

CE_1 is annual operating costs;

CE_2 is annual transport costs;

CE_3 is annual costs of warehouse system management;

CE_4 is annual costs of maintaining stocks;

CE_5 is other costs and losses associated with the operation of the logistics system and taken into account when deciding to create a warehousing subsystem;

C is full capital investments in construction and equipment of warehouses, given based on the time factor – at the discount rate;

T is the payback period of the option.

For implementation, the option of the logistics system that provides the minimum value of the reduced (annual) costs is taken.

Task 3. A company analysed three options of distribution systems A, B, C and obtained the information about each system, which is given in the Table 9.3.

Table 9.3

The initial data

Indicator	Distribution system		
	A	B	C
Annual operating costs, UAH	6 500	5 000	7 500
Annual transport costs, UAH	7 005	5 450	5 570
Capital investments in the construction of the center, UAH	96 700	85 670	93 600
Payback period of the system, years	7.5	7.1	7.2

Provide your recommendations to the company's management on the implementation of the distribution system of the three proposed.

Practical lesson 6. Determination of transport performance indicators

Guidelines to tasks 1 – 2

Utilization rate of the car mileage per day is determined by the following formula:

$$\beta m = \frac{ler}{ler + lid + lz}, \quad (9.4)$$

where βm is the car mileage utilization factor;

ler is mileage with cargo, km;

lid is idling mileage, km;

lz is Zero mileage.

The static coefficient is determined by the following formula:

$$Yst = Q / q, \quad (9.5)$$

where Q is the actual weight of the transported cargo, tons;

q is car capacity, tons.

The dynamic coefficient per shift is determined by the following formula:

$$Yd = \frac{\sum_1^n (Q_i \times L_i)}{q \times \sum_1^n L_i}, \quad (9.6)$$

where L_i is the distance over which the cargo was transported, km.

Task 1. A car made four rides a day. The initial data (the number of the ride is mileage with cargo, km – idling mileage, km): 1 – 25 – 10; 2 – 30 – 20; 3 – 30 – 15; 4 – 60 – 25. Zero mileage: the first is 10 km, the second is 15 km. Determine: the total mileage of the car per day, the utilization rate of the car mileage per day and for each ride.

Task 2. A car with a capacity of 7 tons made three trips: in the first trip it transported (Q1) 5 tons over 30 km, for the second one (Q2) – 3 over a distance of 15 km, in the third ride (Q3) – 3 tons over a distance of 10 km. Determine the static coefficient for each ride, static and dynamic coefficients per shift.

Laboratory work 6. Making a decision on the use of a rented warehouse

Guidelines

The purpose of the work is to study the method of calculating the turnover, in which a wholesale company does not care whether to have its own warehouse or use a rented warehouse (Break-even analysis for public/private warehouses). Solving the task includes the following steps:

1. Determining the cost of keeping in its own warehouse:

$$F_3 = F_1 + F_2 = f_1 \times T + F_2, \quad (9.7)$$

where F_3 is the cost of storage in the company's own warehouse, USD / year;

F_1 is the variable of cargo handling in the company's own warehouse, USD / year;

F_2 is fixed costs of its own warehouse, USD / year;

f_1 is variable cost of cargo processing per 1 ton in its own warehouse, USD / t;

T is cargo turnover, t / year.

2. Determining the cost of storage in a rented warehouse:

$$Z = \alpha \times S_H \times 365, \quad (9.8)$$

where Z is the cost of storage in a rented warehouse, USD / year;

α is the tariff for the services of a rented warehouse, USD for 1 m^2 per day;

S_H is the required area of a hired warehouse, m^2:

$$S_H = \frac{S \times T}{D \times n}, \quad (9.9)$$

where S is the amount of stock in the days of circulation, days;

D is the number of working days per year, days;

n is the load on the 1 m^2 area when stored in a rented warehouse, t / m^2.

3. The results of the calculations for different volumes of the warehouse's annual cargo turnover are listed in Table 9.4.

Table 9.4

The results of the calculation of the storage costs

Indicator	The value of the indicator is different cargo turnover (T, t / year)				
	1000	3000	5000	7000	9000
1. The cost of cargo handling in its own warehouse (F1)					
2. The cost of storage in its own warehouse (F3)					
3. Required area of a hired warehouse (S_H)					
4. The cost of storage in a rented warehouse (Z)					

4. Building a graph of costs (Fig. 9.3). Determining the area of expediency of using their own or rented warehouses depending on the annual cargo turnover.

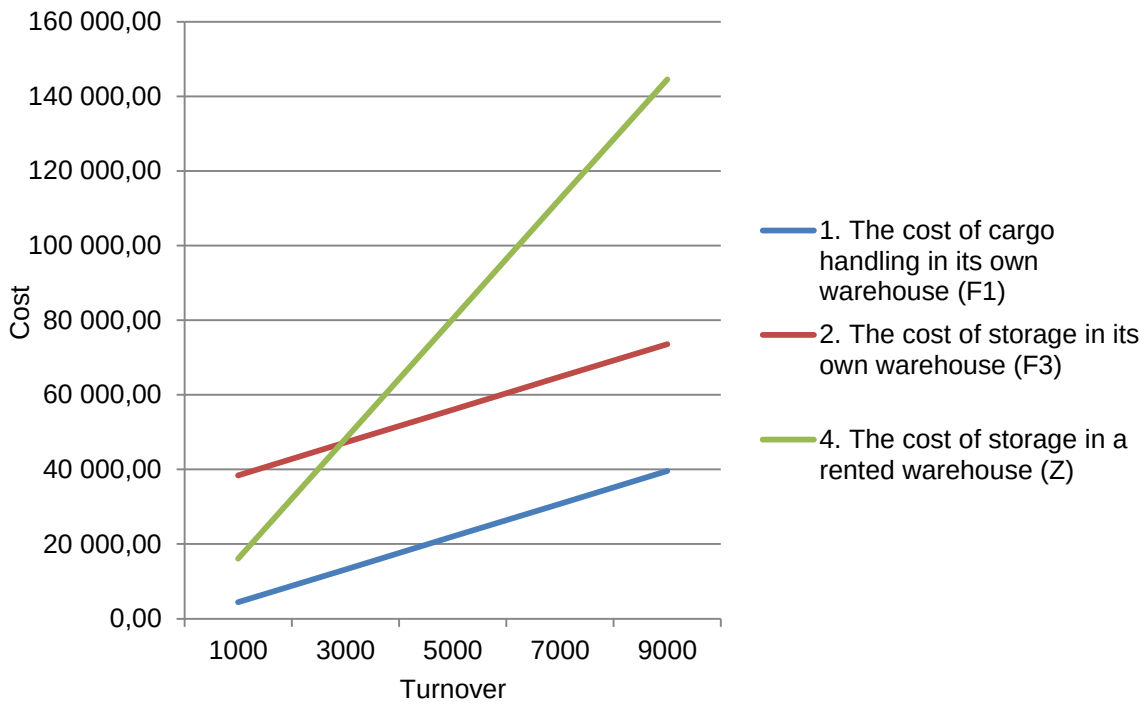


Fig. 9.3. **Graphical presentation of the turnover of "indifference" (Break-even Point)**

5. Derivation of the formula of cargo turnover "indifference" (Break-even Point) is based on the fact that the turnover of "indifference" is the point where the cost of storage in their own and rented warehouses intersect.

Task 1. Make a decision on the use of a rented warehouse based on the initial data. Calculate the freight turnover of indifference graphically and analytically. Give a graphical interpretation. Use Table 9.5.

Table 9.5

Output data [2]

Indicator	Dimensionality	Value
1. The variable cost of cargo handling in its own warehouse (f1)	USD / t	4.4
2. Conditional fixed costs of its own warehouse (F2)	USD / year	34 000
3. Tariff for the services of the rented warehouse (a)	USD for 1 m^2 per day	0.4
4. The amount of stock in the days of circulation (S)	days	64
5. Number of working days per year (D)	days	280
6. Load on the 1 m^2 area when stored in a rented warehouse (n)	t / m^2	2.1

Tasks for independent work

Test tasks

1. Choose the definition that best reflects the concept of procurement logistics:

a) one of the functional subsystems of the organization's logistics;

b) management of material flows and services in the process of providing the organization with material resources and services;

c) management of the material and technical support of the enterprise;

d) applied science about the management of material flows in the process of material and technical support of production;

e) a set of interrelated operations for managing material flows in the process of bringing finished products to the consumer.

2. List the main tasks solved by procurement logistics:

a) establishing a reliable and continuous material flow to ensure the smooth functioning of the organization;

b) coordination and alignment of supply and demand in supply and distribution through the creation of insurance and seasonal stocks;

c) support and improvement of the quality of purchased material resources;

d) answers a, c are correct;

e) all answers are correct.

3. Procurement logistics tasks do not include:

a) adherence to reasonable terms for the purchase of raw materials, materials and components;

b) ensuring the exact correspondence of the number of supplies to the needs for them;

c) compliance with production requirements for the quality of raw materials, materials and components;

d) creation of the maximum seasonal stock of material resources in the supply sector.

4. The functions of procurement logistics do not include:

a) formation of a strategy for the acquisition of material resources and forecasting the need for them;

b) reduction of the production cycle;

c) receiving and evaluating proposals from potential suppliers;

d) selection of suppliers;

e) determining the needs for material resources and calculating the amount of ordered materials and products;

f) negotiation over the price of the ordered resources and the conclusion of supply contracts;

g) control over the timing of delivery of materials.

5. Choose the definition that best reflects the concept of production logistics:

a) science and practice of progressive forms and methods of organizing production and logistics activities;

b) science and practice of systemic management of streaming processes in organizational and economic systems;

c) one of the functional subsystems of the company's logistics;

d) regulation of the production process in space and time;

e) planning, organization of material and related flows and their management.

6. What is the finished product for an industrial enterprise:

a) a part;

b) a product;

c) accessories?

7. The requirements of the modern organization as to the movement of material flows in production do not include:

a) ensuring rhythmic, coordinated work of all production links according to a single schedule and uniform production;

b) ensuring maximum continuity of the production process;

c) securing more orders of finished products from the consumer.

8. The main scheduling standards for organizing the production process in time are not:

a) the duration of the production cycle of the part;

b) the standard size of the batch of parts;

c) the size of stocks of material resources in the supply sector;

d) the duration of the production cycle of manufacturing the product.

9. Are the semantics of the terms "sales", "distribution" and "realization" different:

a) no, the listed terms are synonymous;

b) only the terms "sales" and "distribution" are different;

c) only the terms "sales" and "realization" differ;

d) only the terms "distribution" and "realization" differ;

e) yes, and essential?

10. What is the object of study of sales logistics:

a) material and accompanying (generated) information, financial and service flows;

b) material flow;

c) information and service flows;

d) material and financial flows;

e) organization and management of the rational process of promoting products from the producer to the end consumer?

11. The tasks of sales logistics, solved at the micro level, do not include:

a) planning the implementation process;

b) organization of product shipment;

c) control over transportation to the place of consumption and delivery of products to the consumer;

d) drawing up plans for production and supply of material resources;

e) organization of after-sales service.

12. The tasks of sales logistics at the macro level do not include:

a) selection of a material flow distribution scheme;

b) management of insurance stocks of finished products;

c) formation of distribution channels;

d) placement of distribution centers.

13. A distribution channel is:

a) a set of organizations or individuals that take over or help transfer to some other the ownership of a particular product or service on the way from the manufacturer to the consumer;

b) the physical environment of interaction between retailers and wholesalers;

c) a set of departments of an organization involved in logistics activities.

14. Material stocks in logistics are:

a) material values awaiting production or personal consumption;

b) material values in the warehouses of an enterprise;

c) material, financial and other values awaiting production or personal consumption;

d) material values awaiting product consumption.

15. Inventory management in the logistics system occurs:

a) at the stage of supplying production;

b) in the main production;

c) at the stage of distribution of finished products;

d) throughout the logistics chain, except for production;
e) throughout the supply chain.

16. The main goal of inventory management in the logistics system is:
a) reduction in stocks;
b) minimization of inventory management costs;
c) prevention of a shortage of production;
d) providing a high level of service;
e) reduction of the amount of inventory in transit.

17. What are the main types of commodity stocks in logistics:
a) sales stocks and stocks in transit;
b) commodity stocks in trade;
c) sales stocks, trade stocks and stocks in transit?

18. What are the main reasons for creating stocks:
a) increasing the ability to serve customers;
b) reducing the costs associated with placing orders;
c) increasing the ability of the enterprise to withstand violations of the established delivery schedule;
d) reduction of losses from production downtime arising from the lack of spare parts;
e) all answers are correct?

19. The optimal order size depends on:
a) delivery time;
b) the cost of supplying products;
c) needs for the ordered product;
d) costs of storing stocks;
e) the maximum desired volume of stocks.

20. Transport in logistics is:
a) the branch of material production carrying out the transportation of people and goods;
b) the sphere of providing material services;
c) one of the most costly functional subsystems of an enterprise;
d) a separate subsystem that requires increased attention from management.

21. Cargo transportation in the logistics system occurs:

a) at the stage of supplying production;

b) in the main production;

c) at the stage of distribution of finished products;

d) throughout the logistics chain, except for production;

e) throughout the supply chain.

Recommended reading

Main

1. Kachru U. Logistics and Supply Chain Management / Upendra Kachru. – New Delhi : Excel Books Private Limited. – 2013. – 337 p.

2. Supply Chain Logistics Management / D. J. Bowersox, D. J. Closs, M. B. Cooper, J. C. Bowersox. – 4th ed. – New York, NY : McGraw-Hill, 2013. – 678 p.

3. Supply Chain Management: a Logistics Perspective / John J. Coyle Jr., C. John Langley, Robert A. Novack, Brian J. Gibson. – Boston, USA : Cengage Learning, 2016. – 639 p.

Additional

4. Professional English. Logistics : навч. посіб. / О. М. Акмалдінова, З. Ю. Мазуренко, Л. В. Кучерява, І. С. Козелецька. – Київ : НАУ, 2015. – 416 с.

5. Rushton A. The handbook of logistics and distribution management: understanding the supply chain / Alan Rushton, Phil Croucher, Peter Baker. – Revised edition of The handbook of logistics & distribution management, 5th ed. – London : Kogan Page, 2014. – 690 p.

Information resources

6. ULA Ukrainian Logistics Alliance [Electronic resource]. – Access mode : http://ula-online.org/ua.

7. ELA, the European Logistics Association [Electronic resource]. – Access mode : http://www.elalog.eu.

8. Logistics / S. Kuznets KhNUE PNC. – Access mode : https://pns.hneu.edu.ua/course/view.php?id=4680.

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НАВЧАЛЬНЕ ВИДАННЯ

ЛОГІСТИКА

Методичні рекомендації до практичних завдань, лабораторних робіт та самостійної роботи
студентів спеціальності 073 "Менеджмент" освітньої програми "Логістика" першого (бакалаврського) рівня
(англійською мовою)

Самостійне електронне текстове мережеве видання

Укладач **Колодізєва** Тетяна Олександрівна

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Коректор *З. В. Зобова*

Подано завдання для практичних, лабораторних занять і самостійної роботи студентів із навчальної дисципліни, методичні рекомендації та порядок виконання завдань.

Рекомендовано для студентів першого (бакалаврського) рівня спеціальності 073 "Менеджмент" освітньої програми "Логістика".

План 2023 р. Поз. № 83 ЕВ. Обсяг 47 с.

Видавець і виготовлювач – ХНЕУ ім. С. Кузнеця, 61166, м. Харків, просп. Науки, 9-А

Свідоцтво про внесення суб'єкта видавничої справи до Державного реєстру ***ДК № 4853 від 20.02.2015 р.***