

M.Ye. Zhukovsky National Aerospace University “Kharkiv Aviation Institute”

**CALCULATION OF ECONOMIC INDICATORS FOR MACHINE-BUILDING
ENTERPRISES**

Tutorial

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E45

Розглянуто методику виконання розрахункової роботи з найважливіших розділів курсу економіки підприємства. Основну увагу приділено розрахунку потреби в ресурсах і методичним підходам до визначення витрат і формування ціни продукції.

Для іноземних студентів, що вивчають курс «Economics of Enterprise» англійською мовою.

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Tutorial gives methodology for performing calculation paper including the most important topics of Economics of Enterprise. The main focus is given to the calculation of resource requirements and methodological approaches to determining costs and formation of the products prices.

It is prepared for foreign students studying the course "Economics of Enterprise" in English.

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Introduction

Economy covers all aspects of human life associated with satisfaction of all needs. People need food, clothing, shelter to maintain the standard of living, support a family, bring up children. These items are vital and are produced at industrial enterprises, agricultural and construction companies with the participation of transport and communication companies. Therefore, by knowing the economics of enterprises which create main products for the society, we understand current economic processes.

In reality, the economy that is detached from material production does not exist. A particular economic process that does not follow the requirements of material production and does not take into account the demand for its products is going the wrong way. In order to avoid such a mistake while coming up with ideas and implementing business decisions, we need to study the performance indicators of an enterprise.

Under market conditions, the essence of economic activity lies in the main link of the entire economy — enterprise. It is at this level that the products needed by the society are created and necessary services are provided. At enterprises the most qualified personnel work, decisions on the use of high-performance equipment and advanced technology are made, business plans are developed, marketing, effective management is carried out. In a market economy, only those enterprises survive that quickly adapt to market requirements. They create and organise the production of goods that are in demand, because it can ensure high incomes to their employees. All this requires deep economic knowledge.

This tutorial was made to clarify how to do calculation paper which is intended to master the basic concepts of “Economics of Enterprise” course.

1. GENERAL ECONOMIC CONCEPTS

1.1. Resources, Property and Capital of Enterprises

For conducting a business, any enterprise needs a certain amount of **economic resources** or, in economic terms, **factors of production**. Factors of production include land, labour, capital and entrepreneurial ability, — these are general inputs used to produce goods and services to make a profit. Generally, they mean the following:

- **land** (land itself, minerals, water, timber, coal);
- **labour** (all workers who do physical or intellectual work to keep a business running). There's also intellectual (human) capital and social capital (social laws and norms that contribute to business environment);
- **capital** (buildings, machines and tools, delivery trucks, computer, copying machine etc.);
- **entrepreneurial ability** (entrepreneurship) combines all these factors.

Generally, economic resources for enterprises include the **cost of capital** (property) and **human resources** (human capital/employees). As a result of investment, *capital* means goods that can help produce other goods. Unlike land or labour, it is created by human hands and for human purposes. This means that time has to be invested into capital before it can become useful. Invested capital is the total value of economic **assets** of the company. This is all the funds, in the form of equities or loans, invested into enterprise. Assets represent the property of enterprise in monetary assessment. Operating assets of the company, as a result of capital investment into the production, include:

- **fixed assets** which in material form are the **means of labour** (equipment, tools, building etc.);

- **circulating assets** (working capital) necessary for the capital turnover. That is: cash and **objects of labour** (raw materials, fuel, details, etc.).

To start the business, any enterprise needs the initial amount of capital invested into operating assets (means of labour, objects of labour, cash) and personnel — workers, engineers, managers, lawyers, economists. All general and special skills, education, work experience and skills gained are collectively called **human capital**. The value of human capital is constantly increasing in developing modern economy. Enterprises developing their business under competition understand the value of investing into human resources — education, professional training and improvement of working conditions and social securities for the staff.

Moreover, economic resources have a special property — to create value and generate revenue. The potential success of a business lies within these resources being used effectively. In this regard, one of the most important tasks of enterprise's **management** is to create the conditions for effective use of these resources.

Competition makes companies do their best to meet the growing needs of consumers of goods and services. It encourages companies to introduce scientific and technological achievements, innovative methods of organising production and labour, — all of which reduce the costs of production, improve the quality of products and services, and expand the market. Companies with high economic potential have modern fixed assets, qualified personnel, effectively manage fixed and working capital — these are the enterprises which have the competitive advantages.

1.2. General Description of Enterprise's Assets

Material and technical resources of any enterprise consist of (1) **means (instruments) of labour** and (2) **objects of labour**, which together form the concept of **forces of production**.

(1) Means of labour include tools and machinery (the "instruments of production"), as well as buildings and land used for production purposes.

(2) The objects of labour may be materials provided directly by nature like timber or coal, or materials that have been modified by the labour.

Means of labour and objects of labour reflect the main **fixed and circulating assets**. The way they are divided is as follows:

- *the main production assets* (which are fixed) are involved in many production cycles and their value is partially transferred to the final product during the period of their service (f.e. a machinery which is used for 6 years — its value is not reimbursed after the first batch of product sold, the value is gradually accumulated in **depreciation** fund);

- *the circulating production assets* are fully involved (physically and by cost) in only one production cycle as they transform into the final product.

After selling the product the cost of fixed assets is partially reimbursed and accumulated according to the rate of depreciation. Fixed assets provide long-term income, losing value as they age. That is why these assets are expensed differently than other items. They are subject to periodic depreciation: asset's value decreases along with its depreciation amount on the company's balance sheet. Usually fixed assets have a useful life greater than one year. Therefore, fixed assets can be completely replaced only after their cost has been completely transferred to the cost of output. Buildings, real estate, equipment and furniture are good examples of those.

The cost of circulating capital is reimbursed immediately after the sale is completed. It allows firms to buy materials again to use in a new production cycle.

Information about a company's assets helps create accurate financial reporting, business valuation and thorough financial analysis. Investors use these reports to determine a company's financial health and decide whether to buy shares in or lend money to the business. Because a company may use a range of accepted methods for recording, depreciating and disposing of its assets, analysts need to study the notes on the corporation's financial statements to find out how the numbers were determined.

Effectiveness of economic activity of an enterprise depends on many economic, organisational, managerial and other factors. One of the main factors affecting profitability of a business are fixed assets: their composition and volume, their ability to perform tasks of making a product of appropriate quality, in the right amount, within required time and at the lowest cost.

The costs for acquiring fixed assets (and their maintenance in the future) reach large sums of money that later should be justified by the return that the company will receive from producing and selling the product.

2. CALCULATION PAPER PURPOSE

The main purpose of the calculation paper is to practice and implement a set of calculations to justify economically enterprise's production plan. It is assumed to be a machine-building enterprise that performs mechanical assembly of components for the main products. Its output consists of assembled items aimed for further production.

The explanatory note has the following structure:

Introduction

1. Determining initial value of fixed assets
2. Determining number of employees by categories
3. Determining average monthly salary by categories of employees.
4. Calculating general production costs of enterprise
5. Determining production cost per unit
6. Determining total cost per unit

7. Determining break-even output
8. Calculating the amount of working capital
9. General economic indicators of the enterprise

Conclusion

Bibliography

3. CALCULATION PAPER TASK

1. Enterprise performs mechanical assembly and manufacture of components for the main products.
2. Annual product output plan: _____ pieces.
3. Enterprise operates in two shifts.
4. Duration of the production cycle: _____ h.
5. Units of measure for equipment and technical process:
 - Labour intensity per unit of output in normative-hours
 - Electric power (per unit of equipment) in kW
 - Repair complexity (per unit of equipment) in units of repair complexity
 - Price of equipment (per unit of equipment) in UAH.

All the initial data is given in Tables 3.1, 3.2.

Table 3.1

Main Equipment and Technological Process Data

Equipment name	Labour intensity L_i	Type of work W_i	Electric power E_i	Repair complexity RC_i	Equipment price EP_i
Drilling machine					
Lathe					
Milling machine					
Assembly workbench					
Test installation					

Table 3.2

Additional Data

Name of indicator	Symbol	Value
Technically unavoidable losses,%	UL	
Standard of expenses for transportation and installation of equipment, %	ETI	
Normative rate of extra salaries for the main staff , %	NEMS	
Normative rate of extra salaries for the additional staff, %	NEAS	
Normative rate of extra salaries for service staff, %	NESS	
Standard unified social tax, %	UST	
Weight of blank parts, kg	WB	
Coefficient of load of the main equipment, %	C_{LOAD}	
Average cost of consumable materials (CC) _____ UAH/kg.	CC	
Standard costs for assembly preparation and testing,%	CAP	
Standard costs of transport and procurement ,%	CTP	
Normative rate for administrative expenses, %.	NAC	
Normative rate for marketing and sales expenses, %.	NMS	

4. METHODOLOGICAL GUIDELINES FOR COMPLETING CALCULATION PAPER

4.1. Determining Initial Value of Fixed Assets

4.1.1. Determining Technical and Economic Parameters of Main Equipment

Annual program for launching production is calculated as follows:

$$AP = Q \times (1 + UL / 100), \quad (4.1)$$

where **Q** — quantity of output for annual program, pcs.;

UL — technically unavoidable losses, % (see Table. 3.2).

Annual labour intensity of the product according to the equipment's number (X_i) is determined by the formula:

$$AL_i = T_i \times AP, \quad (4.2)$$

where **T_i** — is the labour intensity for i-equipment for the product, normative hours;

AP— annual output program, pcs.

Annual labour intensity of the product for all types of equipment together:

$$ALE = AL_1 + AL_2 + AL_3 + AL_4 + AL_5, \quad (4.3)$$

Estimated number of equipment for each operation is given as:

$$NEO_i = AL_i / (RTOE_i \times CL_i \times NEW_i), \quad (4.4)$$

where **AL_i** — annual labour intensity for each operation, normative-hours;

RTOE_i — annual real time of equipment operation (for each type of operation);

CL_i — coefficient of workload performance for each type of operation (is given as 1.1);

NEW_i — the number of workers simultaneously working on this equipment (we take it as 1 in these calculations).

The accepted amount of the main equipment would be rounded to a whole number. So that, for example, if the number turns out to be 75.3 pcs., we round it to bigger number = 76 pcs.

The coefficient of load for the main equipment is determined by dividing the estimated number of equipment by the rounded number of equipment:

$$\mathbf{Cload}_i = \mathbf{NEO}_i / \mathbf{RNEO}_i \quad (4.5)$$

After all the calculations the student should submit a summary of all economic indicators of the enterprise in Table 4.1.

Table 4.1

Number of main equipment

Name of equipment	Annual labour intensity AL_i	Annual time RTOE_i	Number of main equipment		Coefficient of load for the main equipment Cload_i
			NEO_i	RNEO_i	
Drilling machine		4015			
Lathe		4015			
Milling machine		4015			
Assembly workbench		4140			
Test installation		3800			
Total		X			X

For the received amount of equipment, it is necessary to calculate total consumed power of the equipment (**TE**), total repair complexity (**TRC**) and total cost of equipment (**TEC**):

$$\mathbf{TE} = \mathbf{E}_1 \times \mathbf{EQ}_1 + \mathbf{E}_2 \times \mathbf{EQ}_2 + \mathbf{E}_3 \times \mathbf{EQ}_3 + \mathbf{E}_4 \times \mathbf{EQ}_4 + \mathbf{E}_5 \times \mathbf{EQ}_5 \quad (4.6)$$

$$\mathbf{TRC} = \mathbf{RC}_1 \times \mathbf{EQ}_1 + \mathbf{RC}_2 \times \mathbf{EQ}_2 + \mathbf{RC}_3 \times \mathbf{EQ}_3 + \mathbf{RC}_4 \times \mathbf{EQ}_4 + \mathbf{RC}_5 \times \mathbf{EQ}_5 \quad (4.7)$$

$$\mathbf{TEC} = \mathbf{EC}_1 \times \mathbf{EQ}_1 + \mathbf{EC}_2 \times \mathbf{EQ}_2 + \mathbf{EC}_3 \times \mathbf{EQ}_3 + \mathbf{EC}_4 \times \mathbf{EQ}_4 + \mathbf{EC}_5 \times \mathbf{EQ}_5, \quad (4.8)$$

where **E**₁, **E**₂, **E**₃, **E**₄, **E**₅ — consumed electrical power (see Table 3.1);

RC₁, **RC**₂, **RC**₃, **RC**₄, **RC**₅ — repair complexity (see Table. 3.1);

EC₁, **EC**₂, **EC**₃, **EC**₄, **EC**₅ — the cost of equipment (see Table. 3.1);

EQ₁, **EQ**₂, **EQ**₃, **EQ**₄, **EQ**₅ — the accepted quantity of equipment (see Table. 4.1.).

4.1.2. Determining Initial Value of Fixed Assets

When performing calculation paper, the main means of production are divided into four groups: buildings and structures; working machines and equipment; measuring instruments; tools and inventory.

The cost of building is determined by the space of the premises for particular purpose and the cost of 1 m³:

$$\mathbf{CB} = \mathbf{SP} \times \mathbf{C}_{\text{PROD}} + \mathbf{SA} \times \mathbf{C}_{\text{EXT}}, \quad (4.9)$$

where **SP** — the space of production building, where production, auxiliary and storage facilities are located, m³;

SA — the space where offices, other premises, departments and services are located, m³;

C_{PROD} — the cost of 1 m³ of the production building (200 UAH/m³);

C_{EXT} — the cost of 1 m³ building extension (350 UAH/m³).

Thus, the entire area of the enterprise in its purpose is divided into: production, extension, warehouse, office-household etc.

Production areas — are areas where the products are manufactured or assembled, including check areas, loading areas, driveways and passageways intended for the movement of workers and transport.

When planning enterprise facilities, the production area is preliminarily determined according to the norms for specific areas per unit of equipment or per workplace. In the calculation paper, the standard of production area is taken as 15 m² per unit of main equipment. When implementing the layout of the enterprise, the production area is customised by taking into account all the necessary space for passages, safety zones, driveways and storage areas.

Auxiliary area — is the area of the sections intended for equipment repair, repair and tool manufacturing (workshop, workshop mechanic shop, electrical workshop).

Warehouse area — is the area of all storages and production warehouses, intended for storage and delivery of materials, semi-finished products, tools, appliances.

Offices and facilities — are the areas of offices, dressing rooms, washrooms, showers, toilets.

Other areas — are the areas of halls, staircases, ventilation chambers.

When performing calculation paper, the layout of the production workshop and areas is made, therefore, auxiliary, storage, office and household areas and other areas can be calculated as standard percentage from the production area through coefficient. On average, for enterprises employing up to 400 people, auxiliary area is 15%, storage area is 15%, office area is 35% and other areas are 10%.

The results of calculating the workshop spaces and the cost of building for the enterprise are presented in Table. 4.2.

Table 4.2

Calculating the Cost of Building

Area type	$C_{aux}, \%$	S, m^2	h, m	$V=S \times h, m^3$	CB, UAH
Production	X		8		
Auxiliary			8		
Warehouse			8		
Office			3		
Other			6		
Total	X		X		

The costs of acquiring the main equipment of the workshop were determined earlier (see formula 4.8). The costs of transportation and installation of equipment is added to this cost, in order to obtain the full cost of equipment:

$$FCE = TEC \times (1 + ETI / 100), \quad (4.10)$$

where **ETI** — (see Table 3.2).

In addition to the main technological equipment, the company has other equipment. In the calculation paper, the cost of this equipment can be taken as a percentage of the cost of the main equipment like (K_{eq}): vehicles — 10%, measuring instruments — 5%, tools and devices — 10%, production and household equipment — 2%.

4.1.3. Calculation of Annual Depreciation Charges

When calculating enterprise's expenses, it is necessary to know the values of annual depreciation from the value of fixed assets of the enterprise. Data on fixed assets and depreciation from this value is recorded in Table. 4.3.

Table 4.3

Cost of Fixed Assets and Annual Depreciation

Asset groups	K _{eq} , %	Price, UAH	Depreciation rate, %	Annual depreciation, UAH
Building	X		5	
Equipment	X		15	
Means of transport	10		20	
Measuring instruments	5		25	
Tools and accessories	10		25	
Production and household equipment	2		25	
Total	X		X	

4.2. Determining Number of Employees by Categories

The following workers belong to the industrial and production personnel of the enterprise: production (main) and secondary workers, specialists (engineering and technical workers), employees, junior maintenance personnel.

The quantity of production (main) workers is calculated by types of workplaces, taking into account the annual labour intensity of work at these locations:

$$QPW = AL_i / (LT_i \times C_{PERF}), \quad (4.11)$$

where AL_i – annual labour intensity of each operation (see Table. 4.1);

LT_i — real annual working time (1800 h.);

C_{PERF} — the coefficient of performance (production rate) ($C_{PERF} = 1.1$).

Accepted number of workers is approximated to the whole number. The calculations for all operations are recorded in Table. 4.4.

Table 4.4

Number of Main Workers

Work place №	Annual labour intensity AL_i	Annual working time LT_i	Type of work	Number of workers	
				calculated	accepted
1		1800			
2		1800			
3		1800			
4		1800			
5		1800			
Total		X	X	X	

The number of secondary workers is calculated: according to the norms regarding the number of main workers, overall repair complexity of equipment, total consumed electric power, depending on the profession (see specifications

in Table 4.5). Using norms, determine the number of secondary workers for each profession. All the data received is recorded in Table 4.5.

Table 4.5

Number of Secondary Workers

Profession	Service rate	Value	Number of workers, per.	Rank
Controllers	20	Main Workers		5
Equipment service locksmith	120	Main Workers		4
Electricians	300	KW		5
Equipment service workers	250	Repair units		4
Tool maker	80	Main Workers		5
Tool keeper	130	Main Workers		X
Warehouse keeper	50	Main Workers		X
Work manager (distributor)	30	Main Workers		X
Transport workers	50	Main Workers		X
Workshop cleaners	60	Main Workers		X

The number of specialists, employees and junior maintenance personnel is determined by standards, the standards of control and maintenance or in percentage from the number of workers.

In Tables 4.6 and 4.7 data is provided on the number of the above-mentioned workers for the production departments of machine-building enterprises, depending on the number of main workers.

Table 4.6

Number of Specialists in Production Department

Position	Number of main workers				Salaries, UAH/month
	50	150	250	350	
Foreman	1	1	1	1	
Deputy Head of Production Planning Department	X	X	1	2	
Deputy Head of Production Department	X	X	1	2	
Head of Technical Bureau	1	1	1	1	
Head of Planning and Logistics Department	X	X	1	1	
Head of Labour and Wages Department	X	X	1	1	
Head of Quality Control	X	1	1	1	
Workshop mechanic	X	X	1	1	
Senior Controller	X	X	1	2	
Head Master	X	1	2	3	
Inspector Foreman	1	1	1	3	
Shift foreman	1	1	4	8	
Technologist	1	X	1	3	
Constructor	X	X	1	2	
Tool Foreman	X	1	1	3	
Planner	X	X	1	2	
Dispatcher	1	1	1	2	
Rate fixer	X	X	1	1	
Economist	X	X	1	1	
Equipment Foreman	X	X	1	1	
Programmer	1	1	1	2	

Table 4.7

Number of Employees and Service Workers of Production Workshop

Position	Number of main workers				Salaries, UAH / month
	50	150	250	350	
<i>Employees</i>					
Work-assignment assistant	X	X	1	1	
The accountant	1	1	1	1	
Archivist	X	X	1	1	
Supply and maintenance manager	1	1	1	1	
Secretary (referent)	1	1	1	1	
<i>Service staff</i>					
Office cleaner	1	1	1	1	

Estimated number of specialists, employees, service staff and secondary workers should be adjusted in accordance with the actual number of main workers, with the features of technological process, production structure and management scheme of the shop and the layout of the workshop itself.

Number of specialists, employees and service staff is recorded in Tables 4.6 and 4.7 and the wages for these categories of workers is then calculated.

4.3. Determining Average Monthly Salary by Categories of Employees

While calculating wages, the next structure is taken as a ground for estimation: the basic salary with extra hours pay and bonus pay, consisting of daily and monthly surcharges.

Extra hours pay is added to the basic salary and are surcharges, allocated from the salary fund, and can be of the following types: bonus from the salary fund, bonuses from the master's fund, pay for night shifts, team

management, and training of apprentices. These funds are formed in agreement with the working community of the enterprise.

Additional salary consists of daily allowances to adolescents and nursing mothers, as well as from monthly surcharges in the form of vacation pay and payment for the performance of public duties.

Basic piece-rate wage of production workers can be determined by total annual labour intensity and average hourly rate:

$$\mathbf{SMW = AL \times AHR,} \quad (4.12)$$

where **AL** — annual labour intensity of the workshop, normative hours;

AHR — the average hourly rate of the main workers, UAH/normative hours;

The average hourly rate corresponds to the average rank of work performed in the workshop. The average values can be obtained from the data in Table. 4.5. and then calculated in Table 4.8.

Table 4.8

Data for calculating the average work rank and the average hourly rate

Work rank, R	Number of workers	Hourly rate (HR), UAH/norm. hours	Calculation data	
	(QPW), person.		R x QPW	QPW x HR
3				
4				
5				
Total		X		

To fill in the Table 4.8 the required number of main workers by category is calculated from Table 4.4, and the hourly rates are taken from the appropriate handbook on wages or for a specific enterprise.

After filling in the Table 4.8, calculate the average rank of work in the shop and the average hourly rate by the following formulas:

$$A_{\text{RANK}} = \Sigma (P \times \text{QPW}) / \Sigma \text{QPW}, \quad (4.13)$$

$$A_{\text{HR}} = \Sigma (\text{QPW} \times \text{HR}) / \Sigma \text{QPW}, \quad (4.14)$$

where the numerator and denominator are taken from Table 4.8.

The average hourly rate and the average rank to an integer are not rounded and counted with two decimals after comma.

Taking into account the data of Table 2 and formula (4.10), it is possible to calculate the basic and additional salary of the main workers in the production workshop as follows:

$$\text{SMW} = \text{AL} \times \text{AHR}, \quad (4.15)$$

$$\text{ASM} = \text{SMW} \times \text{NEMS}/100, \quad (4.16)$$

where **SMW** — basic salary of production workers;

ASM — additional salary of production workers;

NEMS — see Table 3.1.

Total salary (payroll) of main production workers is:

$$\text{TSMW} = \text{SMW} + \text{ASM}, \quad (4.17)$$

where **TSMW** — is a total salary of main production workers (total expenses on salaries).

The salaries of secondary workers are determined depending on their ranks, type of payment and hours worked. Consequently, for each profession of secondary workers (see Table. 4.3) it is necessary to determine three indicators of earnings according to the following formulas:

$$\mathbf{SSW = NSW \times T_{LABOUR} \times P_{rate},} \quad (4.18)$$

$$\mathbf{ASSW = SSW \times NEAS/100,} \quad (4.19)$$

$$\mathbf{TSSW = SSW + ASSW,} \quad (4.20)$$

where T_{LABOUR} — labour time per worker in a year;

P_{rate} — payment rate per unit of time (in UAH per hour/month);

NSW — number of secondary workers in this workshop;

$NEAS$ — see Table 3.1.

If the secondary workers have a rank, then the rate of payment is taken for an hour according to the rank, and the annual operating time is 1800 hours. In the absence of rank, the rate is charged for the month in the form of salary, and the annual work time is 11 months. Hourly rates and salaries are taken from regulatory documents for machine-building enterprises.

The calculated values of the wages of the auxiliary workers are recorded in the Table. 4.9.

Labour of specialists, non-production employees and junior maintenance workers (W_{maint}) is paid by official salaries. The official salaries are given in the Table. 4.6 and 4.7. Calculations of basic, additional and general wages for the year for these categories of employees are determined as follows:

$$\mathbf{BS = NW \times 11 \times MS,} \quad (4.21)$$

$$\mathbf{AS = BS \times NESS/100,} \quad (4.22)$$

$$\mathbf{TS = BS + AS,} \quad (4.23)$$

where NW — the number of employees (specialists, non-production employees or junior maintenance workers);

MS — monthly salary;

$NESS$ — see Table 3.1.;

BS , AS , TS — are basic, additional and total salaries for the year of relevant employees.

Calculations on the number of specialists, non-production employees and junior maintenance workers, as well as their salaries are presented in Tables 4.10, 4.11, 4.12.

Average monthly salary is determined for all categories of workers in the production shop: the main workers, secondary workers, specialists, non-production employees, service staff:

$$AMS = TS / (12 \times NW), \quad (4.24)$$

where **TS** — salary for a year of corresponding category workers;

NW —number of corresponding category workers.

Table 4.9

Salary for secondary workers

№	NSW, № people	T _{LABOUR} , h/year, month/year	P _{RATE} , UAH/h, UAH/month	SSW, UAH	ASSW, UAH	TSSW, UAH
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total		X	X			

Table 4.10

Number of specialists and their salary

Position	NW, person	MS, UAH.	BS, UAH.	AS, UAH.	TS, UAH.
Foreman					
Deputy Head of Production Planning Department					
Deputy Head of Production Department					
Head of Technical Bureau					
Head of Planning and Logistics Department					
Head of Labour and Wages Department					
Head of Quality Control					
Workshop mechanic					
Senior Controller					
Head Master					
Inspector Foreman					
Shift foreman					
Technologist					
Constructor					
Tool Foreman					
Planner					
Dispatcher					
Rate fixer					
Economist					
Equipment Foreman					
Programmer					
Total		X			

Table 4.11

Number of non-production employees and their salary

Position	NW, person.	MS, UAH.	BS, UAH.	AS, UAH.	TS, UAH.
Work-assignment assistant					
The accountant					
Archivist					
Supply and maintenance manager					
Secretary (referent)					
Total		X			

Table 4.12

Number of service workers and their salary

Position	NW, person.	MS, UAH.	BS, UAH.	AS, UAH.	TS, UAH.
Office cleaner					
Total		X			

4.4. Calculating General Production Costs

When calculating general production expenses, we also calculate annual variable costs and annual fixed costs.

4.1.1. Calculating Annual Variable Costs

These costs make up four types of costs, each of which consists of several types of expenses.

Article 1 takes into account costs of maintaining and operating equipment for five types of expenses:

1) cost of auxiliary materials (lubricating, wiping, cooling) is determined at a rate of 500 UAH a year per workplace;

2) cost of power energy (can be taken in the amount of 2000 UAH per year for 1 kW of installed power capacity at a schedule of two shifts);

3) annual salary of mechanics for maintenance of equipment, and electricians (see Table 4.9, professions 2 and 3);

4) unified social tax from the annual salary of locksmiths for maintenance of equipment and electricians (UST from TS);

5) other expenses related to the operation of the equipment (to accept in the amount of 2% of the amount of expenditure under the previous cost elements).

Article 2 takes into account the workshop costs for the intra-plant movement of goods by three types of expenses:

1) annual salary of shops transport workers (see Table 4.9, profession 9);

2) unified social tax from the annual salary of transport workers (UST from TS);

3) other expenses for services of the plant's transport department, the use of vehicles (50% from TS from paragraph 1).

Article 3 takes into account costs of personnel involved in servicing the production process in the shop by three types of expenses:

1) the annual salary of secondary workers: professions 6, 7, 8 (see Table 4.9), as well as specialists: posts 13 - 21 (see Table 4.10);

2) unified social tax from their salary (UST from TS for these categories of employees).

3) other expenses related to the maintenance of the production process in the shop (take in the amount of 2% of the TS of paragraph 1).

Article 4 takes into account the costs of controlling production process and consists of three types of expenses:

1) annual salary of controllers (see Table. 4.9, profession 1);

- 2) unified social tax from the salaries of supervisors (UST from TS);
- 3) other expenses related to the control of the production process (taken as 5% from paragraph 1).

These costs are presented in Table 4.13.

Table 4.13

Variable Production Costs

Expenses	Formula for calculating expenses	Value
1. Maintenance and operation of equipment	1) $500 \times SA$ (see Table 4.1)	
	2) $2000 \times TE$ (see formula 4.6)	
	3) salary of professions 2 and 3 from Table. 4.9.	
	4) (element 3) $\times 37.45/100$	
	5) (the sum of elements 1, 2, 3, 4) $\times 2/100$	
2. In-plant movement of goods	1) salary of professions 9 from Table 4.9.	
	2) (element 1) $\times 37.45/100$	
	3) (element 1) $\times 50/100$	
3. Production maintenance	1) salary of professions 6, 7, 8 from Table 4.9 and the salary of professions 13-21 from Table 4.10	
	2) (element 1) $\times 37.45/100$	
	3) (element 1) $\times 2/100$	
4. Control of the production process	1) salary of professions 1 from Table 4.9.	
	2) (element 1) $\times 37.45/100$	
	3) (element 1) $\times 5/100$	
TOTAL variable general production costs		

4.1.2. Calculating Annual Fixed Costs

These costs contain five types of expenses, each consisting of either a single expense or several.

Article 1 takes into account annual depreciation of fixed assets (see Table 4.11).

Article 2 takes into account management salaries of the workshop and consists of three types of expenses:

1) annual salary for specialists: positions 1-12 (see Table 4.10);

2) unified social tax from the salaries of specialists (UST from TS for these categories of employees);

3) other costs of the workshop management, not included previously (5% of the amount spent for expenses 1).

Article 3 takes into account cost of maintaining the building and inventory of the workshop for four elements of costs:

1) annual pay for workshop cleaners (see Table 4.9, profession 10);

2) unified social tax from salaries of workshop cleaners (UST from TS cleaners);

3) the cost of auxiliary materials for keeping the building clean (determined at a rate of 0.1% from building value);

4) energy costs (heating, ventilation, lighting, water supply, sewerage); expenses are determined as 20% from the workshop building cost.

Article 4 takes into account the costs of the workshop for current equipment repair, transport and tools for the three elements of costs:

1) annual salary for repair of equipment and tools mechanics (see Table 4.9, professions 4, 5);

2) unified social tax from the salaries of locksmiths and machine operators for the repair of equipment and devices (UST from TS for these categories of workers);

3) materials, semi-finished products, spare parts used by the workshop for current repairs (5% of the cost of workshop equipment).

Article 5 takes into account the costs of tests, experiments, research, inventions, clothing costs, non-capital expenditures on labour protection, and reserve for vacation money (10% of the costs of previous four items).

These costs are presented in Table 4.14.

Table 4.14

Fixed General Production Costs

Expense	Formula for calculating expenses	Value
1. Depreciation	Data from Table 4.3.	
2. Expenses for production management	1) salary of professions 1-12 from Table 4.10	
	2) (element 1) x 37.45/100	
	3) (element 1) x 5/100	
3. Maintenance of buildings and inventory	1) salary of professions 10 from Table 4.9.	
	2) (element 1) x 37.45/100	
	3) CB x 0,1/100 (CB from Table 4.2)	
	4) CB x 20/100 (CB from Table 4.2)	
4. Expenses for repair of fixed assets	1) salary of professions 4-7 from Table 4.9.	
	2) (element 1) x 37.45/100	
	3) FA x 5/100 (see formula 4.8)	
5. Other expenses	(the sum of the element 1, 2, 3, 4) x 10/100	
TOTAL fixed general production costs		

After calculating variable and fixed general production costs of the workshop, it is necessary to determine their normative rate relative to basic wages of main workers by the formulas:

$$\mathbf{VPC}_{\text{norm}} = \mathbf{VPC}_{\text{annual}} \times \mathbf{100} / \mathbf{SMW}, \quad (4.25)$$

$$\mathbf{FPC}_{\text{norm}} = \mathbf{FPC}_{\text{annual}} \times \mathbf{100} / \mathbf{SMW}, \quad (4.26)$$

where $\mathbf{VPC}_{\text{annual}}$ — annual variable general production costs of the workshop, UAH.;

FPC_{annual} — annual fixed general production costs of the workshop, UAH;
SMW — basic salary of production workers for a year, UAH;
VPC_{norm}, FPC_{norm} — are corresponding normative rates, %.

4.5. Determining Production Cost per Unit

The costs of raw materials and materials **RM** for the product are calculated as follows:

$$\mathbf{RM = WB \times CC \times (1 + CTP/100)}, \quad (4.27)$$

where **WB** — Weight of blank parts, kg (see Table 3.2);

CC — Average cost of consumable materials _____ UAH/kg (see Table 3.2);

CTP — Standard costs of transport and procurement, %.

Returnable waste is found by the formula

$$\mathbf{RW = (WB \times C_{LOAD}/100) \times CC \times 0.1}, \quad (4.28)$$

where **C_{LOAD}** — is a coefficient of the main equipment load, % (see Table 3.2).

Basic salary of main production workers **SMW** for the product is calculated by the formula:

$$\mathbf{SMW = L \times AHR}, \quad (4.29)$$

where **L** — labour intensity of making the product, h;

AHR — is average hourly rate (see formula (4.14)).

The complexity of manufacturing the product is determined from the data in Table. 3.1. To find **L**, it is necessary to sum the corresponding figures from the column of labour intensity of the work.

Additional wages of production workers are calculated according to formula (4.16) as follows:

$$\mathbf{ASM = (NEMS/100) \times SMW,} \quad (4.30)$$

where the **NEMS** ratio determines the relation of extra salary to basic.

Unified social tax from production workers' salaries included into the cost of the product is calculated as a percentage of **SMW** and **ASM** according to the following formula:

$$\mathbf{USTPW = (SMW + ASM) \times UST / 100,} \quad (4.31)$$

where **UST** is the normative rate for social tax, %.

Variable general production costs **VPC** per one unit are determined as follows:

$$\mathbf{VPC = SMW \times VPC_{norm} / 100,} \quad (4.32)$$

where normative rate for variable general production costs **VPC_{norm}** was calculated earlier by formula (4.25)

Fixed general production costs **FPC** per one unit are determined as follows:

$$\mathbf{FPC = SMW \times FPC_{norm} / 100,} \quad (4.33)$$

where normative rate for fixed general production costs **FPC_{norm}** was calculated earlier by formula (4.26)

Expenses for production preparation and testing **C_{PREP}** are determined from material costs and basic salary of production workers for the product:

$$\mathbf{C_{PREP} = (RM + SMW) \times CAP / 100,} \quad (4.34)$$

where **CAP** — normative costs for production preparation and testing (see Table. 3.2); the remaining parameters were calculated previously.

Production cost is calculated by the formula:

$$\mathbf{PrC = RM - RW + SMW + ASM + USTPW + VPC + FPC + C_{PREP}. \quad (4.35)}$$

All the parameters in (4.35) were calculated above.

4.6. Determining Total Cost Per Unit

The total cost of production is calculated by three components:

$$\mathbf{TPrC = PrC + AC + C_{SALES}, \quad (4.36)}$$

where **PrC** is production cost (see formula (4.35));

AC — administrative costs of the enterprise;

C_{SALES} — selling costs, costs associated with delivering and selling products to customers.

Administrative costs are calculated as a normative rate for administrative expenses **AC_{NORM}** from the basic salary of production workers:

$$\mathbf{AC = SMW \times AC_{NORM} / 100. \quad (4.37)}$$

Distribution and sales costs are calculated as a normative rate for sales costs **NMS** from the production cost of unit:

$$\mathbf{C_{SALES} = PrC \times NMS / 100. \quad (4.38)}$$

After calculating total cost of the product, it is necessary to consult with the instructor what would be the wholesale price for the product **W_{PRICE}** without the VAT (value-added tax).

Calculation of cost and pricing should also be summarised in Table 4.14.

Table 4.14

Cost and Price of the Product

Name of indicators	Value
Expenses for raw materials and materials	

Table 4.14 continuation

Name of indicators	Value
Returnable waste	
Basic salary of production workers	
Additional salary of production workers	
Unified social tax for production workers salaries	
Variable production costs	
Fixed production costs	
Expenses for production preparation and testing	
Total: production cost	
Administrative expenses	
Distribution and sales	
Total: total cost	
Price of the product (wholesale)	

4.7. Determining Break-Even Output

The value of break-even output **BEO** for annual volume of output is the minimum amount of output for the year, when income from sales **IS** is equal to the cost of production **APrC**, and the profit is zero. The quantity of break-even output is determined analytically or graphically with the condition of full load of enterprise's capacity.

Graphically, break-even output is defined as a projected point of intersection of two curves: annual income from sales **IS** and annual cost of production **APrC** (Figure 4.1).

The graph is constructed as follows: on horizontal axis we put quantity of output **Q** for the product. Annual fixed costs **FC** will be shown as a line parallel to the horizontal axis. This value is constant throughout the year, and does not

depend on the volume of output. It is calculated at initial launch of production.

Annual fixed costs **FC** are determined with three types of costs by the formulas (4.33), (4.37), (4.38) and multiplying this amount by the planned output quantity being launched **AP**, given as the initial data:

$$\mathbf{FC = (FPC + AC + PC) \times AP.} \quad (4.39)$$

Then a line is drawn from the axes start for variable costs **VC**, calculated by the following formula:

$$\mathbf{TVC = VC \times Q.} \quad (4.40)$$

Variable cost of **VC** per unit is determined by subtracting from the production cost (formula 4.35) fixed total production costs:

$$\mathbf{VC = PrC - FPC.} \quad (4.41)$$

When the lines of constant and variable costs are added graphically, we get annual production costs **APrC**, which is parallel to variable costs by the amount of fixed costs. Annual income from sales **IS** also starts from the beginning of the axes and is determined by the formula:

$$\mathbf{IS = W_{PRICE} \times Q.} \quad (4.42)$$

Analytically, break-even output BEO is calculated by dividing fixed cost **FC** by the difference between the price of one unit **W_{PRICE}** and variable cost **VC** per one unit, i.e.

$$\mathbf{BEO = FC / (W_{PRICE} - VC).} \quad (4.43)$$

In the break-even point, the revenue will be calculated as follows:

$$\text{BEP}_{\text{REV}} = W_{\text{PRICE}} \times \text{BEO}. \quad (4.44)$$

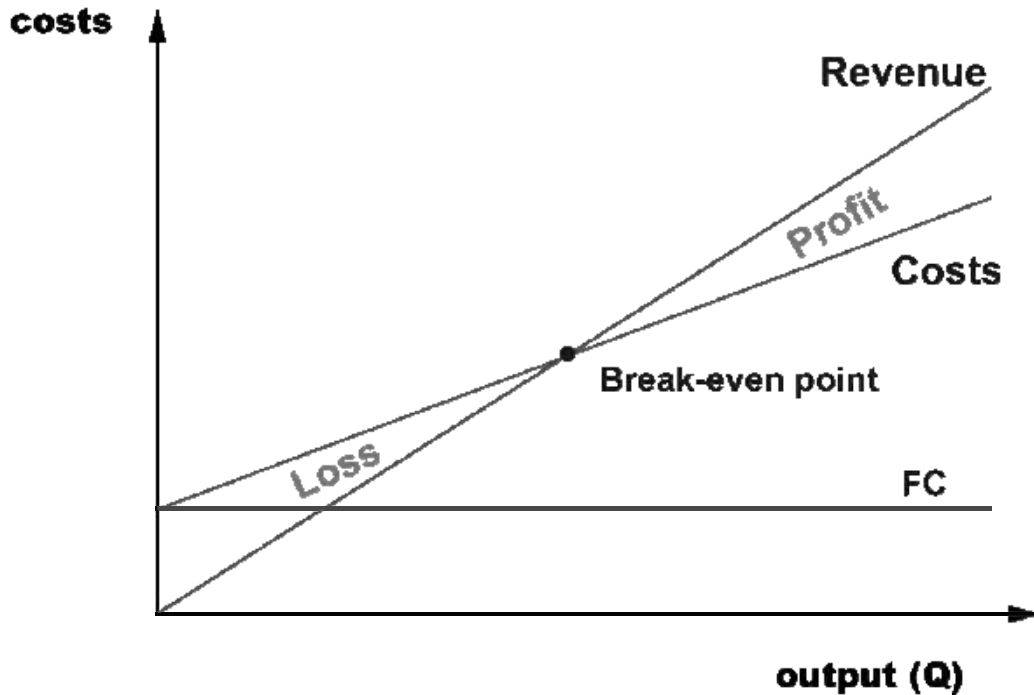


Fig. 4.1. Determining the Break-even Output

4.8. Calculating the Amount of Working Capital

In this paper, the necessary amount of working capital consists of eight elements in the following sequence. First we determine the annual demand of the working capital element. Then, this value is divided into 360 days a year to get daily requirement. After this, we multiply daily value by the rate of the working capital reserve in days. The sum of all the values is the normalised amount of working capital. The data is summarised in Table 4.15.

The annual need for raw materials and materials is calculated as follows:

$$\text{MAT} = \text{RM} \times \text{AP}. \quad (4.45)$$

Annual requirement for extra materials is determined from the two tables by summing two values: from Table 4.13, element 1, Article 1; and from Table 4.14, element 3, Article 3.

Annual need for energy resources is calculated from Table. 4.13 and 4.14 by summing up two values: from Table 4.13, element 2, Article 1; and from Table 4.14, element 4, Article 3.

Annual need for spare parts is defined as 5% from the cost of workshop equipment (see Table. 3.14, element 3, Article 4).

Annual need for low-value and short-wearing items is calculated as 50% from the sum of the costs of tools, fixtures and equipment (see items 5 and 6 in Table 3.3).

Annual need for special equipment should be defined as 50% from annual amount of expenses for the production preparation and testing:

$$E_{\text{SPECIAL}} = C_{\text{PREP}} \times 0,5 \times \text{AP}. \quad (4.46)$$

Annual normative amount of work-in-process is determined by multiplying the production cost by annual output program and coefficient of readiness (0.5):

$$\text{NORM}_{\text{WORK-IN-PROG}} = \text{PrC} \times \text{AP} \times 0.5. \quad (4.47)$$

Annual value of finished product in the warehouse is equal to annual cost of production **APrC**:

$$\text{APrC} = \text{TPrC} \times \text{Q}. \quad (4.48)$$

Reserve days for the first six elements of working capital should be set under 15 days. Reserve days for work-in-progress is determined by

dividing the duration of the production cycle in hours (see paragraph 4 of the Task) by two shifts (i.e., 16 hours).

The amount of reserve days for the finished products depends on the frequency of shipping, and in this calculation work it can be taken as 5 days.

Table 4.15

Calculation of working capital

Circulating assets	Annual demand	Daily demand	Stock Rate (in days)	Standard value
Raw materials and materials				
Extra materials				
Energy Resources				
Spare parts for equipment repair				
Items of low value and highly wearable				
Special equipment				
Unfinished production				
Finished goods in stock				
Total	X	X	X	

4.9. Calculating General Economic Indicators

General economic indicators of enterprise are presented in Table 4.16. Annual income from sales is determined by the formula (4.42). The production cost estimate **APrC** was determined by the formula (4.48).

Balance sheet profit **BSP** is calculated as follows:

$$\mathbf{BSP = IS - APrC.} \quad (4.49)$$

The cost of fixed assets **FA** is presented in Table. 4.3.

The amount of working capital **W_{CAP}** is given in Table 4.15.

The number of workers **NW** consists of the main workers, auxiliary, specialists, employees and service staff (see Table. 4.4, 4.9, 4.10, 4.11, 4.12).

Total annual salary **TS** is calculated by summing up the annual wages of all categories of employees (see formula (4.17) and Table (4.9), (4.10), (4.11), (4.12)).

Enterprise's building space **S** is presented in Table 4.2.

Labour productivity **LPr** is calculated by dividing the annual income from sales **IS** by the number of workers **NW**:

$$\mathbf{LPr = IS / NW.} \quad (4.50)$$

Capital productivity **Cpr** is determined by dividing the annual income from sales **IS** by the value of fixed assets **FA**:

$$\mathbf{Cpr = IS / FA.} \quad (4.51)$$

Profitability of turnover **PT** is calculated by the formula:

$$\mathbf{PT = BSP \times 100 / IS.} \quad (4.52)$$

Cost-to-revenue ratio **CRR** is defined as follows:

$$\mathbf{CRR = IS \times 100 / APrC.} \quad (4.53)$$

Return on capital **RC** is calculated by the formula:

$$\mathbf{RC = BSP \times 100 / (FA + Wcap),} \quad (4.54)$$

where **FA, Wcap** — fixed assets and the value of working capital.

Capital turnover **CT** is defined as follows:

$$\mathbf{CT = IS / (FA + Wcap).} \quad (4.55)$$

The calculation of general economic indicators is presented in Table 4.16.

Table 4.16

General Economic Indicators of Enterprise

Name of indicator	Unit of measure	Value
Annual income from sales	UAH	
Production costs	UAH	
Balance sheet profit	UAH	
Cost of fixed assets	UAH	
The amount of working capital (normalised)	UAH	
Number of workers	# of people	
Annual salary	UAH	
Enterprise's building space	m ²	
Labour productivity	UAH	
Revenue at break-even point	UAH	
Break-even output	piece	
Profitability of turnover	%	
Capital productivity	-	
Cost-to-revenue ratio	%	
Return on capital	%	
Capital turnover	-	

Conclusion

In this paper economic assessment of development and implementation of _____ was performed. The development of the product included the following stages:

- the identification of the main segments and the market volume, which was estimated and amounted to _____ units / year;

- the calculation of summarised indicators. This device was compared with the competitive products and as a result the system with a summarised indicator of quality equal to _____ was chosen as the most competitive.

- the labour intensity was defined and all the steps of the performers. Total labour intensity was estimated to be _____ man/days, the labour intensity for the developer will be 16 days, the ... - 11 days, the ... 9 days, ... - 12 days, the manager - 18 days;

- the calculation of wages and the price of the developed project. The main salary is equal to _____ UAH, and price _____ UAH. The profit from selling the product was estimated to be at _____%.

Based on a full analysis of the production processes and the development of the _____, you can draw the following conclusions: in one year sales amount to _____ units. The analysis of the break-even point showed us the volume of sales, necessary to start making a profit after its reach.

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Appendix 1 EXAMPLE OF TITLE PAGE

Ministry of Education and Science of Ukraine
M.Ye. Zhukovsky National Aerospace University
“Kharkiv Aviation Institute”
Department of Economic Theory

CALCULATION OF ECONOMIC INDICATORS FOR MACHINE-BUILDING ENTERPRISES

Calculation paper
On Economics of Enterprise

Done by:

Group and name _____
(Family name and initials)

Checked by:

Teaching assistant № 601 _____
(Family name and initials)

Kharkiv “KhAI” 20__

Appendix 2 EXAMPLE OF FINISHED PAPER

1. Calculation Paper Task

1. Enterprise performs mechanical assembly and manufacture of components for the main products.
2. Annual output product plan: 5000 pieces.
3. Enterprise operates in two shifts.
4. Duration of production cycle: 112 h.
5. Units of measure for equipment and technical process:
 - Labour intensity per unit of output in normative-hours
 - Electric power (per unit of equipment) in kW
 - Repair complexity (per unit of equipment) in units of repair complexity
 - Price of equipment (per unit of equipment) in UAH.

Table 1

Main Equipment and Technological Process Data

Equipment name	Labour intensity L_i	Type of work W_i	Electric power E_i	Repair complexity RC_i	Equipment price EP_i
Drilling machine	10	3	3	4	150 000
Lathe	12	4	8	5	200 000
Milling machine	16	5	4	7	250 000
Assembly workbench	12	4	1	1	100 000
Test installation	10	5	3	9	350 000

Additional Data

Name of indicator	Symbol	Value
Technically unavoidable losses, %	UL	1
Standard of expenses for transportation and installation of equipment, %	ETI	1
Normative rate of extra salaries for the main staff , %	NEMS	40
Normative rate of extra salaries for the additional staff, %	NEAS	30
Normative rate of extra salaries for service staff, %	NESS	25
Standard unified social tax, %	UST	22
Weight of blank parts, kg	WB	50
Coefficient of load of the main equipment, %	C_{LOAD}	75
Average cost of consumable materials (CC) _____ UAH/kg.	CC	100
Standard costs for assembly preparation and testing, %	CAP	1
Standard costs of transport and procurement , %	CTP	1.5
Normative rate for administrative expenses, %.	NAC	1
Normative rate for marketing and sales expenses, %.	NMS	1.5

2. Calculation of Economic Indicators for Machine-Building Enterprises

2.1. Determining initial value of fixed assets

2.1.1. Determining technical and economic parameters of main equipment

Annual program for launching production is calculated as follows:

$$\mathbf{AP = Q \times (1 + UL / 100)} \quad (2.1)$$

$$AP = 5000 * (1 + 1/100) = 5050 \text{ pcs,}$$

where **Q** — quantity of output for annual program, pcs.;

UL — are technically unavoidable losses, % (see Table. 2.2).

Annual labour intensity of the product according to the equipment's number (X_i) is determined by the formula:

$$\mathbf{AL_i = T_i \times AP} \quad (2.2)$$

$$AL_1 = 10 * 5050 = 50500 \text{ normative hours.}$$

$$AL_2 = 12 * 5050 = 60600 \text{ normative hours.}$$

$$AL_3 = 16 * 5050 = 80800 \text{ normative hours.}$$

$$AL_4 = 12 * 5050 = 60600 \text{ normative hours.}$$

$$AL_5 = 10 * 5050 = 50500 \text{ normative hours.}$$

where **T_i** — is the labour intensity for each equipment, normative hours;

AP — annual output program, pcs.

Annual labour input of the product for all types of equipment

$$\mathbf{ALE = AL_1 + AL_2 + AL_3 + AL_4 + AL_5} \quad (2.3)$$

$$ALE = 5050 + 60600 + 80800 + 60600 + 50500 = 303000 \text{ normative hours.}$$

Estimated number of basic equipment for each operation is given by:

$$\mathbf{NEO_i = AL_i / (RTOE_i \times CL_i \times NEW_i)} \quad (2.4)$$

$$NEO_1 = 50500 / (3900 * 1.1 * 1) = 11.8 \text{ pcs.}$$

$$NEO_2 = 60600 / (3900 * 1.1 * 1) = 14.1 \text{ pcs.}$$

$$NEO_3 = 80800 / (3900 * 1.1 * 1) = 18.8 \text{ pcs.}$$

$$NEO_4 = 60600 / (4000 * 1.1 * 1) = 13.8 \text{ pcs.}$$

Appendix 2 EXAMPLE OF FINISHED PAPER

$$NEO_5 = 50500 / (3800 * 1.1 * 1) = 12.1 \text{ pcs.}$$

where **AL_i** — annual labour intensity for each operation, normative-hours;

RTOE_i — annual real time of equipment operation (for each type of operation);

CL_i — coefficient of workload performance for each type of operation (is given as 1.1);

NEW_i — the number of workers simultaneously working on this equipment (we take it as 1 in these calculations).

The accepted amount of the main equipment is rounded to a whole number.

The coefficient of load of the main equipment is determined by dividing the estimated number of equipment by the rounded number of equipment:

$$\mathbf{Cload}_i = \mathbf{NEO}_i / \mathbf{RNEO}_i \quad (2.5)$$

$$Cload_1 = 11.8 / 12 = 0.983$$

$$Cload_2 = 14.1 / 15 = 0.94$$

$$Cload_3 = 18.8 / 19 = 0.99$$

$$Cload_4 = 13.8 / 14 = 0.986$$

$$Cload_5 = 12.1 / 13 = 0.93$$

Summary of all economic indicators of the enterprise is given in Table 2.1.

Table 2.1

Number of main equipment

Name of equipment	Annual labour intensity	Annual time	Number of main equipment		Coefficient of load for the main equipment
	AL_i	RTOE_i	NEO_i	RNEO_i	Cload_i
Drilling machine	50500	3900	11.8	12	0.983
Lathe	60600	3900	14.1	15	0.94

Table 2.1 continuation

Name of equipment	Annual labour intensity AL_i	Annual time $RTOE_i$	Number of main equipment		Coefficient of load for the main equipment $Cload_i$
			NEO_i	$RNEO_i$	
Milling machine	80800	3900	18.8	19	0.99
Assembly workbench	60600	4000	13.8	14	0.986
Test installation	50500	3800	12.1	13	0.93
Total	303000	X	70.6	73	X

For the received amount of equipment, it is necessary to calculate the total consumed power of the equipment (**TE**), total repair complexity (**TRC**) and total cost of equipment (**TEC**):

$$TE = E_1 \times EQ_1 + E_2 \times EQ_2 + E_3 \times EQ_3 + E_4 \times EQ_4 + E_5 \times EQ_5 \quad (2.6)$$

$$TE = 3 \times 12 + 8 \times 15 + 4 \times 19 + 1 \times 14 + 3 \times 13 = 285 \text{ kWt}$$

$$TRC = RC_1 \times EQ_1 + RC_2 \times EQ_2 + RC_3 \times EQ_3 + RC_4 \times EQ_4 + RC_5 \times EQ_5 \quad (2.7)$$

$$TRC = 4 \times 12 + 5 \times 15 + 7 \times 19 + 1 \times 14 + 9 \times 13 = 387$$

$$TEC = EC_1 \times EQ_1 + EC_2 \times EQ_2 + EC_3 \times EQ_3 + EC_4 \times EQ_4 + EC_5 \times EQ_5 \quad (2.8)$$

$$TEC = 150\,000 \times 12 + 200\,000 \times 15 + 250\,000 \times 19 + 100\,000 \times 14 + 350\,000 \times 13 = \\ 15\,500\,000 \text{ UAH}$$

where E_1, E_2, E_3, E_4, E_5 — consumed electrical power (see Table 1.1);

$RC_1, RC_2, RC_3, RC_4, RC_5$ — repair complexity (see Table 1.1);

$EC_1, EC_2, EC_3, EC_4, EC_5$ — the cost of equipment (see Table 1.1);

$EQ_1, EQ_2, EQ_3, EQ_4, EQ_5$ — is the accepted quantity of equipment (see Table 2.1.).

2.1.2. Determining initial value of fixed assets

When performing calculation paper, the main means of production are divided into four groups: buildings and structures; working machines and equipment; measuring instruments; tools and inventory.

The cost of building is determined by the space of the premises for particular purpose and the cost of 1 m³:

$$CB = SP \times C_{PROD} + SA \times C_{EXT}, \quad (2.9)$$

where **SP** — the space of production building, where production, auxiliary and storage facilities are located, m³;

SA — the space where offices, other premises, departments and services are located, m³;

C_{PROD} — the cost of 1 m³ of the production building (200 UAH/m³)

C_{EXT} — the cost of 1 m³ building extension (350 UAH/m³)

Thus, the entire area of the enterprise in its purpose is divided into: production, extension, warehouse, office-household etc.

The results of calculating the workshop spaces and the cost of the building of the enterprise are presented in the Table. 2.2.

Table 2.2

Calculating the Cost of Building

Area type	C _{aux} , %	S, m ²	h, m	V=S x h, m ³	CB, UAH
Production	X	1095	8	8760	17 520 000
Auxiliary	15	164.25	8	1314	2 628 000
Warehouse	15	164.25	8	1314	2 628 000
Office and facilities	35	383.25	3	1149.75	4 024 125
Other	10	109.5	6	657	2 299 500
Total	X	1916.25	X	13194.75	29 099 625

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The costs of the main equipment acquiring of the workshop were determined earlier (see formula 2.8). The costs of transportation and installation of equipment is added to this cost, in order to obtain the full cost of equipment:

$$\mathbf{FCE = TEC \times (1 + ETI / 100)} \quad (2.10)$$

$$FCE = 15\,500\,000 * (1+1/100) = 15\,655\,000 \text{ UAH,}$$

where **ETI** — (see Table 2.2).

In addition to the main technological equipment, the company has other equipment. In the calculation paper, the cost of this equipment can be taken as a percentage of the cost of the main equipment (K_{eq}) like: vehicles — 10%, measuring instruments — 5%, tools and devices — 10%, production and household equipment — 2%.

1) vehicles — 10%,

$$15\,500\,000 * (10/100) = 1\,550\,000 \text{ UAH}$$

2) measuring instruments — 5%,

$$15\,500\,000 * (5/100) = 775\,000 \text{ UAH}$$

3) tools and devices — 10%,

$$15\,500\,000 * (10/100) = 1\,550\,000 \text{ UAH}$$

4) production and household equipment — 2%,

$$15\,500\,000 * (2/100) = 310\,000 \text{ UAH}$$

2.1.3. Calculation of annual depreciation charges

When calculating enterprise's expenses, it is necessary to know the values of annual depreciation from the value of fixed assets of the enterprise. Data on fixed assets and depreciation from this value is recorded in Table. 2.3.

Table 2.3

Cost of fixed assets and annual depreciation

Asset groups	$K_{eq},$ %	Price, UAH	Depreciation rate, %	Annual depreciation, UAH
Building	X	29 099 625	5	1 454 981.25
Equipment	X	15 655 000	15	1 565 500
Means of transport	10	15 50 000	20	310 000
Measuring instruments	5	775 000	25	193 750
Tools and accessories	10	1 550 000	25	387 500
Production and household equipment	2	310 000	25	77 500
Total	X	48 939 625	X	3 989 231.25

2.2. Determining number of employees by categories.

The following workers belong to the industrial and production personnel of the enterprise: production (main) and auxiliary workers, specialists (engineering and technical workers), employees, junior maintenance personnel.

The number of production (main) workers is calculated by types of workplaces, taking into account the annual labour intensity of the work at these locations:

$$QPW = AL_i / (LT_i \times C_{PERF}) \quad (2.11)$$

where AL_i — the annual complexity of each operation (see Table. 2.1);

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LT_i — real annual working time (1800 h.);

CL_i — labour intensity

The coefficient of performance or production rate (**C_{PERF} = 1,1**).

The accepted number of workers is approximated to the whole number.

The calculations for all operations are recorded Table. 2.4.

Table 2.4

Number of main workers

Workplace number	Annual labour input AL _i	Annual working time LT _i	Type of work	Number of workers	
				calculated	accepted
1	50500	1800	3	25.5	26
2	60600	1800	4	30.6	31
3	80800	1800	5	40.8	41
4	60600	1800	4	30.6	31
5	50500	1800	5	25.5	26
Total	303000	X	X	X	155

The number of secondary workers is calculated: according to the norms regarding the number of basic workers, the overall repair complexity of equipment, the total consumed electric power, depending on the profession (see specifications in Table 2.5). Using norms, determine the number of secondary workers for each profession. All the data received is recorded in the Table. 2.5.

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Table 2.5

Number of secondary workers

Profession	Service rate	Value	Number of workers, person.	Rank, R
Controllers	20	Main Workers	8	5
Equipment service locksmith	120	Main Workers	6	4
Electricians	300	KW	1	5
Equipment service workers	250	Repair units	2	4
Tool maker	80	Main Workers	2	5
Tool keeper of the tool pantry	130	Main Workers	2	X
Warehouse keeper	50	Main Workers	4	X
Work manager (distributor)	30	Main Workers	3	X
Transport workers	50	Main Workers	4	X
Workshop cleaners	60	Main Workers	3	X

Table 2.6

Number of specialists in production department

Position	Number of main workers	Salaries, UAH / month
Deputy Head of Production Department	1	10000
Head of Technical Bureau	1	8500
Head of Planning and Logistics	1	8500

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Table 2.6 continuation

Position	Number of main workers	Salaries, UAH / month
Department		
Workshop mechanic	1	7900
Head Master	1	7250
Inspector Foreman	1	6500
Shift foreman	5	6200
Technologist	1	6350
Tool Foreman	1	6300
Dispatcher	1	4950
Rate fixer	1	5520
Programmer	1	9500

Table 2.7

Number of employees and service workers of production workshop

Position	Number of main workers				Salaries, UAH / month
	50	150	250	350	
<i>Employees</i>					
The accountant		1			5000
Supply and maintenance manager		1			4850
Secretary (referent)		1			4000
<i>Service staff</i>					
Office cleaner		1			3500

2.3. Determining average monthly salary by categories of employees

While calculating wages, the next structure is taken as a ground for estimation: the basic salary with extra hours pay and bonus pay, consisting of daily and monthly surcharges.

Extra hours pay is added to the basic salary and are surcharges, allocated from the salary fund, and can be of the following types: bonus from the salary fund, bonuses from the master's fund, pay for night shifts, team management, and training of apprentices. These funds are formed in agreement with the working community of the enterprise.

Additional salary consists of daily allowances to adolescents and nursing mothers, as well as from monthly surcharges in the form of vacation pay and payment for the performance of public duties.

The average hourly rate corresponds to the average rank of work performed in the workshop.

Table 2.8

Data for calculating the average work rank and the average hourly rate

Work rank, R	Number of workers QPW, person.	Hourly rate HR, UAH/norm. hours	Calculation data	
			P x QPW	QPW x HR
3	26	27.076	78	703.98
4	62	31.911	248	1978.48
5	67	36.746	335	2461.98
Total	155	X	661	5144.44

The average rank of work in the shop and the average hourly rate by the following formulas:

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$$A_{\text{rank}} = \Sigma (\mathbf{P} \times \mathbf{QPW}) / \Sigma \mathbf{QPW} \quad (2.12)$$

$$A_{\text{rank}} = 661/155 = 4.27$$

$$\mathbf{AHR} = \Sigma (\mathbf{QPW} \times \mathbf{HR}) / \Sigma \mathbf{QPW} \quad (2.13)$$

$$\mathbf{AHR} = 5144.44/155 = 33.19$$

where the numerator and denominator are taken from Table 2.8

Taking into account the data of Table 2 and formula (3.10), it is possible to calculate the basic and additional wages of the main workers in the production workshop as follows:

$$\mathbf{SMW} = \mathbf{AL} \times \mathbf{AHR} \quad (2.14)$$

$$\mathbf{SMW} = 303000 \times 33.19 = 10\,056\,570$$

where **AL** — the total labouriousness of the annual workload of the workshop, normative hours;

AHR — is the average hourly rate of the main workers, UAH. normative hours;

$$\mathbf{ASM} = \mathbf{SMW} \times \mathbf{NEMS}/100 \quad (2.15)$$

$$\mathbf{ASM} = 10\,056\,570 \times 40/100 = 4\,022\,628$$

where **SMW** — the basic salary of industrial workers of shop;

ASM — is additional salary of production workshops.

The total wage (payroll) of production workers is:

$$\mathbf{TSMW} = \mathbf{SMW} + \mathbf{ASM} \quad (2.16)$$

$$\mathbf{TSMW} = 10\,056\,570 + 4\,022\,628 = 14\,079\,198$$

TSMW — is the total wage (payroll) of production workshops.

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The salaries of secondary workers are determined depending on their ranks, type of payment and hours worked. Consequently, for each profession of secondary workers (see Table. 2.3) it is necessary to determine three indicators of earnings according to the following formulas:

$$\mathbf{SSW = NSW \times T_{LABOUR} \times P_{rate}} \quad (2.17)$$

where T_{LABOUR} — labour time per worker in a year;

P_{RATE} — payment rate per unit of time (in UAH per hour/month);

NSW — number of secondary workers in this workshop.

$$\mathbf{ASSW = SSW \times NEAS/100} \quad (2.18)$$

$$\mathbf{TSSW = SSW + ASSW} \quad (2.19)$$

If the secondary workers have a rank, then the rate of payment is taken for an hour according to the rank, and the annual operating time is 1800 hours. In the absence of rank, the rate is charged for the month in the form of salary, and the annual work time is 11 months. Hourly rates and salaries are taken from regulatory documents for machine-building enterprises.

The calculated values of the salaries of secondary workers are recorded in the Table. 2.9.

Table 2.9

Salary of secondary workers

№	NSW, № people	T _{LABOUR} , h/year, m/year	P _{RATE} , UAH/h, UAH/m	SSW, UAH	ASSW, UAH	TSSW, UAH
1	8	1 800	36.746	529 142.4	158 742.72	687 885.12

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Table 2.9 continuation

№	NSW, № people	T _{LABOUR} , h/year, m/year	P _{RATE} , UAH/h, UAH/m	SSW, UAH	ASSW, UAH	TSSW, UAH
2	6	1 800	31.911	344 638.8	103 391.64	448 030.44
3	1	1 800	36.746	66 142.8	19 842.84	85 985.64
4	2	1 800	31.911	114 879.6	34 463.88	149 343.48
5	2	1 800	36.746	132 285.6	39 685.68	171 971.28
6	2	11	3 200	70 400	21 120	91 520
7	4	11	3 200	140 800	42 240	183 040
8	3	11	3 200	105 600	31 680	137 280
9	4	11	3 200	140 800	42 240	183 040
10	3	11	3 200	105 600	31 680	137 280
Total	34	X	X	1 750 289.2	528 086.76	2275375.96

Labour of specialists, non-production employees and junior maintenance workers (W_{maint}) is paid by official salaries. The official salaries are given in the Table. 2.6 and 2.7. Calculations of basic, additional and general wages for the year for these categories of employees are determined as follows:

$$\mathbf{BS = NW \times 11 \times MS} \quad (2.20)$$

$$\mathbf{AS = BS \times NESS/100} \quad (2.21)$$

$$\mathbf{TS = BS + AS} \quad (2.22)$$

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where **NW** — the number of employees (specialists, employees or service workers);

MS — monthly salary;

NESS — see Table 2.1.;

BS, AS, TS — are basic, additional and total salaries for the year of relevant employees.

Calculations on the number of specialists, non-production employees and junior maintenance workers, as well as their salaries are presented in Table 2.10, 2.11, 2.12.

Table 2.10

Number of specialists and their salary

Position	NW, person.	MS, UAH.	BS, UAH.	AS, UAH.	TS, UAH.
Head of workshop	1	10 000	110 000	27 500	137 500
Head of the technical bureau	1	8 500	93 500	23 375	116 875
Head of Quality Control	1	8 500	93 500	23 375	116 875
Workshop mechanic	1	7 900	86 900	21 725	108 625
Head Master	1	7 250	79 750	19 937,5	99 687.5
Inspector Foreman	1	6 500	71 500	17 875	89 375
Shift foreman	5	6 200	68 200	17 050	85 250
Technologist	1	6 350	69 850	17 462.5	87 492.5
Tool Foreman	1	6 300	69 300	17 325	86 625
Dispatcher	1	4 950	54 450	13 612.5	68 062.5
Rate fixer	1	5 520	60 720	15 180	75 900
Programmer	1	9 500	104 500	26 125	130 625
Total	16	X	962 170	240 542.5	1 202 712.5

Table 2.11

Number of non-production employees and their salary

Position	NW, person	MS, UAH.	BS, UAH.	AS, UAH.	TS, UAH.
The accountant	1	5 000	55 000	13 750	68 750
Supply and maintenance manager	1	4 850	53 350	13 337.5	66 687.5
Secretary (referent)	1	4 000	44 000	11 000	55 000
Total	3	X	152 350	38 087.5	190 437.5

Table 2.12

Number of service workers and their salary

Position	NW, person	MS, UAH	O3, UAH.	AS, UAH.	TS, UAH.
Office cleaner	1	3 500	38 500	9 625	48 125
Total	1	X	38 500	9 625	48 125

Average monthly salary is determined for all categories of workers in the production shop: the main workers, secondary workers, specialists, non-production employees, service staff:

$$\mathbf{AMS = TS / (12 \times NW)} \quad (2.24)$$

$$AMS_{\text{main}} = 14\,079\,198 / 155 \cdot 12 = 7569.46$$

$$AMS_{\text{add}} = 2\,275\,375.96 / 12 \cdot 34 = 5576.9$$

$$AMS_{\text{spec}} = 1\,202\,712.5 / 12 \cdot 16 = 6264.13$$

$$AMS_{\text{serv}} = (190\,437.5 + 48\,125) / 12 \cdot 6 = 3313.37$$

where **TS** — the salary for a year of workers of corresponding category;
NW — is the number of employees of the corresponding category.

2.4. Calculating General Production Costs

When calculating general production expenses, we also calculate annual variable costs and annual fixed costs.

2.1.4. Calculation Annual Variable Costs

These costs contain four types of costs, each of which consists of several expenses.

Article 1 takes into account costs of maintaining and operating equipment for five types of expenses:

- 1) cost of auxiliary materials (lubricating, wiping, cooling) is determined at a rate of 500 UAH a year per workplace;
- 2) cost of power energy (can be taken in the amount of 2000 UAH per year for 1 kW of installed power capacity at a schedule of two shifts);
- 3) annual salary of mechanics for maintenance of equipment, and electricians (see Table. 4.9, professions 2 and 3);
- 4) unified social tax from the annual salary of locksmiths for maintenance of equipment and electricians (UST from TS);
- 5) other expenses related to the operation of the equipment (to accept in the amount of 2% of the amount of expenditure under the previous cost elements).

Article 2 takes into account the workshop costs for the intra-plant movement of goods by three types of expenses:

- 1) annual salary of shops transport workers (see Table 2.9, profession 9);
- 2) unified social tax from the annual salary of transport workers (UST from TS);
- 3) other expenses for services of the plant's transport department, the the use of vehicles (50% from TS from paragraph 1).

Article 3 takes into account costs of personnel involved in servicing the production process in the shop by three types of expenses:

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1) the annual salary of secondary workers: professions 6, 7, 8 (see Table 2.9), as well as specialists: posts 13 - 21 (see Table 2.10);

2) unified social tax from their salary (UST from TS for these categories of employees).

3) other expenses related to the maintenance of the production process in the shop (take in the amount of 2% of the TS of paragraph 1).

Article 4 takes into account the costs of controlling production process and consists of three types of expenses:

1) annual salary of controllers (see Table 2.9, profession 1);

2) unified social tax from the salaries of supervisors (UST from TS);

3) other expenses related to the control of the production process (taken as 5% from paragraph 1).

Table 2.13

Variable Production Costs

Expenses	Formula for calculating expenses	Value
1. Maintenance and operation of equipment	1) $500 \times SA$ (see Table 1.1)	73 000
	2) $2000 \times TE$ (see formula 2.6)	855 000
	3) salary of professions 2 and 3 from Table 2.9.	534 016.08
	4) (element 3) $\times 37.45/100$	117 483.54
	5) (the sum of elements 1, 2, 3, 4) $\times 2/100$	31 590
2. In-plant movement of goods	1) salary of professions 9 from Table 2.9.	183 040
	2) (element 1) $\times 37.45/100$	40 268.8
	3) (element 1) $\times 50/100$	91 520
3. Production maintenance	1) salary of professions 6, 7, 8 from Table 2.9 and the salary of professions 13-21 from Table 2.10	1 484 203.78
	2) (element 1) $\times 37.45/100$	326 524.83

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Table 2.13 continuation

Expenses	Formula for calculating expenses	Value
	3) (element 1) x 2/100	29 684.08
4. Control of the production process	1) salary of professions 1 from Table 2.9.	687 885.12
	2) (element 1) x 37.45/100	151 334.73
	3) (element 1) x 5/100	34 394.26
TOTAL variable general production costs		4 639 945.22

2.4.2. Calculating Annual Fixed Costs

These costs contain five types of expenses, each consisting of either a single expense or several.

Article 1 takes into account annual depreciation of fixed assets (see Table 2.11).

Article 2 takes into account management salaries of the workshop and consists of three types of expenses:

1) annual salary for specialists: positions 1-12 (see Table 2.10);

2) unified social tax from the salaries of specialists (UST from TS for these categories of employees);

3) other costs of the workshop management, not included previously (5% of the amount spent for expenses 1).

Article 3 takes into account cost of maintaining the building and inventory of the workshop for four elements of costs:

1) annual pay for workshop cleaners (see Table 2.9, profession 10);

2) unified social tax from salaries of workshop cleaners (UST from TS cleaners);

3) the cost of auxiliary materials for keeping the building clean (determined at a rate of 0.1% from building value);

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4) energy costs (heating, ventilation, lighting, water supply, sewerage); expenses are determined as 20% from the workshop building cost.

Article 4 takes into account the costs of the workshop for current equipment repair, transport and tools for the three elements of costs:

1) annual salary for repair of equipment and tools mechanics (see Table 2.9, professions 4, 5);

2) unified social tax from the salaries of locksmiths and machine operators for the repair of equipment and devices (UST from TS for these categories of workers);

3) materials, semi-finished products, spare parts used by the workshop for current repairs (5% of the cost of workshop equipment).

Article 5 takes into account the costs of tests, experiments, research, inventions, clothing costs, non-capital expenditures on labour protection, and reserve for vacation money (10% of the costs of previous four items).

Table 2.14

Fixed General Production Costs

Expense	Formula for calculating expenses	Value
1. Depreciation	Data from Table 2.3.	3 989 231.25
2. Expenses for production management	1) salary of professions 1-12 from Table 2.10	534 875
	2) (element 1) x 37.45/100	117 672.5
	3) (element 1) x 5/100	26 743.75
3. Maintenance of buildings and inventory	1) salary of professions 10 from Table 2.9.	185 405
	2) (element 1) x 37.45/100	40 789.1
	3) CB x 0,1/100 (CB from Table 2.2)	29 099.63
	4) CB x 20/100 (CB from Table 2.2)	2 909 962.5

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Table 2.14 continuation

Expense	Formula for calculating expenses	Value
4. Expenses for repair of fixed assets	1) salary of professions 4-7 from Table 2.9.	149 343.48
	2) (element 1) x 37.45/100	32 855.57
	3) FA x 5/100 (see formula 2.8)	310 000
5. Other expenses	(the sum of the element 1, 2, 3, 4) x 10/100	832 597.78
TOTAL fixed general production costs		9 158 575.56

After calculating variable and fixed general production costs of the workshop, it is necessary to determine their normative rate relative to basic wages of main workers by the formulas:

$$\mathbf{VPC}_{\text{norm}} = \mathbf{VPC}_{\text{annual}} \times 100 / \mathbf{SMW} \quad (2.24)$$

$$\mathbf{VPC}_{\text{norm}} = 4\,639\,945.22 \times 100 / 10\,056\,570 = 46.1 \%$$

$$\mathbf{FPC}_{\text{norm}} = \mathbf{FPC}_{\text{annual}} \times 100 / \mathbf{SMW} \quad (2.25)$$

$$\mathbf{FPC}_{\text{norm}} = 9\,158\,575.56 \times 100 / 10\,056\,570 = 91\%$$

where $\mathbf{VPC}_{\text{annual}}$ — annual variable general production costs of the workshop, UAH.;

$\mathbf{FPC}_{\text{annual}}$ — annual fixed general production costs of the workshop, UAH;

\mathbf{SMW} — basic salary of production workers for a year, UAH;

$\mathbf{VPC}_{\text{norm}}$, $\mathbf{FPC}_{\text{norm}}$ — corresponding normative rates, %.

2.5. Determining Production Cost per Unit

The costs of raw materials and materials RM for the product are calculated as follows:

$$\mathbf{RM} = \mathbf{WB} \times \mathbf{CC} \times (1 + \mathbf{CTP}/100) \quad (2.26)$$

$$\mathbf{RM} = 50 \times 100 \times (1 + 1.5/100) = 5\,075$$

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Returnable waste is found by the formula:

$$\mathbf{RW = (WB \times C_{LOAD}/100) \times CC \times 0.1} \quad (2.27)$$

$$RW = 50 * (1 - 75/100)* 100*0.1 = 125$$

The basic salary of industrial workers OZPR for the product is calculated by the formula:

$$\mathbf{SMW = L \times AHR} \quad (2.28)$$

$$SMW = 60*33.19 = 1\ 991.4$$

where **L** — labour intensity of making the product;

AHR — is average hourly rate (see formula (2.14)).

The complexity of manufacturing the product is determined from the data in Table. 2.1. To find **L**, it is necessary to sum the corresponding figures from the column of labour intensity of the work.

Additional wages of production workers are calculated according to formula (2.16) as follows:

$$\mathbf{ASM= (NEMS/100) \times SMW} \quad (2.29)$$

$$ASM= (40/100)* 1\ 991.4 = 796.56$$

where the **NEMS** ratio determines the relation of extra salary to basic

Unified social tax from production workers' salaries included into the cost of the product is calculated as a percentage of **SMW** and **ASM** according to the following formula:

$$\mathbf{USTPW = (SMW + ASM) \times UST / 100} \quad (2.30)$$

$$USTPW= (1\ 991.4 + 796.56) * 22/100 = 613.35$$

where **UST** is the normative rate for social tax, %.

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Variable general production costs **VPC** per one unit are determined as follows:

$$\mathbf{VPC = SMW \times VPC_{norm} / 100} \quad (2.31)$$

$$VPC = 1\,991.4 \times 46.1 / 100 = 918$$

where normative rate for variable general production costs **VPC_{norm}** was calculated earlier by formula (2.24)

Fixed general production costs **FPC** per one unit are determined as follows:

$$\mathbf{FPC = SMW \times FPC_{norm} / 100} \quad (2.32)$$

$$FPC = 1\,991 \times 4 \times 91 / 100 = 1\,812.17$$

where normative rate for fixed general production costs **FPC_{norm}** was calculated earlier by formula (2.25)

Expenses for production preparation and testing **C_{PREP}** are determined from material costs and basic salary of production workers for the product:

$$\mathbf{C_{PREP} = (RM + SMW) \times CAP / 100} \quad (2.33)$$

$$C_{PREP} = (5075 + 1991.4) \times 1 / 100 = 70.66$$

where CAP — the standard of costs for the production preparation and testing (see Table. 2.2), and the remaining data are calculated above.

The production cost is calculated by the formula:

$$\mathbf{PrC = RM - RW + SMW + ASM + USTPW + VPC + FPC + C_{PREP}} \quad (2.34)$$

$$PrC = 5\,075 - 125 + 1\,991.4 + 796.56 + 613.35 + 918 + 1\,812.17 + 70.66 = 11\,152.14$$

All the parameters in (2.34) were found above.

2.6. Determining Total Cost Per Unit

The total cost of the product is calculated by three components:

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$$\mathbf{TPrC = PrC + AC + C_{SALES}} \quad (2.35)$$

$$\text{TPrC} = 11\,152.14 + 19.91 + 167.28 = 11\,339.33$$

where **PrC** is production cost (see formula (2.35);

AC — administrative costs of the enterprise;

C_{SALES} — selling costs, costs associated with delivering and selling products to customers.

Administrative costs are calculated as a normative rate for administrative expenses **AC_{NORM}** from the basic salary of production workers:

$$\mathbf{AC = SMW \times AC_{NORM} / 100} \quad (2.36)$$

$$\text{AC} = 1\,991.4 \times 1 / 100 = 19.91$$

Distribution and sales costs are calculated as a normative rate for sales costs **NMS** from the production cost of unit:

$$\mathbf{C_{SALES} = PrC \times NMS / 100} \quad (2.37)$$

$$\text{PC} = 11\,152.14 \times 1.5 / 100 = 167.28$$

After calculating total cost of the product, it is necessary to consult with the instructor what would be the wholesale price for the product **W_{PRICE}** without the VAT (value-added tax).

Calculation of cost and pricing should also be summarised in Table 2.14.

Table 2.15

Cost and Price of the Product

Name of indicators	Value
Expenses for raw materials and materials	5 075
Recyclable waste	125
The basic salary of production workers	1 991.4
Additional salary of production workers	796.56

Table 2.15 continuation
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Name of indicators	Value
Accrual to the social fund for wages of production workers	613.35
Variable production costs	918
Fixed general production costs	1 812.17
Expenses for preparation and mastering of production	70.66
Total: production cost	11 152.14
Administrative expenses	19.91
Distribution costs	167.28
Total: total cost	11 339.33
Price of the product (wholesale)	12 500

2.7. Determining Break-Even Output

Annual fixed costs **FC** are determined with three types of costs by the formulas (2.32), (2.36), (2.37) and multiplying this amount by the planned output quantity being launched **AP**, given as the initial data:

$$\mathbf{FC = (FPC + AC + PC) \times AP} \quad (2.38)$$

$$FC = (1812.17+19.91+167.28)*5\ 050 = 10\ 096\ 768$$

Next, we construct a line of total variable costs, starting from the origin, using the formula:

$$\mathbf{TVC = VC \times Q} \quad (2.39)$$

$$TVC = 9\ 339.97*5\ 000 = 46\ 699\ 850$$

The variable costs of **VC** per one product are determined by subtracting from the production cost (formula 3.35) fixed total production costs:

$$\mathbf{VC = PrC - FPC} \quad (2.40)$$

$$VC = 11\ 152.14-1\ 812.17=9\ 339.97$$

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When the lines of constant and variable costs are added graphically, we get annual production costs **APrC**, which is parallel to variable costs by the amount of fixed costs. Annual income from sales **IS** also starts from the beginning of the axes and is determined by the formula:

$$\mathbf{IS = W_{PRICE} \times Q.} \quad (2.41)$$

$$\mathbf{IS = 12\,500 \times 5\,000 = 62\,500\,000.}$$

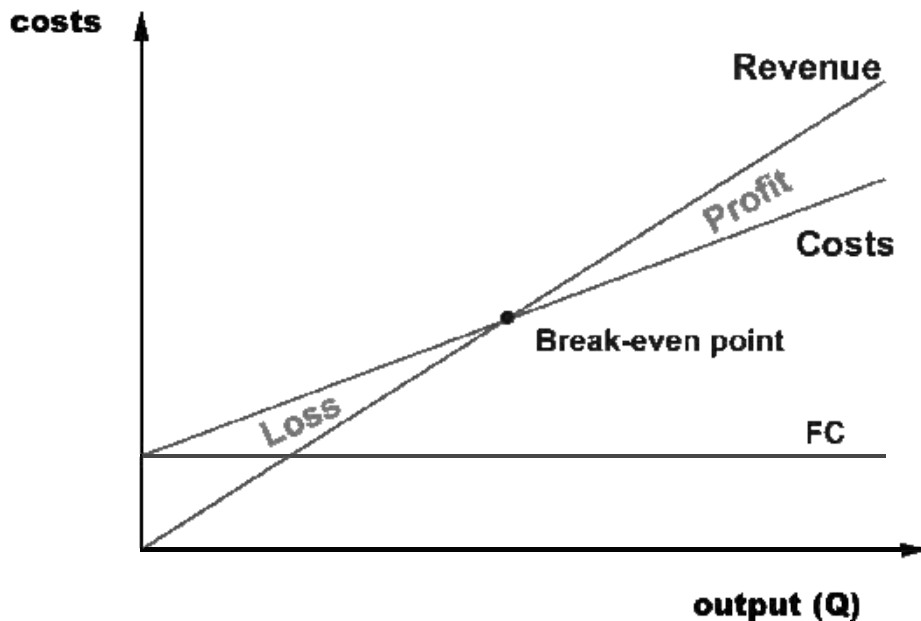


Fig. 1 Determining break-even output program

Analytically, break-even output BEO is calculated by dividing fixed cost **FC** by the difference between the price of one unit **W_{PRICE}** and variable cost **VC** per one unit, i.e.

$$\mathbf{BEO = FC / (W_{PRICE} - VC).} \quad (2.42)$$

$$\mathbf{BEO = 10\,096\,768 / (12\,500 - 9\,339.97) = 3\,195.15.}$$

In the break-even point, the amount of revenue will be as follows:

$$\mathbf{BEP_{REV} = W_{PRICE} \times BEO.} \quad (2.43)$$

$$\mathbf{BEP_{REV} = 12\,500 \times 3\,195.15 = 39\,939\,375 \text{ UAH.}}$$

2.8. Calculation of normalised working capital

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The annual demand for raw materials and materials of the timing is calculated as follows:

$$\mathbf{MAT = RM \times AP.} \quad (2.44)$$

$$\text{MAT} = 5\,075 \times 5\,050 = 25\,628\,750.$$

Annual need for special equipment should be defined as 50% from annual amount of expenses for the production preparation and testing:

$$\mathbf{E_{SPECIAL} = C_{PREP} \times 0,5 \times AP.} \quad (2.45)$$

$$E_{SPECIAL} = 178\,416.5.$$

The annual standardised value of the work in process is determined by multiplying the value of the production cost by the annual startup program and the availability factor, where KG is the availability factor of 0.5:

$$\mathbf{NORM_{WORK-IN-PROG} = PrC \times AP \times 0.5.} \quad (2.46)$$

$$NORM_{WORK-IN-PROG} = 11\,152.14 \times 5050 \times 0.5 = 28\,159\,153.5.$$

Annual value of finished product in the warehouse is equal to annual cost of production **APrC**:

$$\mathbf{APrC = TPrC \times Q.} \quad (2.47)$$

$$APrC = 11\,33933 \times 5000 = 56\,696\,650.$$

Table 2.15

Calculation of working capital

Circulating assets	Annual demand	Daily demand	Stock Rate (in days)	The value of the standardised value
Raw materials and materials	25 628 750	71 191	15	1 067 865

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Table 2.15 continuation

Circulating assets	Annual demand	Daily demand	Stock Rate (in days)	The value of the standardised value
Auxiliary materials	102 099.63	283.6	15	4254
Energy Resources	3 764 962.5	10 458.2	15	156 873
Spare parts for equipment repair	6200	17.2	15	258
Low-value and high-wear items	930 000	2583	15	38 745
Special equipment	178 416.5	495.6	15	7434
Unfinished production	28 159 153	78 219.9	7	547 537.9
Finished goods in stock	56 696 650	157 490.7	5	787 453.5
Total	X	X	X	2 610 420.4

2.9. Calculating General Economic Indicators

General economic indicators of enterprise are presented in Table 2.16. Annual income from sales is determined by the formula (2.42). The production cost estimate **APrC** was determined by the formula (2.48).

Balance sheet profit **BSP** is calculated as follows

$$\mathbf{BSP = IS - APrC.} \quad (2.48)$$

$$\mathbf{BSP = 62\,500\,000 - 56\,696\,650 = 5\,803\,350.}$$

The cost of fixed assets **FA** is presented in Table 2.3.

The amount of working capital **W_{CAP}** is given in Table 2.15.

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The number of working people in the **NW** consists of the main workers, auxiliary, specialists, employees and service staff (see Tables 2.4, 2.9, 2.10, 2.11, 2.12).

The annual salary of **TS** is calculated by summing up the annual wages of all categories of employees (see formula (2.17) and Tables (2.9), (2.10), (2.11), (2.12)).

Enterprise's building space **S** is presented in Table 2.2.

Labour productivity **LPr** is calculated by dividing the annual income from sales **IS** by the number of workers **NW**:

$$\mathbf{LPr = IS / NW.} \quad (2.49)$$

Capital productivity **Cpr** is determined by dividing the annual income from sales **IS** by the value of fixed assets **FA**:

$$\mathbf{Cpr = IS / FA.} \quad (2.50)$$

Profitability **PT** turnover is calculated by the formula:

$$\mathbf{PT = BSP \times 100 / IS.} \quad (2.51)$$

Profitability of P is defined as follows:

$$\mathbf{CRR = IS \times 100 / APrC.} \quad (2.52)$$

Return on capital **RC** is calculated by the formula:

$$\mathbf{RC = BSP \times 100 / (FA + Wcap),} \quad (2.53)$$

where **FA**, **Wcap** — are fixed assets and the value of working capital.

Capital turnover **CT** is defined as follows:

$$\mathbf{CT = IS / (FA + Wcap).} \quad (2.54)$$

Table 2.16

General Economic Indicators of Enterprise

Name of indicator	Unit of measure	Name of indicator
Annual income from sales	UAH	62 500 000
Production costs	UAH	56 696 650
Balance sheet profit from sales	UAH	5 803 350
Cost of fixed assets	UAH	48 939 625
The amount of working capital (normalised)	UAH	2 610 420.4
Number of employees	# of people	209
Annual salary fund	UAH	17 795 848.96
Enterprise's buildings space	m ²	1916.25
Labour productivity	UAH	299 043.1
Income at break-even point	UAH	39 939 375
Break-even output program	piece	3195.15
Profitability of turnover	%	9.3
Capital Return	-	1.27
Profitability	%	10.24
Profitability of capital	%	11.26
Capital turnover	-	1.2

Conclusions

In this paper... (for more details see the Tutorial for preparing Calculation Paper).

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