

## **MODELLING AND SIMULATION OF THE LABOUR COST IN UNIT AND SMALL BATCH PRODUCTION**

### **1. Introduction**

In response to pressures imposed by increasing global competition, developing technologies, more discerning customers companies have to change to survive. Costs, availability of people and skills, competitors' actions and market conditions bring additional pressures.

Companies have to produce the right product for the customers with better performance and appropriate levels of cost and quality. Products must be developed and manufactured fast so they get to market ahead of the competition.

In order to satisfy customers' growing needs, expectations and to understand marketplace, companies may need to undergo some changes, for ex. they may introduce new product line, new engineering process, new machinery, new materials or it is necessary they change production line. Each change needs money and time. There are needed the right resources, properly allocated included people, technology and finance.

To manage business effectively the rational personnel policy adequate to market economy conditions must be kept.

### **2. Personnel management in today's companies**

The main key to success is well-trained and motivated staff, especially managerial staff. People have a great impact on company's survival and development and they are today regarded as the most valuable and important resource on which depends firm's success.

The effective personnel management means especially:

- ?? right selection of people to the particular workplaces
- ?? objective and just individual appraisal and compensation
- ?? employees participation in management process
- ?? humanization of interpersonal relations and working conditions.

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Technological and organisational changes including transformation processes introduced in companies have a great impact on employment structure. There are new workplaces demanding new skills, larger knowledge, higher responsibility from a worker. To meet requirements of new workplaces it may be necessary to make decision about:

?? sending the workers to training or conversion training courses

?? employing new persons from external labour market fulfilling jobs' requirements with simultaneous dismissal of those who haven't needed qualifications

?? internal shifts of actual workers due to their qualification levels

From the above mentioned suggestions, the first is specially recommended. Contemporary market economy forces enlarging and up-to-dating knowledge and skills upon people. Companies within the framework of their personnel policy should assist employees in developing their skills and personal policy. A well-qualified worker is more flexible, ready to do a wider range of duties, able to cope with the change in his job content. Today multi-occupational or multi-job-tasking training plays an important role for personal growth. It leads to master doing different tasks at different workplaces by a worker. The training makes enlarging worker's knowledge range and professional skills.

Well prepared and organized training scheme helps to avoid the social problems concerned with for ex. dismissal of a great number of employees.

Each job needs right knowledge and skills from a worker. In companies manufacturing in unit and small batches workers are required to possess a higher qualifications level then their actual jobs demand. Owing to this qualifications surplus workers are able to cope with new tasks more easily and quickly. They are able to master new speciality, new occupation, to replace a co-worker if necessary. In consequence, the company may introduce technical and organisational changes. The high workers' qualifications level makes facile for planning the manufacture process. Work process is rhythmical, without demurrage time, overtime etc. But on the other hand, the higher qualifications level the higher labour cost. How to find the optimum required qualifications level, how to forecast and plan training actions? The problem is complex and it requires some data on labour cost in order to analyze and evaluate consequences of different actions.

It is obvious that training program should be an integral part of company's development plan. Each today's company needs to develop its own cost planning system. The cost system is composed of many elements. One of them is labour cost. On labour cost the deciding impact has the firm's employment and payment policy. Employment and payment policy should support company's mission and objectives.

### **3. Remuneration — The main incentive factor**

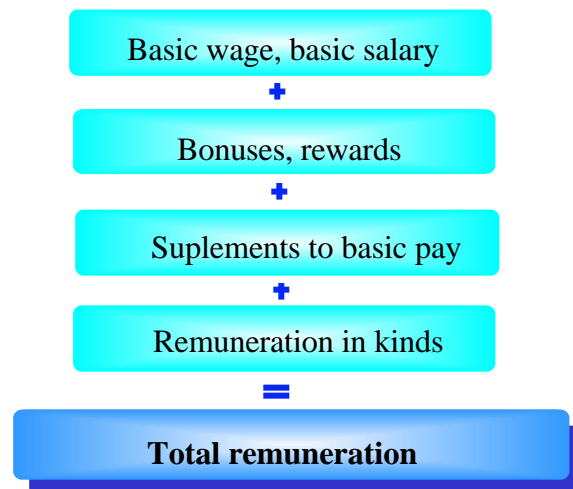
Remuneration system design should take into consideration and optimize the main pay functions. Pay in money is a basic (and often a only) source of income for an employee and his family. Pay is a essential incentive factor. To earn money people apply for a job, improve and develop their skills, undertake more difficult and responsible tasks etc. Pay levels influence human relations, public opinion and jobs' status in the labour market. For the company pay is the main cost element.

Remuneration may be determined both singly both as a sum of different components. It depends on the agreement following from pay talks in the company.

The total remuneration may consist of many components as shown in figure1. These are:

- ?? basic rate which relates to the importance of the job, the responsibilities involved in it and the level of education and experience required
- ?? special supplements associated with such factors as for ex. long service, managerial function, poor working conditions, other inconveniences as shift work, night work, overtime work etc.
- ?? payment paid due to work performance and enterprise's profitability; for ex. bonuses, rewards
- ?? remuneration in kind (fringe benefits such as extra holiday with pay, life insurance, cars etc).

*Figure 1. Components of the total remuneration*



Obviously payment structure can differ in companies. However, the first component — the basic rate — is the most important, because:

- ?? it is a obligatory element
- ?? it is used as a basis for calculating other remuneration elements e.g. supplements
- ?? in many present companies, especially in small ones, basic pay is the only remuneration element
- ?? employee's promotion is mostly related to increase of basic pay.

To be motivate the basic pay should be a determinant of job content; that means it should consider job's difficulty degree, responsibility level, working condition and also quality and quantity of performance.

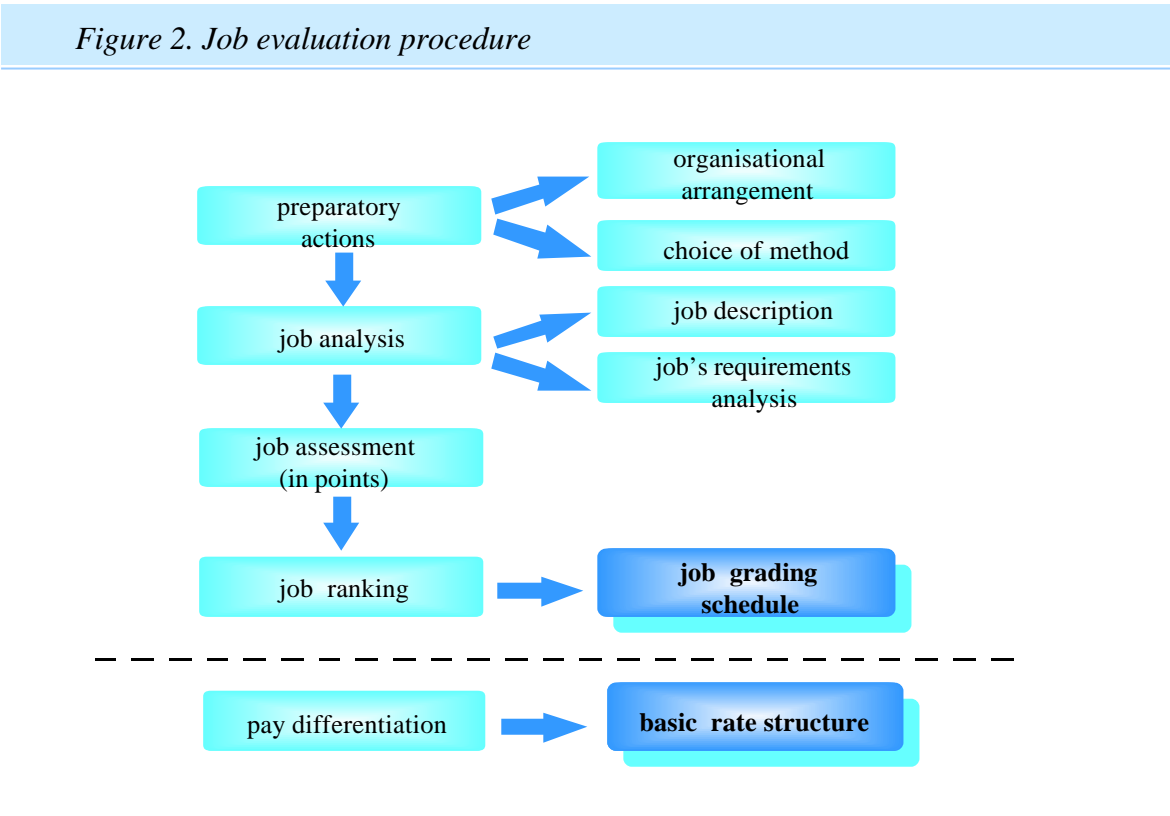
#### **4. Job evaluation as a tool in personnel management**

To improve the labour cost the rational bases for just and objective pay differentiation due to done job should be established. The best and only tool for this is job evaluation.

**Job evaluation** is the process of analysing and assessing the content of jobs, in order to place them in an acceptable rank order which can be then used as a basis for a remuneration system.

The value of using job evaluation lies in its logical, factual and systematic approach to the definition of job relationships. It is based on facts, on that what actually happens in a job. Jobs are compared by the aid of common, previously determined criteria, such as required educational level, preferred experience, responsibility for decision, equipment, physical effort, mental effort, working condition etc. The whole process is one of systematically relating jobs one to another by examination of the importance and difficulty of a job.

Job evaluation is a very important in point of efficiency of organisation's payment policy and for that reason it should be properly and carefully prepared and introduced. Implementation of the job evaluation process is broken down into stages — see figure2.



In preparatory work, before the evaluation process begin some decision must be made. One of them is the choice of job evaluation method, the most appropriate to the particular conditions and needs of an organisation.

There are a many of job evaluation methods, which can be divided into two types of schemes: analytical and non-analytical. Non-analytical methods are relatively simple. Each job is considered as a whole, without any detailed analysis. These methods may be used in organisations with a small number of jobs (about 10-15 jobs). Analytical methods are quantitative. Values of jobs are usually expressed in numerical points. Each job is considered according to specific aspects or factors and allocated in appropriate number of points related to a pre-defined scale. The same criteria and point scale are used for every job. The total points value places a job in an appropriate job grade. Each job grade includes jobs of the same worth.

None the less, the fundamental question of how much to pay is not determined by job evaluation. Job evaluation may only show that job X should be paid more than job Y. The principal aim of job

evaluation is to establish acceptable and justifiable jobs' grade structure, which is a foundation for negotiation about pay differentiation to be based on facts rather than opinion. The last — financial evaluation of jobs is the separate process and it can be made in many various ways. However, as base rate structure is directly or indirectly founded on job evaluation result, it is involved in stages of job evaluation.

The substantial characteristic of job evaluation is also that during the process only the job is evaluated, not the person doing it. The attention is taken away from the man performing the job, to the job itself. There are the separate methods evaluating the workers, their efficiency, performance level and other individual features. On the base of joining the result of job evaluation to the result of employee evaluation it is possible to differentiate the individual pay basic rate for a particular worker.

Besides job evaluation exercise can be valuable in other areas. The results from job evaluation can be used for:

- ?? recruitment, promotion and training purposes
- ?? personnel planning through a better understanding of qualifications and skills needed for a particular job
- ?? work simplification and elimination of redundant and duplicated functions
- ?? improvement of working methods, better designed jobs and identification of poor working conditions and hazardous jobs.

## 5. Labour cost

In changeable conditions of running the company, the planning process including especially cost planning has a special meaning. No modern company may allow to improvise that's way a rational system of cost planning should be developed.

Today to offer the competitive prices the company must be able to determine precisely a product's cost.

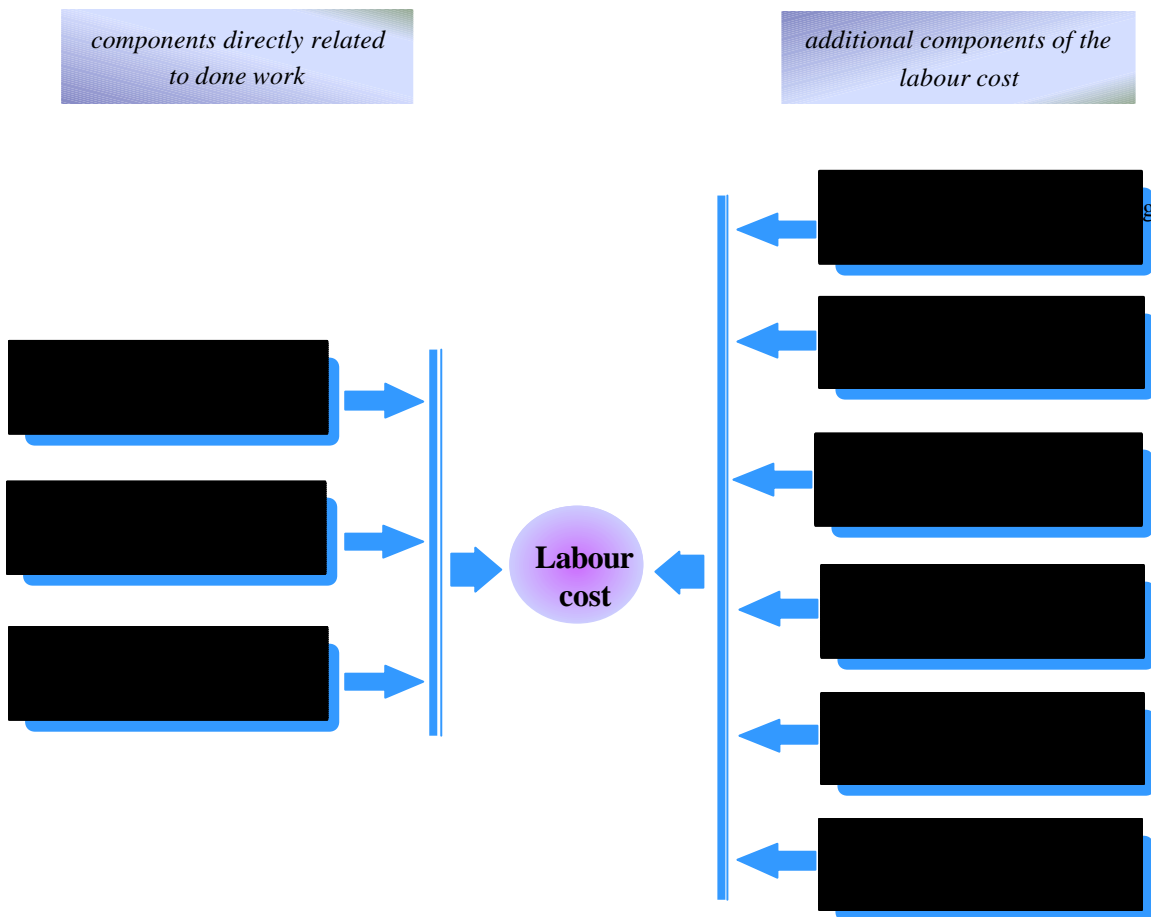
For cost system the labour cost plays an important role. **Labour cost** includes all expenses covered by an employer and concerned with people involved in business activity. The knowledge of the labour cost gives reasons for its rationalisation and optimisation of quantitative and qualitative employment structure due to company's development strategy. The account and analysis of the labour cost provide meritorious bases for profitability of investment in quality of own staff. For management knowledge of the labour cost enables to answer the question how to spend money for work.

Developed structure of the labour cost consists of the following elements:

- ?? basic wages, salaries and supplements to wages, salaries (involved in business activity cost)
- ?? cost of insurance rates
- ?? social charges
- ?? training cost
- ?? cost of labour safety
- ?? cost of health services
- ?? reward, bonuses paid in from the made profit
- ?? remuneration in kind etc.

Above mentioned components may be divided in many ways, according to defined criteria of division. The classification of the labour cost due to relation with done work is shown in figure 3.

Figure 3. Components of the labour cost — example classification



## 6. The place of the direct labour cost in cost account

In planning tasks concerned with business activity an essential role plays the data derived from the cost account. The aim of the cost account is to evidence the production cost for particular products and services. On the base of that a product's cost may be calculated, a decision on profitability of accepting a potential order may be made etc.

The cost account usually includes three stages presented in figure 4.

The company bears the costs connected with purchase, manufacture and distribution. These costs are recorded in the type based cost account. There may be mentioned the following general types of costs:

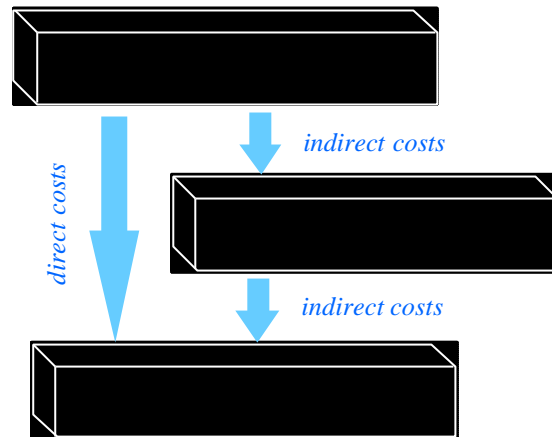
- ?? material cost
- ?? labour cost
- ?? capital cost

?? cost of services rendered by outer companies

?? social cost.

Particular types of costs are allocated to workplaces to which relate and next a cost driver.

Figure 4. Stages in the cost account



The workplaces cost account enable to allocate indirect costs to the workplaces with the use of division keys. Indirect costs means costs which can not be traced directly to a product.

The workplaces cost account is based on isolating cost workplaces. A cost workplace is here regarded as a work system, e.g. single machine, machine-family, department etc. Workplace cost is a sum of different cost components related to a given place.

To record and analyse the costs within the workplace cost account Establishmental Cost Sheet (ECS) is used. The ECS takes the form of a table where particular types of costs are specified in rows and cost workplaces in column. On the sheet the costs' values are recorded and allocated to the workplaces to which are concerned.

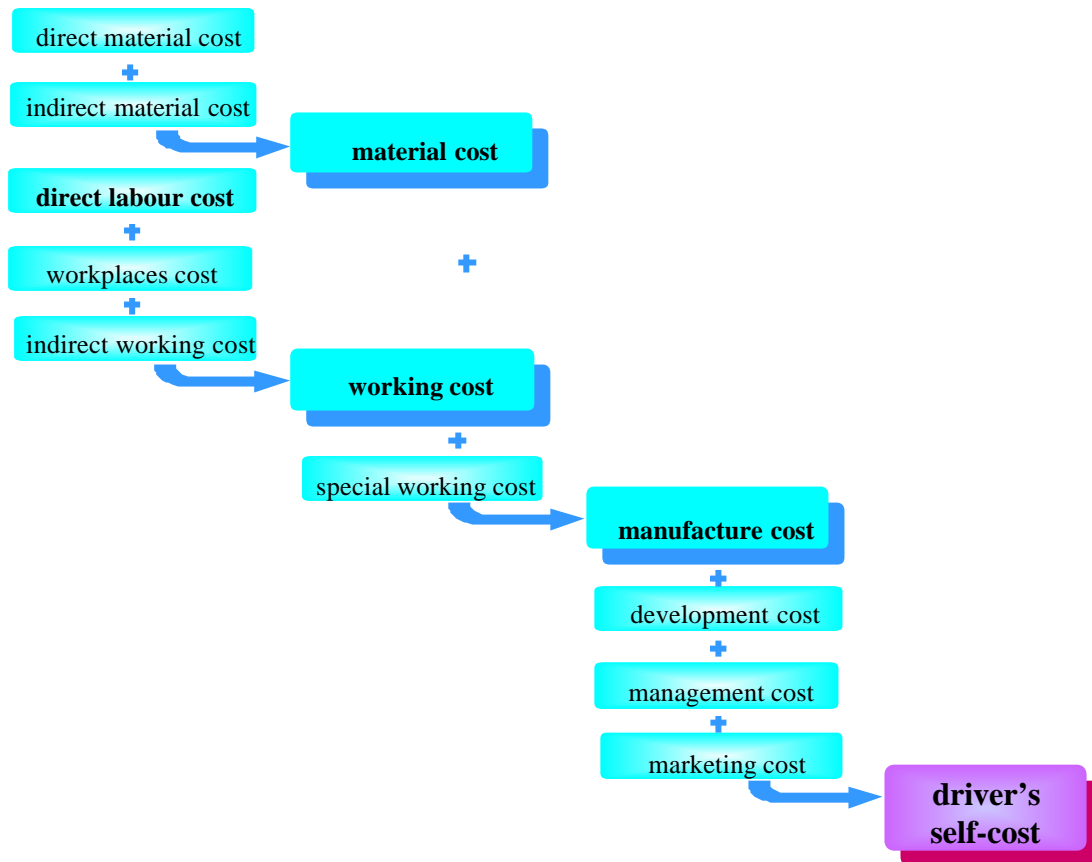
On the ground of the ECS's analysis it is possible to identify the places to be improved and to evaluate effects of taken enterprises.

The last stage of the cost account is to trace the costs to a cost driver (regarded as product, production program, order etc). For this purpose the calculation methods are needed. For companies of unit and small batch production where different products diversified with regard to material costs, wage costs etc. are manufactured, the method of „adding” calculation is recommended. Figure5 is a simple model of product's cost counting according to this method.

The direct costs connected with product manufacture are traced straight to cost drivers and the indirect costs are added to products using percentaged bases derived from the ECS.

The direct labour cost is connected with directly productive workers and includes their remuneration, insurance charges, social charges, expenses on preventives, training courses etc.

Figure 5. Adding calculation method



## 7. Simulation of the direct labour cost in relation to workers' qualification levels.

### Attention:

An example given below presents the simplified simulation of the direct labour cost (here regarded only as the direct wage cost) relatively to multi-job-tasking levels. In real, the problem is more complex and the computer program (e.g. MANAGER II) is needed to make simulation.

### Analytical example.

There is a small production company employing 5 directly productive workers. On the base of job evaluation and employee appraisal, jobs and jobholders have been classified to the adequate grades. A multi-job-tasking worker able to do different jobs from different grades has been classified to the highest grade. Simulation of labour cost relatively to multi-job-tasking level is made. There is assumed that a worker classified to a given grade is also able to do all jobs from lower grades.

For the simulation purpose three cases concerned with three different workers' qualification levels are considered (see table 1).



*Table 1. Classification of the workers into the grades*

Case I		Case II		Case III	
<i>grade</i>	<i>a number of workers in the grade</i>	<i>grade</i>	<i>a number of workers in the grade</i>	<i>grade</i>	<i>a number of workers in the grade</i>
III	2	III	1	X	5
VI	2	VI	2		
X	1	X	2		

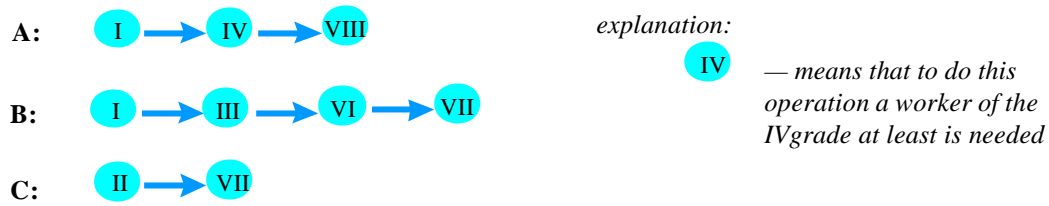
Next, the money values have been determined for the grades (see table2). If a worker is idle his demurrage rate is equal 60% of the basic rate.

*Table 2. Pay rates*

<b>grade</b>	<b>basic rates (PLN/day)</b>	<b>demurrage rates (PLN/day)</b>
III	24	16
IV	28	18
V	32	21
VI	36	23
VII	40	26
VIII	48	31
IX	56	36
X	68	44

Production plan includes 16 units of product A, 16 of B and 8 of C. Manufacturing process for product A consists of three operations carried out at three different workplaces. To simplify calculation, each operation lasts 1 hour. Manufacture processes for particular products and jobs requirements are depicted in figure 6.

Figure 6. Manufacture processes for particular products with consideration of operations' requirements

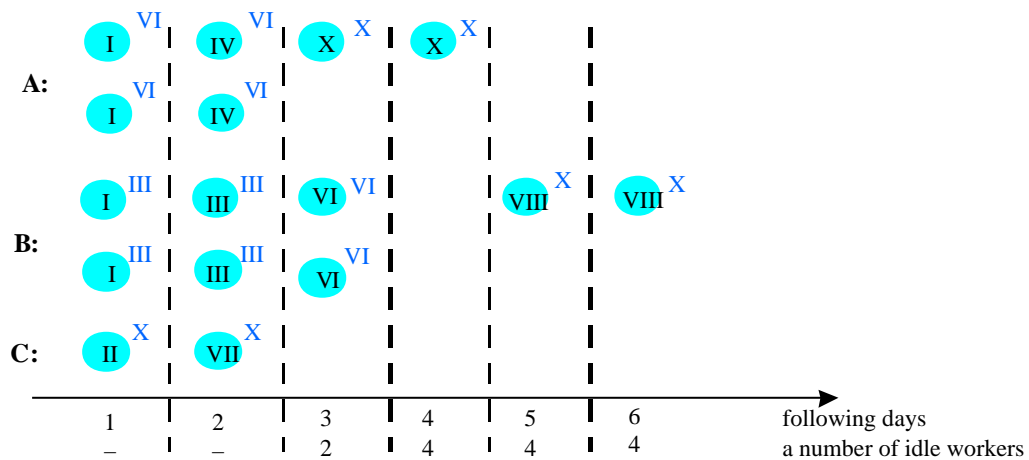


There has been assumed that:

- ?? there is one-shift work lasting 8 hours per day
- ?? there is no overtime work
- ?? all workplaces are available in any time
- ?? if there is no adequate work for a worker, he is idle.

Taking into account above mentioned, the workers are allocated to the workplaces due to jobs' requirements (see figure7).

Figure 7. Work run for the realization of production plan (for case I)



explanation:

**VII<sup>X</sup>** — means that this operation (requiring a worker of the VII grade at least) is carried out by a worker of the X grade

Direct labour cost ( $L_d$ ) connected with running the production plan is expressed by below formula:

$$L_d = \sum (b_i \cdot n_b) + \sum (d_j \cdot n_d)$$

where:

$b_i$  — basic rate for „i”-worker involved in work process

$n_b$  — number of days compensated by  $b_i$

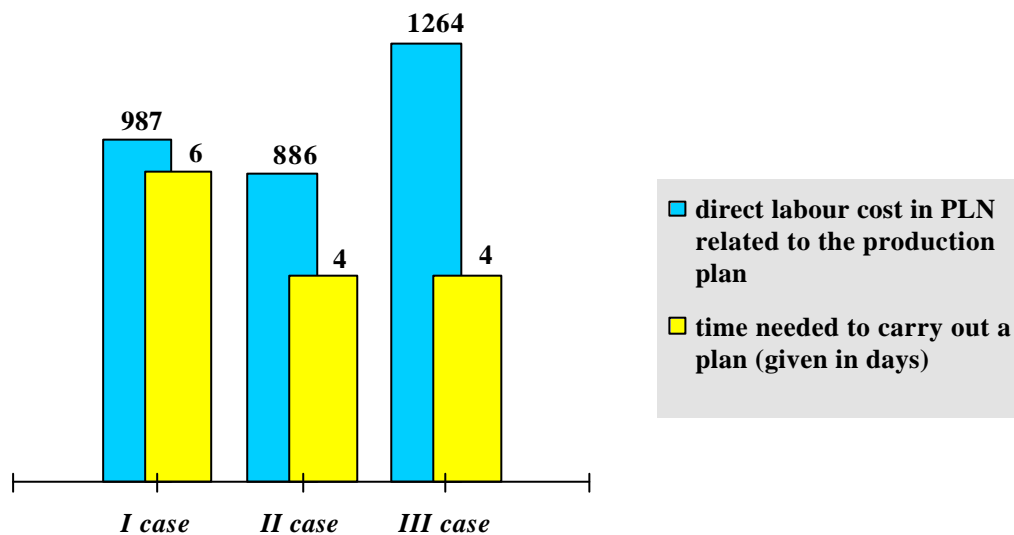
$d_j$  — demurrage rate for idle „j”-worker

$n_d$  — number of idle days

For I case  $L_d = 986$  PLN and 6 days are needed to carry out the production plan.

The analogical procedures have been made for II and III cases. Obtained results are diagrammed in figure 8.

Figure 8. Simulation results



## 7. Conclusion

Nowadays, each company should be able to determine the exact products' costs and to make the simulation of costs with regard to the particular cost components. These action need to define costs structure, cost workplaces. The cost account based on Establishmental Cost Sheet may be used to develop the principles for modelling and simulation of the costs in relationship to:

?? production size

?? production range

?? production profile

?? used manufacture process etc.

Rational personnel management needs to apply the modern management methods. One of them is job evaluation. Job evaluation has an important relationship to the total personnel policy in a company. It provides the exact requirements for each job, a disciplined framework for pay decision and it offers the opportunity for career progression.

The direct labour cost as an essential cost component may be a subject of analysis and optimisation in order to improve production self-cost. The study of the labour cost aims at providing the managers with the detailed data about expenses carried on labour and making appropriate decision on better usage of human resources.

Well prepared computer program based on job evaluation results gives opportunity to simulate the direct labour cost relatively to taken firm's strategy. For management it is a valuable tool which supports making decision process concerned with especially personnel policy.

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