Cost Estimating Method of Industrial Product Implemented in WinCOST Software System

Gheorghe OANCEA, Lucia Antoneta CHICOS, Camil LANCEA
Manufacturing Engineering Department
Transilvania University of Brasov
B-dul Eroilor, No. 29, Brasov
ROMANIA
gh.oancea@unitbv.ro; l.chicos@unitbv.ro; camil@unitbv.ro

Abstract: - The paper presents a method for estimating the cost of industrial products and its implementation into a software system named WinCOST. The software is used for calculating the manufacturing time and cost evaluation of industrial products with high level of customization manufactured by chip removing and/or cold forming processes.

Key-Words: - Cost estimation, Cost per hour, Software system, Chip removing process, Cold forming processes

1 Introduction
The worldwide competition has demonstrated that it is not important how good the project is, if the product couldn't be designed and manufactured in a short time, with competitive cost and adequate quality. In today’s global market the competitiveness of industrial products is mostly based on cost, quality, innovation and productivity [5]. Therefore, the design must be made not only according to the requirements and technical specifications of the industrial product, but also using innovative manufacturing processes with a maximum economic efficiency.

The production cost is the factor with major influence on the market and its decrease is the key for companies to survive overall in the world.

2 Product cost calculation
The cost of industrial product can be calculated by summing the cost of raw material and manufacturing cost, as the following equation [4]:

\[ C_p = C_{\text{mat}} + C_{\text{man}} \ [\€]. \]  
(1)

where:
- \( C_{\text{mat}} \) is the cost of raw material;
- \( C_{\text{man}} \) is the manufacturing cost.

The workpiece cost or raw material cost is described in literatures for different manufacturing processes [1, 3]. This cost can be easily determined using the following relation:

\[ C_{\text{mat}} = p \cdot (1 + k) \ [\€]. \]  
(2)

where:
- \( p \) is the unit cost of workpiece/raw material;
- \( k \) is a coefficient that depends on production volume.

Usually value of the coefficient \( k \) is 0.1 for a large series and 0.05 for a small series of production.

The manufacturing cost can be determined using the relation [2]:

\[ C_{\text{man}} = \sum_{i=1}^{n} t_i \cdot C_i \ [\€]. \]  
(3)

where:
- \( t_i \) is the total production time at operation number \( i \);
- \( C_i \) is the average cost of an hour of the manufacturing in a subunit where the operation \( i \) is made.
- \( n \) is the total number of operations for current product.

The average cost per hour \( C_i \) for each company subunit depends on two costs: cost per hour of the company without productive subunits (indirect cost) and the cost per hour of productive units where the workpiece is manufactured (direct cost) [2]:

\[ C_i = C_{\text{company}} + C_{\text{subunit}_i} \ [\€/hour]. \]  
(4)

In the above relation, the symbols have the following meanings [2]:
- \( C_{\text{company}} \) is the company cost per hour without productive subunits;
- \( C_{\text{subunit}_i} \) is the cost per hour of subunit \( i \) (it just includes the costs of subunit \( i \)).

The unproductive cost of the company includes a number of expenses such as [2]:
company's management salaries;
- TESA staff salaries (including design, manufacturing planning and scheduling);
- other salaries and bonuses related to company management and administrative staff;
- amortization of buildings;
- building insurance, cars and machine-tools insurance;
- expenses heat;
- electricity costs;
- unproductive expenditure for renting of buildings;
- unproductive expenses and amortization of buildings;
- other indirect costs.

The indirect cost of company can be calculated as a sum of costs defined above and divided by the total number of manufacturing hours in a year (for all machine tools from the current company). The equation is:

$$\text{C}_{\text{compay}} = \frac{\sum_{j=1}^{10} \text{C}_j}{\text{hours}_{\text{year}}\text{company}} [\text{€/hour}]. \quad (5)$$

The average cost per hour of a production subunit depends on the following data [2]:
- staff salaries directly productive;
- amount for depreciation of buildings;
- annual rental costs of buildings and/or machine-tools;
- TDC acquisition costs;
- material costs for maintenance;
- other direct costs required for production;
- amount of existing equipment in production subunit;
- average duration of operation of the machine-tools.

This cost can be calculated as a sum of costs mentioned above and divided by the total number of manufacturing hours in a year and for all machine-tools from the production subunit. The equation is the following:

$$\text{C}_{\text{subunit}} = \frac{\sum_{k=1}^{7} \text{C}_k}{\text{hours}_{\text{year}}\text{subunit}} [\text{€/Hour}]. \quad (6)$$

Substituting relations (5) and (6) in equation (4), we obtain the manufacturing cost of the studied product. It is given by the following:

$$\text{C}_{\text{man}} = \sum_{i=1}^{n} t_i * \left( \frac{\sum_{j=1}^{10} \text{C}_j}{\text{hours}_{\text{year}}\text{company}} + \frac{\sum_{k=1}^{7} \text{C}_k}{\text{hours}_{\text{year}}\text{subunit}_i} \right) [\text{€}]. \quad (7)$$

Considering the relation (7) given above, and the relation (2), we can write the relation for the cost of an industrial product as follows:

$$\text{C}_p = p*(1+k) + \sum_{i=1}^{n} t_i * \left( \frac{\sum_{j=1}^{10} \text{C}_j}{\text{hours}_{\text{year}}\text{company}} + \frac{\sum_{k=1}^{7} \text{C}_k}{\text{hours}_{\text{year}}\text{subunit}_i} \right) [\text{€}]. \quad (8)$$

3 Cost per hour determination using WinCOST software

All the relations previously presented, were implemented in a software tool named WinCOST and used for calculating the manufacturing total time and cost evaluation of industrial products with high level of customization.
For a friendly user-computer dialogue, an Integrated Development Environment (see figure 1) was developed and implemented. The software system has defined the following components wherefrom the macros can be launched:

- a main menu that contains the environmental commands and macro-commands for development of the workpiece project;
- a toolbar where the principal commands are placed on the buttons;
- a pop-up menu that also contains the principal commands of the environment.

The macros are positioned in the submenu in the order of their calling as follows:
- General data;
- Indirect costs;
- Subunits costs.

The last submenu of WinCOST menu (see figure 2), named Company data, contains three commands that defines the company in which the products under study are manufactured and calculate the cost per hour in each productive subunit.

Using the modal window from the figure 4, for each productive subunit, the same macro allows to the user to input the following data:

- subunit name;
- number of existing machine-tools in the subunit;
- number of shifts;
- number of working hours per shift;
- number of working days in the year.
Fig. 6. Direct cost of a productive subunit

Fig. 7. The costs per hour for each productive subunit

After launching the sequence of three macros from the Company data submenu, the software system automatically calculates the manufacturing cost per hour for each productive subunit. Values thus obtained are stored in the system database and are written in a protected area of the software system (figure 7).

4 Conclusion
The WinCOST software system can be used in industrial companies, mainly with small and medium size, because it has been implemented customization methods allowing calculation of cost per hour for each productive subunit and for whole company. It also calculates the manufacturing total time and estimates costs for each operation and for whole product.

The software system can be used for the industrial products with small and medium dimensions which are manufactured using chip removing and/or cold forming processes.

References: