PRACTICAL ASPECTS REGARDING THE DRAWING OF THE PROCUREMENT PROGRAM WITHIN INDUSTRIAL COMPANIES

CLAUDIA ISAC, CODRUȚA DURA [*]

ABSTRACT: *The rhythmical and continuous activity of the modern industrial company is strongly influenced by the supply of material resources, fuels and energy, ensured in quantities and with the structure imposed by the characteristics of the production process. Accordingly, supplying the necessary materials for the production process represents the material core which ensures the company's adequate operation. Starting from this hypothesis, the paper deals with the laborious phases involved in the process of drawing the material supply program within industrial companies and it illustrates, by means of presenting a mini-case study, calculations which must be pursued in order to obtain an accurate estimation for the main parameters of the procurement plan. Finally, the importance of the above mentioned elements is emphasized by using a realistic managerial approach upon the overall activity of the company, which yields new ways of increasing efficiency, directly derived from the procurement management domain.*

KEY WORDS: *procurement program, the need of material resources, resources for covering consumption requirements, the necessary quantity to be supplied*, *the specific supply consumption norm.*

JEL CLASSIFICATIONS: *L20, M10, M31.*

1. INTRODUCTION

The performances of a company largely depend on the quality of activities carried out within the commercial department. Henry Fayol has expressed in significant terms this axiom when he stated that *knowing how to buy and sell is as important as knowing how turn out production* (Zahiu & Năstase, 2005).

The procurement of material resources represents the activity which provides the necessary elements for production, in a certain quantity, structure and in due time

[*] *Assoc. Prof., Ph.D., University of Petrosani, Romania, isacclaudia@gmail.com*
Assoc. Prof., Ph.D., University of Petrosani, Romania, codrutadura@yahoo.com

so as to ensure a continuous activity at maximum capacity and thus bringing a higher profit (Fundătură, 1999).

On the whole, the role of bringing up of supplies is demonstrated in figure 1.

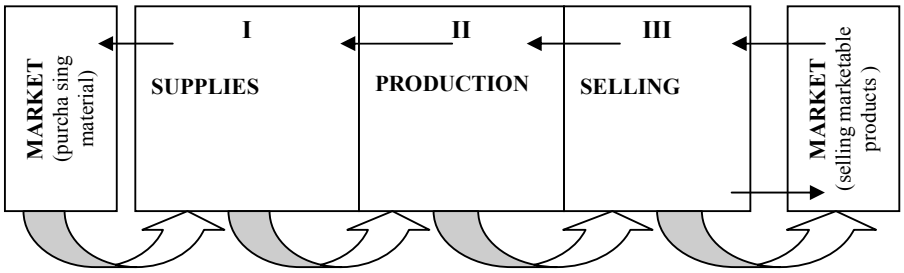

Figure 1. The place occupied by the activity of procurement in the company's economic circuit

The rhythmical and continuous activity of the company is thus conditioned by the procurement of material resources, fuels and energy in quantities and with the structure imposed by production process. On the opposite side, the selling of products resulted from the production process is a requisite for covering the expenses made with material supplies, getting the profit and thus restarting the whole economic circuit of the company. Consequently, supplying the necessary materials for the production process represents the support, the material core of the company's economic activities.

The complexity of purchasing activities carried out in modern companies and the continuous improvement of methods and techniques have led towards a distinct economic science – *procurement management*.

From conceptual point of view, the procurement management is a complex concept associated with a set of activities regarding specific problems of forecasting, scheduling, organization, coordination, program running, control and evaluation of supply processes within the company. From pragmatic point of view, the procurement management is a component of the commercial function which needs to ensure the equilibrium between production requirements and the available material resources which can be used in a company.

2. STAGES OF ELABORATING THE SUPPLY PROGRAM

The process of elaborating the technical material procurement program requires two important stages, such as: **preparing for the procurement program** and **the drawing of the procurement program**, determining the target figures, respectively.

A. During the first **preparatory stage**, the purchasing departments, together with the other departments within the company, are concerned with gathering the necessary data for the program and with preparing the documentation. Thus, the list of material resources is being drawn up and the consumption is being determined for the products and processes involved in the production program.

The list of material resources comprises all the categories of raw materials, energy, water, steam, fuels etc. required by the company to accomplish its objectives and it uses a certain index system. For each type of material resource from the list it is necessary to estimate the consumption corresponding to the production of various products and /or to the processes and services involved in the company's production program.

The specific supply consumption norm represents the maximum quantity of a resource estimated to be used for the production of an element or for carrying out a certain activity in normal technical – organizational and production conditions. The norm of specific consumption has three components: *proper consumption* (representing the quantity of an item which can be identified among the components of the finished product), *material losses* (caused by carrying out the technological process) and the *quantity of recoverable material*. Proper consumption together with the recoverable materials and the technological material losses make up the *specific supply consumption norm*.

In order to determine the consumption norm we can use three different methods (Gavrilă & Lefter, 2004):

- *The analytical method*, based on *determining separately each element of the specific consumption rate* considering the following: the technical – economic documentations for each item (execution drawings, technological charts etc.) as well as the machining allowance, the material weariness indicators etc.;
- *The experimental method* applied in case the technical – economic documentation and the regulations are not available for the use of materials. This method is based on the specialists' experience and intuition, as well as on carrying out analogies with similar products and materials for determining the proper consumption, the recoverable materials and the material losses;
- *The statistical method* uses statistical data to determine future consumption norms; this data refers to real previous consumption norms. It is obvious that this is going to be corrected and updated according to the changes occurred while carrying out production and purchasing activities.

In practice, it is recommendable to use the statistical method to determine the consumption norm, taking into consideration that this is the only approach which provides real consumption norms for each item. Starting from the objective approach of implementing the other two methods – the experimental and the analytical one – we can conclude that they generate approximate values for the specific consumption norms.

B. Elaborating the supply program. This phase can be divided into two important sections, in its turn:

1. determining the indicators which reflect **the need of material resources**: proper requirement for carrying out the production program; requirement for completing the stock of materials by the end of the inventory period and the total requirement of materials;
2. calculating the indicators which reflect **the resources and the coverage of consumption requirements with material resources**: the stock of materials from the beginning of the inventory period;

internal resources which can be used during a year and the quantity of materials which must be purchased.

The elaboration of the procurement program actually consists in determining each indicator, as shown in table 1.

Table 1. The structure of the procurement program

The need of material resources for consumption – REQUIREMENTS	Resources for covering consumption requirements - RESOURCES
1. Requirement for accomplishing the company's production program - N_{pl} 2. Requirement for completing the stock of material resources by the end of the inventory period -S_f 3. Total requirement of materials to achieve production plan - N_t	a) Internal resources of the company: 1. The stock of resources from the beginning of the inventory period - S_i 2. Other internal resources – R_i 3. The quantity of supplies that must be purchased from suppliers - N_a
Total material requirements to accomplish the productive program– N_t	= Total material resources necessary to cover consumption requirements

The determination of the actual input of material resources in order to achieve the production plan can be possible with the help of several methods which, in practice, deal with specific implementation methods according to the field of activity, to the sub-branch or to the company's sector of activity, and also according to the types of products, works or services supplied by them. Moreover, choosing the adequate calculation method depends on the type of material resources, on their source of origin, on the form of supply etc. Among the most frequently implemented methods, we mention the following (Lădar & Prada, 2004; Băşanu & Fundătură, 1999; Gavrilă & Lefter, 2004):

1***. Direct calculation method (the analytical method)*** implies the estimation of the input in order to achieve the production plan through multiplying the forecasted production volume by the specific consumption rate:

$$N_{pl} = \sum_{i=1}^{n} Q_i \cdot n_{ci} \qquad (1)$$

where:

$i = \overline{1,n}$ defines the types of products which include that certain material resource;

Q_i – the scheduled production volume of product "i";

n_{ci} – the norm of specific supply consumption for the material used in manufacturing the product "i".

2. ***The dynamic coefficient method*** has a statistic root and it implies the extrapolation of data regarding the consumption of materials during the reference period for the plan year:

$$N_{pl} = \sum_{i=1}^{n} C_{ef\,i} \cdot I_{Q\,i} \cdot \frac{100 - r_{nc\,i}}{100} \tag{2}$$

where:
C_{efi} represents the actual material consumption during the basic period of producing the item "i";
I_{Qi} – the variation index of the production volume during the plan period (Q_{i1}) as compared to the base period (Q_{i0});
r_{nci} – the forecasted rate of reducing consumption for the material resource used in creating the product „i".

The applicability of this method is limited by the following conditions:

- maintaining production structure during the plan period as compared to the reference period;
- determining the percentage of reducing the consumption in the case of each material and product must have in view the evolution of actual consumptions registered in the previous years and the influence of new technical – organizational conditions forecasted for the plan year.

If the company decides to implement, during the next phase, retooling and modernization programs, the changes in material consumption will be difficult to forecast. As a consequence, the rate of reduction will not always reflect the real effect of technological, technical and organizational changes that may occur in the future. Since the results of this method are approximate, it is mostly used in establishing the input for auxiliary consumption units or for products and services for which the norm of specific consumption has not been determined yet.

3. ***Calculations based on analogy*** are used to determine the input of material for new products, which are to be produced in lots and for which the specific consumption norm, based on technical – economic documentation, have not been determined yet. For this reason, specific consumption norms from other products, turned out previously, are being brought into discussion as they present constructive – technological similarities between them and the new products. The relation used to determine the input of material resources takes a general form:

$$N_{pl} = \sum_{i=1}^{n} Q_{ni} \cdot n_{cai} \cdot (1 \pm K_i) \tag{3}$$

where:
Q_{ni} represents the scheduled quantity of the new product "i" produced during the plan year;
n_{cai} – the norms of specific consumption taken from analogue products;
K_i – the correction coefficient which reflects the constructive differences (i.e. weight, size, complexity etc.) between the new products and the analogue ones.

The results obtained through implementing this method largely depend on the real size of the correction coefficient, or, to be more precise, on the relative degree of

expressing the differences between products with the help of K coefficient. This method of calculation based on analogy is used to estimate the input of material for the following period, after introducing the new product in serial production; by the time it is assimilated by serial production, the norms of specific consumption for each constructive variant will have been determined, starting from the information contained in the technical – economic documentation.

4. ***Calculations based on the type of product*** are used by companies which turn out a wide range of products (textile companies, garment enterprises, food industry etc.) and present significant variations regarding the production structure for each product, as a result of the influences brought about by fashion, seasons, unpredicted orders etc. In order to be able to make the calculations, the type of products must be determined first, meaning that certain type of product which has a rate of consumption closer to the average consumption rate ($\overline{n_c}$) which has been determined for the entire range of products, using the following formula:

$$\overline{n_c} = \frac{\sum_{i=1}^{n} Q_{i0} \cdot n_{ci}}{\sum_{i=1}^{n} Q_{i0}} \tag{4}$$

where Q_{i0} represents the quantity of products "i" turned out during the reference period.

The actual material input can be determined as follows:

$$N_{pl} = \sum_{i=1}^{n} Q_i \cdot n_{csti} \tag{5}$$

where n_{csti} represents the norm of specific consumption for type "i" of product.

Practice has proven that this method usually leads to establishing an input of material which is greater than the real one and this is due, mainly, to large weight of the type of product within the total production volume as compared to other types of product.

This is why the area of applicability of this method is limited; this process is also influenced by the fact that electronic techniques come in handy and they are extremely valuable in carrying out rapidly and effectively some hard projects regarding a coherent procurement program based on science. Under the circumstances, the direct method is by far the most realistic mean of estimating the necessary material resources used in carrying out the company's activities.

Another important indicator of the technical – material supply program is the **stock at the end of the plan period (S_f)**, which equals the safety stock (S_{sig}):

$$S_f = S_{sig} \tag{6}$$

The safety stock (S_{sig}) represents the available quantity of materials which must exist in the company in order to ensure the continuity of the production process in case the current stock has been used up, and the ordered items have not been delivered by suppliers in due time because of purchasing failure. The safety stock is determined with the help of the direct method and it represents a multiplication of the daily average consumption by the sum of the units of time necessary to supply the company with the required material resources:

$$S_{sig} = Cmz \cdot (t_1 + t_2 + t_3 + t_4) \tag{7}$$

where:
Cmz – is the daily average consumption;
t_1 – the time necessary to contact, negotiate and sign contract with suppliers;
t_2 – the time necessary to prepare material resources for delivery;
t_3 – the time necessary to transport materials from suppliers to beneficiaries;
t_4 – the time necessary to load – unload, to receive, manipulate and store material resources.

In its turn, *the daily average consumption* (Cmz) refers to the average quantity of materials used by the company during the inventory period and it can be determined through the relation of the actual material input to the number of working days (N_{zl}):

$$Cmz = \frac{N_{pl}}{N_{zl}} \tag{8}$$

So that the activity could be carried out in normal conditions, specialists recommend for industrial companies and for companies from the construction field and services to make other stocks as well, beside the safety stock. Thus, according to internal and external conditions, to the type of material resources, to the characteristics of production processes, to the localization of consumption units, as well as according to some other factors, companies make and control, most frequently, the following categories of stocks: current stocks, preparatory (conditioning) stocks, internal transport stocks, safety stocks, seasonal stocks.

The current stock (S_c) represents the quantity of material resources destined to ensure the continuity of the production process between two consecutive supplies, in normal activity conditions. Controlling the current stock uses the following relation:

$$S_c = Cmz \cdot \bar{I} \tag{9}$$

where $\bar{I}$ - represents the average period between two consecutive deliveries (expressed in days) as stipulated in the contracts signed by suppliers and beneficiaries.

The preparatory (conditioning) stock exists on condition the characteristics of production flows within some companies impose a preliminary preparation of materials before using them in production (for example, drying timber used in furniture industries, packing cotton used in textile industry, chipping some materials used in

machine industry etc.) The preparatory stock is determined using the following relation:

$$S_{pr} = Cmz \cdot t_{pr} \quad (10)$$

where t_{pr} - refers to the period of time necessary to carry out preparations for a certain type of item.

The stock for internal transportation (S_{tr}) represents the quantity of material resources obtained during the release and the transportation of materials from the central stockyard to the places of consumption. This type of stocks is made only in case of companies which operate subsidiaries located all over the area within significant distances from the central stockyard. In order to calculate the internal transport stock, we use the following relations:

$$S_{tr} = Cmz \cdot t_{d} \quad (11)$$

where t_d refers to the period of time necessary to transport material resources from the central stockyard to consumption units.

It is noticeable that there is a number of companies which do not separate the transportation stock from the current stock. This decision can be justified by the fact that considering this stock separately would only increase the volume of circulating means and it would reduce their rotation speed; this will lead to poor efficiency indicators of the activity carried out.

The seasonal stock defines the quantity of materials stored in the company's stockyards meant to supply continuously the consumption units in harsh natural and climate conditions when the supply of materials may be blocked. The seasonal stock can be determined using the relation below:

$$S_{sez} = Cmz \cdot t_{î} \quad (12)$$

where t_i refers to the number of interruptions (expressed in days) occurred in supplying a certain item.

By summing up the types of stock presented above we obtain the total volume of the rate stock for the company (S_n):

$$S_n = S_{sig} + S_c + S_{pr} + S_{tr} + S_{sez} \quad (13)$$

It is imperative to establish an optimum level of the rate of stock for the efficiency of the activity carried out in a company, having in view the fact that a level under requirements may cause interruptions in production; at the same time, a stock level above requirements brings about overstocks which have a negative influence upon the company's economic – financial flows.

Finally, the determination of the total demand of material resources gives a general insight into the first part of the procurement program which means to identify the requirements of material resources (thus the data will be entered in the first column of table 1). The total demand of materials (N_t) can be determined by summing up the

actual material requirement for achieving the production plan with the stock of materials form the end of the plan period (S_f):

$$N_t = N_{pl} + S_f \tag{14}$$

The process of identifying the sources for covering the demands must take into consideration the following:

1. The first possible source may be **the stock of materials from the beginning of the scheduled period** (S_i). This refers to the estimated quantity of material resources which exists in the company's stockyard at the beginning of the period with a view to cover the consumption requirements during the first days. At the time of elaborating the procurement program, the stock from the beginning of the period has a preliminary characteristic.

The main material base for this source is the actual production stock (S_{ef}) from the previous period which can still be found in the company's stockyard. Moreover, due to the stock book (which registers the level of the real stock for each material resource) and to a correlative control of the supply contracts, to the rate of releasing materials from the stockyard, respectively, we can determine the preliminary stock for the beginning of the plan period as follows:

$$S_i = S_{ef} + I_i - C_i = S_{ef} + I_i - Q_{pl} \cdot n_{ci} \tag{15}$$

where:
I_i – the inputs of item "i" from the beginning of the procurement program till the beginning of the plan period;
C_i – consumption of item "i" from the estimation period till the end of the plan period;
Q_{pl} – the volume of scheduled production from the beginning of the plan till the end of the inventory period.

It is worth mentioning that the inputs and outputs from the current year used in this formula (15) have estimated values because, as we have already said, the supply program had been set up before the beginning of the actual plan period. This preliminary stock is going to suffer some corrections according to the material resource inventory which takes place before the beginning of the forecasting period; thus, S_i will become the real stock. Adjusting the preliminary stocks results in additional corrections made on a series of other plan indicators, among which the most important is, undoubtedly, the necessary supply.

2. ***The internal resources*** (R_i) represent another way of covering part of the material supplies. It refers to various types of material resources which are produced by the company and can be delivered by the company's subunits (production sectors or workshops), as well as, to recoverable materials from technological processes which can be re-introduced in the internal consumption (strips, boring dust, oils etc.). The category of internal resources also includes recycling materials and items resulted from breaking up fixed assets or from rejected products. Enterprises from developed countries pay great attention to the process of re-introducing recoverable materials into the economic cycle; companies from outside the country should also follow this

tendency, considering the fact that this orientation represents a virgin territory for reducing production costs, for increasing economic efficiency, as well as for developing concerns regarding environment protection problems.

3. ***The necessary stock to be supplied*** (N_a) reflects the quantities of materials which are to be purchased from suppliers during the inventory period, with a view to complete the stock. It is determined using the following formula:

$$N_a = N_{pl} + S_f - S_i - R_i \text{ or } N_a = N_t - S_i - R_i \quad (18)$$

When the company does not have enough internal material resources which could be used in the process, the formula from above does not include that certain resource:

$$N_a = N_{pl} + S_f - S_i \text{ or } N_a = N_t - S_i \quad (19)$$

The materials purchased from external suppliers are in fact the most important source for covering the company's stock of consumption. That is why, employees responsible for the purchasing activity must contact the suppliers in time, must negotiate and sign contracts with the local or foreign suppliers.

The indicator of the stock necessary to be supplied may suffer, however, a series of corrections in the long run, after the first calculations have been made with a formula like (18) or (19). Thus, the first adjustment is usually made at the beginning of the inventory period and it is compulsory because of the differences which may result from the process of comparing the preliminary stock with the real one, resulted from the inventory. This correction can be made with the help of the following relation:

$$N_{aC} = N_a \pm \Delta S_i \quad (20)$$

where:

N_{aC} – the adjusted stock to be supplied;

ΔS_i – the differences (according to the inventory) between the preliminary level of the stock and the real one for item "*i*".

Updating the stock which needs to be supplied may result in increasing or decreasing the value of this indicator as compared to preliminary calculations; this will require immediate measures to purchase additional quantities of supplies or to identify additional internal resources, as the case may be. The evaluation of the stock that needs to be supplied can be done during the inventory period as well, and every time the initial internal conditions modify or the changing of some influence factors from the environment may require that.

3. CASE STUDY REGARDING THE DETERMINATION OF THE STOCK NECESSARY TO COMPLETE THE PROCUREMENT PLAN FOR A MACHINE BUILDING COMPANY

Let's take for example the case of an industrial company within the machine building field which currently turns out two products: X and Y (Crăciun, et al, 2003). Product Y has three constructive variants: Y_1, Y_2 and Y_3. The following year, the company is going to turn out a new product Z. All these products use the raw material M.

In order to determine the supply plan for this raw material, we have come up with the following information:

- the production program established for the following year estimates a turnout of 1500 t of product X, 1800 t of product Y and 800 t of product Z;
- the specific consumption of raw material M for products X amounts to 500 kg/t;
- the new product Z resembles product X, except for the fact that it weighs by 15% less (K=15%);
- at the time of elaborating the plan, we do not know exactly how the total production volume of product Y was distributed for each type of constructive variant. During the current year, the production and the specific consumption for the three items can be seen in the table below:

Table 2. The production program and specific consumption norms

Item	Annual production program (t) - Q_{i0}	Specific consumption norms - n_{ci} (kg/t)
Y_1	600	700
Y_2	400	500
Y_3	500	350

- at the beginning of the process of elaborating the supply plan (October, 27th), 125 t of raw material M could be found in the company's stockyard ;
- by the end of the current year, there will have been a material input of 95 t;
- it is estimated that, by the end of the current year, 3 t of material M will have been used daily;
- it is desired that by the end of the following year, the company's stock size would reach 70 t.

The determination of **the stock necessary to complete the plan** can be done by adding up the stock of raw material necessary for each item. In order to calculate the stock, appropriate methods will be used, taking into consideration all the information available.

$$N_{pl} = N_{pl}^{X} + N_{pl}^{Y} + N_{pl}^{Z} \tag{21}$$

In the case of product X, **the direct calculation method** will be used. We shall use formula (1):

$$N_{pl} = \sum_{i=1}^{n} O_i \cdot n_{ci} \tag{22}$$

where:

$\overline{i = 1, n}$ defines the types of products which include M material resource;

Q_i – the scheduled production volume of product "i";

n_{ci} – the norm of specific supply consumption for the material used in creating the product "i".

Hence, $N_{pl}^{X} = 1.500 \times 500 = 750.000kg = 750t$.

In the case of product Y, we shall use **the method based on the type of item**. Thus we can determine the type of item through calculating the specific average consumption based on the current year's production program. The item with a specific consumption close to the average consumption will be considered the reference type.

$$\overline{n_c} = \frac{\sum_{i=1}^{n} O_{i0} \cdot n_{ci}}{\sum_{i=1}^{n} O_{i0}} = \frac{600 \cdot 700 + 400 \cdot 500 + 500 \cdot 350}{600 + 400 + 500} = 530 \text{ kg/t}$$

It is noticeable that Y_2 is the reference type.

As a result, the required quantity for accomplishing the plan will be:

$$N_{pl} = \sum_{i=1}^{n} O_i \cdot n_{csti}$$

where n_{csti} represents the norm of specific consumption for type "i" of product.

$$N_{pl}^{Y} = 1800 \cdot 530 = 954.000kg = 954t$$

In the case of product Z, a new product, we shall use t**he method based on analogy**. The formula is:

$$N_{pl} = \sum_{i=1}^{n} O_{ni} \cdot n_{cai} \cdot \left(1 \pm K_i\right)$$

where Q_{ni} represents the scheduled quantity of the new product "i" produced during the plan year;

n_{cai} – the norms of specific consumption taken from analogue products;

K_i – the correction coefficient which reflects the constructive differences (weight, size, complexity etc.) between the new products and the analogue ones.

$$N_{pl}^{Z} = 800 \cdot 500 \cdot \left(1 - 15/100\right) = 340000kg = 340t$$

The total quantity of supplies necessary in order to complete the plan (N_{pl}) is determined as follows:

$$N_{pl} = N_{pl}^{X} + N_{pl}^{Y} + N_{pl}^{Z} = 750 + 954 + 340 = 2044t$$

The necessary quantity of supplies (N_a) can be calculated starting from the formula below:

$$N_a = N_{pl} + S_f - S_i - R_i$$

The stock at the end of the inventory period will reach 70 t.

The preliminary stock of material resources for the beginning of the inventory period is determined by the following formula:

$$S_i = S_{ef} + I_0 - C_0$$

where S_{ef} – the level of stock based on an inventory at the time of elaborating the strategic supply plan (its size equals 125 t);
I_0 – material input available since the moment of strategic supply plan elaboration up to the inventory period (the amount of material input is 95 t);
C_0 – material consumption during the input period.

C_0 is determined by multiplying *the daily average consumption* to the working days remained until the end of the current year (73 days).

Based on this information we can determine the size of the stock at the beginning of the period:

$$S_i = 125 + 95 - 2t / zi \times 73\ zile = 74\ t$$

Finally, the necessary quantity to be purchased from suppliers for item M will be:

$$N_a = 340 + 70 - 74 = 336\ t$$

The elements mentioned above are important from the point of view of identifying the means of making the company effective, considering that the profit represents the difference between the unit price of the finished product and the average costs; the price is mainly determined by market conditions. As a result, the reduction of costs is the main way to increase the company's effectiveness, while the percentage of material resources in the unit cost of the product has, in most cases, significant values.

As a consequence, carrying out the purchasing activity in a rational way is important for reducing costs; these costs may provide possible sources of profit in the future.

4. CONCLUSIONS

Procurement management incorporates, as a whole, the entire flow of material resources in an industrial company, starting from the taking up of the providing process until the resources are converted into marketable products, namely from the moment when a necessity of resources is determined, continuing with provider's choosing, the purchasing phase, the transport phase, the storage phase, and finally, reaching the consume stage and the control of using material resources in order to get maximum effects from the amount of money spent on inputs for the production process.

Nowadays, the importance of the procurement system within industrial companies has increased substantially, as it came out that the weight of the value of material resources supplied for the production is significant, ranging from 50% to nearly 80% in certain industrial branches (Băşanu & Pricop). Therefore, any effort made in the procurement area - such as finding new providers with smaller prices or identifying equivalent material resources that could be used with comparable outcomes - can induce notable positive effects as far as the efficiency is concerned.

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