

PRODUCTION DATA COLLECTION, EXPOSURE AND ANALYSIS IN A SMALL PRODUCTION ENTERPRISE

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Subject review

The paper shows the reader to the basic problems involved in the collection of data on production. It shows that there is the necessity of data collecting describes possible methods and advantages resulting from data analysis. It also refers to the systems of class ERP. It demonstrates, too, a simple way in which the system of data collection, exposure and analysis can be organized in a small firm, with a discussion of advantages to be taken of it.

Keywords: data collection, ERP class systems, forecasts

Prikupljanje proizvodnih podataka, izlaganje i analiza u malim proizvodnim poduzećima

Pregledni članak

Rad uvodi čitatelja u osnovne probleme prikupljanja proizvodnih podataka. Pokazuje da postoji potreba prikupljanja podataka, opisuje moguće metode i prednosti dobivene analizom podataka. Također upućuje na sustave ERP klase. Isto tako demonstrira jednostavan način na koji se sustav prikupljanja podataka, izlaganja i analize može organizirati u malom poduzeću, te iznosi prednosti koje se na taj način mogu steći.

Ključne riječi: predviđanja, prikupljanje podataka, sustavi ERP klase

1 Introduction

Data collection and processing is very important for a company management. It is a necessary condition for quick response to the market dynamics. The proper response should be aiming at the elimination of problem sources, at improvement of the processes executed in the company [1]. This is made possible (among others) by data collection. Data collection allows for the analysis of the causes of various phenomena in any period of time, current assessment and forecasting future states. It also gives an opportunity to determine various indices important for the existence of the company as, for example, the efficiency of the production process - number of products made by an employee in one hour while executing a given process [2].

The tools serving it can have various forms. The simplest form of data stored on paper no longer has the right to exist. Modern forms have replaced them long time ago. Today, those are often complicated computer systems with automatic parameter measurement and immediate generation of coefficients. They ensure permanent access to the data at any time and location on the globe. They offer the possibility to compare the results of firms, companies, departments or even individual employees. They also enable planning of material demands. Then, they are labelled class MRP (Materials Requirements Planning) systems and bring measurable benefits. An MRP system enables relatively low level of reserve to be maintained, but it requires a precise production plan [3]. More complex systems comprise larger management areas. In the basic version, the MRP II system, considering plan of sales or even business plan as a basis, performs an initial balancing of the production capacity. Positive results of the balance (i.e. determination that the possessed resources enable the aggregated orders to be realized) make detailed analysis of the production ability possible and, on that basis supplies and production can be controlled (operational program can be elaborated

and the work progress can be monitored [3]. This version can be extended to include further areas in addition to the modules characteristic of the MRP II which are:

- module of capacity requirements planning (CRP),
- module of material requirements planning (MRP),
- module of master production scheduling (MPS),
- module of shop floor control (SFC).

Modules involving accountancy, bookkeeping, controlling fixed assets, sales service and many others (e.g. ones involved in material economy or business planning) have been created. Systems of this type, expanded as compared to MRP II, are often referred to as the systems of enterprise resources planning (ERP) [3]. Moreover, in the ERP/MRP III method, mechanisms enabling simulation of various steps and analysis of their results, also the financial ones, are commonly applied. This allows all actions to be precisely planned, tested and compared [4]. They usually have complicated form which can discourage small and medium businessmen to the implementation and utilization of those systems.

However, it is possible to build a simple tool based on the Excel program. It has many advantages and, as for the beginning, offers much possibility. The employer in a small enterprise usually keeps everything in his mind but this does not guarantee that mistakes are always avoided. Seeing the state of affairs on the computer screen, one can more easily consider it and get back to the given problem at any time. Work with such a tool shows its advantages for the firm and enables one to believe that professional tools are worth investment.

2 The example of the system for collecting and analysis of production data

The example presented here functions in a production enterprise employing about 80 %, approximately 70 % of them being production employees. The firm manufactures two kinds of products for household equipment and for

construction industry. The production is not technically highly advanced and is based on simple devices and manual labour of man. The system has been functioning for three years and is continually being modified, which is certainly its advantage. In this way, one can make corrections and introduce such indices as are necessary at the moment. Due to it, there is no necessity to generate costs for employing expensive external service. Modifications are now effected by one person authorized to perform this type of actions upon the order of the manager of the enterprise. So far, the system has helped to solve several technical problems and has put in order the processes involved in accounting for the work effects of the individual departments and employees.

The system has been created on the basis of the Excel program. It developed as the firm evolved and the staff responsible for production recognized the advantages of its functioning. At the beginning, there was one computer (Fig. 1) with one table in which, in addition to the date and time of the work start, the plan of works to be done was recorded, as well as the degree of realization at the end of the day and notes concerning events and technical details of production. Tasks to be done in the nearest future were recorded in advance. Gradually, the system developed. The amount of data and the number of persons involved in collecting them increased.

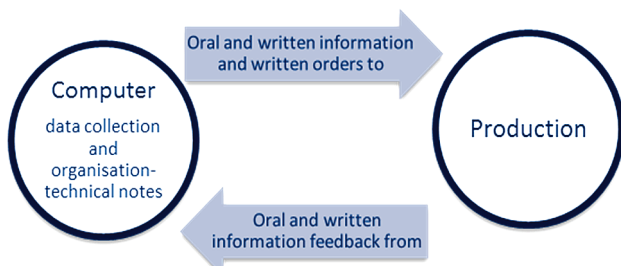


Figure 1 The principle of operation of the data collection and analysis system

Perception of advantages, possibilities and the subsequent necessities related to the possibilities of this simple solution has resulted in the creation of the system in its present version. There are a number of computers involved in the system. The data are entered into all of them and are visible in all of them due to which there is a possibility of current monitoring. Each computer has two logins. One of them has the name of the department. The password is known to each employee. After logging, only reading is possible. The other login, together with the password, enables an authorized employee of the department to interfere. The possibility to interfere in the system is determined by the authorization.

The management has the possibility of total monitoring and interference in the system. The authorization of foremen and other authorized employees is limited to reading and entering the data about the results of tasks they have performed without the possibility to correct a mistake once it had been entered. Correction can be effected only by the production manager after the check of the actual state. Possible mistake in one department, e.g. a production one, will appear after another department, e.g. machining, if the quantities are not in conformance. The present state of the

system development can be seen in Fig. 2. From the post of the production manager, one can create simulations of various phenomena and forecasts for the subsequent accounting periods.

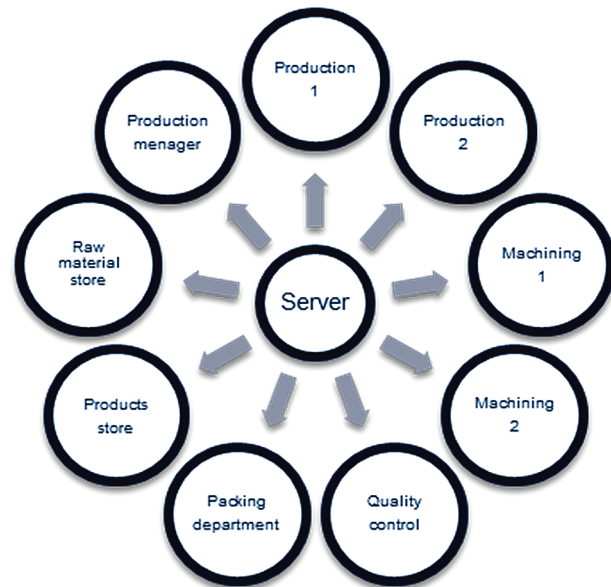


Figure 2 The present day state of the system in the enterprise

At the moment, all the departments and even special machining stands possess a computer with an application elaborated for the firm's needs in Excel program. Access is granted to each employee, which enables him to currently control the results of his work. All the computers collaborate via the server. Checking the production assignments is the responsibility of the authorized persons prior to the start of each shift and reporting no later than 15 minutes before the end of the shift. Records concerning the course of the shift are currently entered in the predetermined locations of the sheets or with the use of the so called comments.

3 The present state and description of the functions

The present appearance and the whole system are a result of the firm evolution, as well as permanent search for guidelines on the process optimization while maintaining low costs. It is an advantage of the system that it can be modified at any time to adapt to the current needs without the necessity to employ and pay for external service. Modifications mostly consist of addition of indices we are interested in at the given moment, and necessary for analyses. They also consist in removing of the data which certainly do not bring any profit to the firm's operation but merely obscure the image and make conclusions difficult.

The system consists of an Excel file which is visible on the console under the name of the given month. The file consists of a predetermined number of sheets. The names of the individual sheets are the names of the firm organizational units. The main role is played by the locations to which the current production data from the departments are entered. This facilitates the analysis of actions and results with division into the individual departments. Each sheet contains the firm data, the name of the department and calendar data: the individual days,

weeks and the total number of working days in the month. On their basis, later analyses are affected. Each sheet is connected to other sheets via formulas enabling data from other production units to be used. The basic data on the period which the file concerns are to be updated in the main sheet only; in the other ones they will be updated automatically.

The system appearance, its visualization on the screen, is up to the persons creating it. Here, Excel offers broad possibilities. An important thing is the easiness of moving in the system and legibility. The first sheet, shown in Fig. 3, contains collective assemblies of the results of all the departments, reference to the forecast always made prior to the subsequent accounting period, the percentage of the

forecast realization. One can also find here information on the consumption of the basic raw material calculated on the basis of the number of pieces produced on the given day, incrementally in the period of a month, as well as the average consumption per one piece. This allows information about the necessity to generate orders for the raw material with an allowance for the time of delivery. This has an advantageous influence on the minimization of the warehouse reserve of the raw material. The page contains also information on the number of defective pieces and the number of pieces subjected to final machining. The set of all the information contained in the system at the moment can be found in Tab. 1.

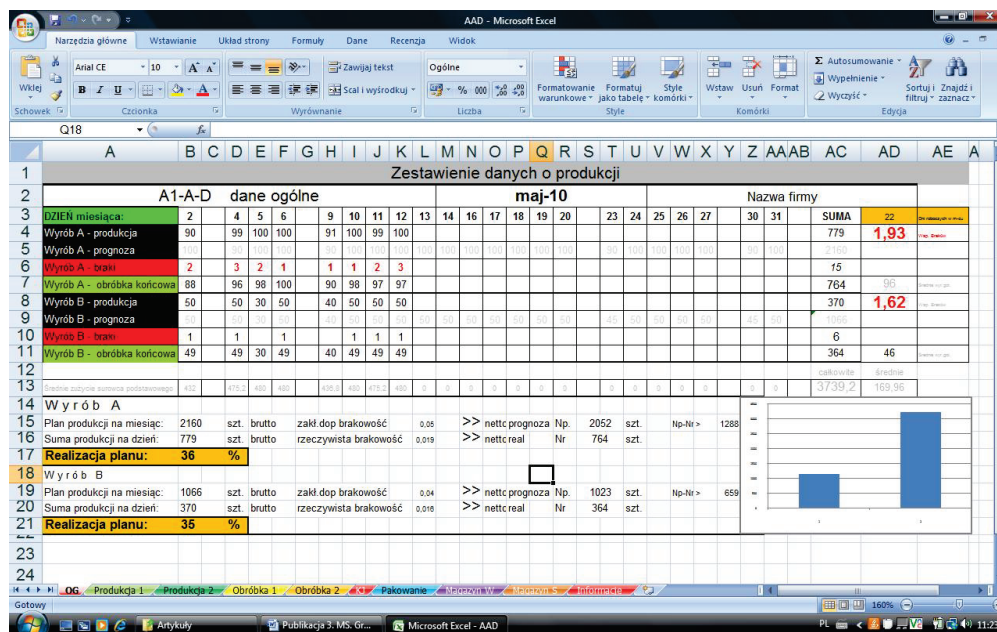


Figure 3 Starting sheet of the system

Table 1 List of the data

Item	Department name	Data entered by authorized employee	Indices and data generated by formulas
1	Main collective sheet	- data automatically generated from other sheets	- collective assemblies of the results of all departments, - percentage of forecast realization, - average daily and monthly consumption of the basic raw material calculated based on the number of pieces produced on the given day
2	Production department	- number of pieces made by the brigade and by each of its workers separately, - total number of defective pieces made by the brigade and by each employee - notes	- percentage of the plan execution, - productivity – number of pieces made per one person, - quantity of raw material used by the brigade in kg, - the amount of bonus gained or lost by each employee, incrementally, at the end of the period, - employee's contribution in days as related to all the working days in the accounting period
3	Machining department 1	- number of pieces subjected to machining by each employee of the department, - notes	- total number of pieces subjected to machining on the day and in the month, - daily norm of an employee and the portion executed in pieces and in %, in the month, - the amount of bonus due to or lost by the employee, depending on the portion of norm realized in the month

Table 1 List of the data (continued)

Item	Department name	Data entered by authorized employee	Indices and data generated by formulas
4	Machining department 2	- number of pieces subjected by each employee of the department, - total number of more difficult pieces subjected to machining by each employee of the department, - notes	- total number of pieces subjected to machining on the day and in the month, - number of more difficult pieces subjected to machining on the day and in the month, - daily norm of an employee and the portion executed in pieces and in %, - the amount of bonus due to or lost by the employee, depending on the portion of norm realized in the month, - percentage of more difficult pieces
5	Quality control department – defective pieces	- number of pieces subjected to checking by each employee-inspector including the number of pieces accepted, - number of pieces rejected as unsuitable, - number of pieces unsuitable rejected for obvious undisputable reasons	- total number of pieces subjected to checking by each employee – inspector including the number of pieces accepted, number of pieces rejected as unsuitable, number of pieces rejected for obvious undisputable reasons, counted for each quality inspector, as well as for all the department - general percentage of defective pieces in the whole production
6	Product packing department	- number of pieces packed by each employee separately, - notes	- total number of products packed by the department and each employee separately, - daily norm of an employee and the degree of its execution in the month, in pieces and in %, - the amount of bonus due to or lost by the employee, depending on the portion of norm realized in the month
7	Warehouse of ready products	- number of readymade products leaving the warehouse on the given day as divided into customers, - notes	- total number of readymade products leaving the warehouse on the given day or month as divided into customers, - trends of total sale and for key clients
8	Raw material warehouse	- quantity of the basic raw material released to production on a day, - notes	- total quantity of the basic raw material released to production on the day, in the month
9	Weekly analysis of discarded pieces	- defective pieces grouped for production brigades or individual employees, characteristic data of the product (size, colour etc.), reason of rejection (a dozen or so most frequent possibilities to choose)	- total number of rejected pieces, - percentage of defective pieces in the individual categories with the indication of the major reasons in the given period, - trends of the spoilage factor
10	Special notes and remarks	- notes concerning particular events taking place in the shift and work organization, suggestions and proposals	- none

4 Conclusions

Each system of data collection, exposure and analysis, even the simplest one, is an indispensable tool supporting management. The system described in the present paper is practically utilized in a production firm. It possesses many advantages. First of all, it is cheap. Elaboration of it requires no additional cost. Hence, it can be built in any firm. It is easy to use, does not require special training – internal training suffices. It makes permanent quick access to current or historical data possible. Access to the system via the server can be granted to any number of internal users. Thanks to the internet, the owner can monitor the results from any location in the world. The system makes it possible to compare many indices, from the comparison of the results

of brigades or employees, comparison of periods, recognition of trends, to the creation of reports, assemblies and diagrams for various needs and the employees themselves. Thanks to the analysis, production limitations are easier to identify. A significant part of the collected and processed data can be a basis for the creation of budgets for future financial periods. This can be affected in combination with the analyses and data from marketing, accountancy, investment plans, etc. It is also an advantage that comments can be added to each of the data facilitating later interpretation, particularly in a long period of time. There is a possibility of monitoring both manufacturing parameters and those related to the introduction of a new product to the market.

Basing on the monthly reports, the managing staff themselves can, to a large extent, check whether they

have reached the predetermined objectives. The deviations found are a basis for remedies to be undertaken in the departments subordinated to them [5].

By properly developed sheets and elaborated formulas, the system can signal mistakes accidentally or purposely made when entering the data. It can also generate any number of diagrams (Fig. 4).

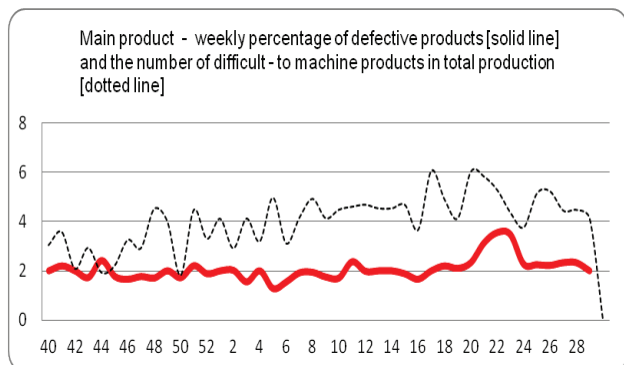


Figure 4 Example of an analysis of the system

Fig. 4 shows the diagram of a defective product and the portion of the more difficult finish machining. The analysis is currently performed in week periods. It shows problems between the 21st and the 24th week. Detailed examination of the basic raw material composition has proved a change of one of the components, so far considered to be of minor importance.

It should be kept in mind, however, that too large quantity obscures the image and makes interpretation difficult. That is why it is worthwhile to create the system in a well-considered, professional way rendering actual advantages.

A kind of drawback, as compared to professional systems, is, of course, the necessity of manual entering of the data. The person responsible for the unit management must rely on trusted employees or build a system ensuring error signalling on the screen.

In spite of that, such a system of data handling is recommendable, particularly to small enterprises which cannot afford purchasing professional devices of this kind.

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