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SYSTEM DO POMIARU WYDAJNOŚCI W PRZEDSIĘBIORSTWIE

Streszczenie: Wydajność jest jednym z czynników, który każde z przedsiębiorstw musi uwzględniać i analizować. Aby można było wydajność monitorować w sposób stały i wiarygodny, potrzebny jest system jej oceny. Taki system opisano w niniejszym artykule. Osiąganie pożądanej wydajności wymaga wdrożenia stałego procesu z możliwością natychmiastowego reagowania i wprowadzania koniecznych usprawnień.

Słowa kluczowe: wydajność, efektywność, dźwignie produktywności, system oceny/mierzenia wydajności, częściowa wydajność, wydajność wieloczynnikowa.

ENTERPRISE PRODUCTIVITY MEASUREMENT SYSTEM

Abstract: Productivity is one of the topics, that the business should be involved in. For its proper monitoring, it is necessary to design a system for analysis, measurement, whose proposal is described in the article. Productivity requires a continuous process of doing things today better than yesterday and tomorrow better than today.

Keywords: Productivity, efficiency, productivity levers, multifactor productivity, partial productivity, productivity measurement system.

1. Introduction

The arrival of the 21st century all countries have begun to strive with a never-changing set of challenges. The most popular current and future periods are, in practical, the globalisation of the economy, the transition from mass production to customer-oriented production, the flexible and high growth of competitiveness, the transition from cost factors to innovation and total efficiency and flexibility. All

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these signs and their growth can be ensuring only in the case of a corresponding level of productivity, either in enterprises or in the national economy. It is important to increase productivity, this has led to it, that an objective is transnational character.

1.1. Productivity

Productivity is a key to maintaining competitiveness, not only in organisation, but also in states in ensuring socio-economic development. Various productivity tools, techniques, methods and practices that have been developed and accepted over the years in the production and consumption of goods and services, are essential to the dynamism and development of the economy. The concept of productivity has evolved over the years to represent more, than just an effective ratio between inputs and outputs. The task of the system is to help correctly measure productivity, current defining of pitfalls, productivity barriers, and bottlenecks in processes and by using appropriate tools, techniques and methods productivity to increase. Productivity is ratio between quantity of outputs O (manufactured goods and services) and quantity of inputs (resources such as materials, machines and energy), which are used in production. [5,4]

1.2. Measuring productivity

Regular implementation of productivity measurement in enterprises is very important. Productivity can be measured on a partial or total basis at the individual assembly and production section or at the company level. Productivity measurement identifies factors, that affect revenue, added value and help in prioritising decision-making. Introducing productivity measurement into a company can increase productivity by 5% by 10% without change or investment. Productivity measurement is essentially process of identifying the appropriate measures or metrics, to be used and calculating their results in order to determine the efficiency and effectiveness of the resources used. As explained above, productivity is ratio between outputs and inputs. This is the reason why measured outputs and inputs with productivity levers (Figure 1) is key to increasing productivity. [2,6]

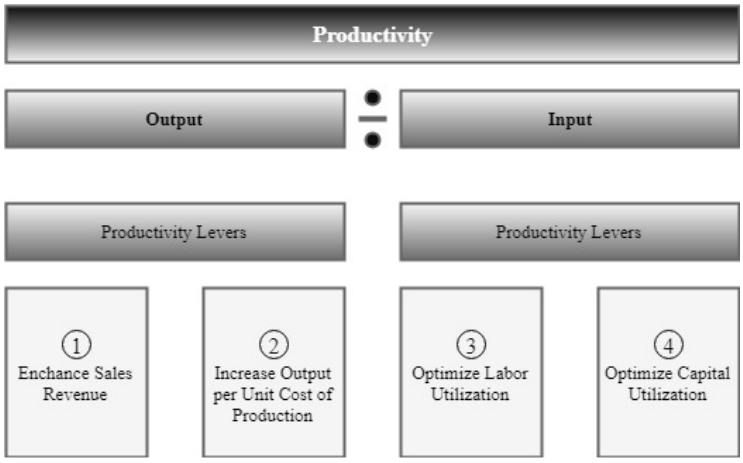

Figure 1. Productivity levers [6]

Once productivity levers are created a structured approach can by accepted to measure key productivity indicators and productivity indicators from both pairs of productivity levers. The key steps of an efficient productivity measurement system are shown in the Figure 2. [3,4]

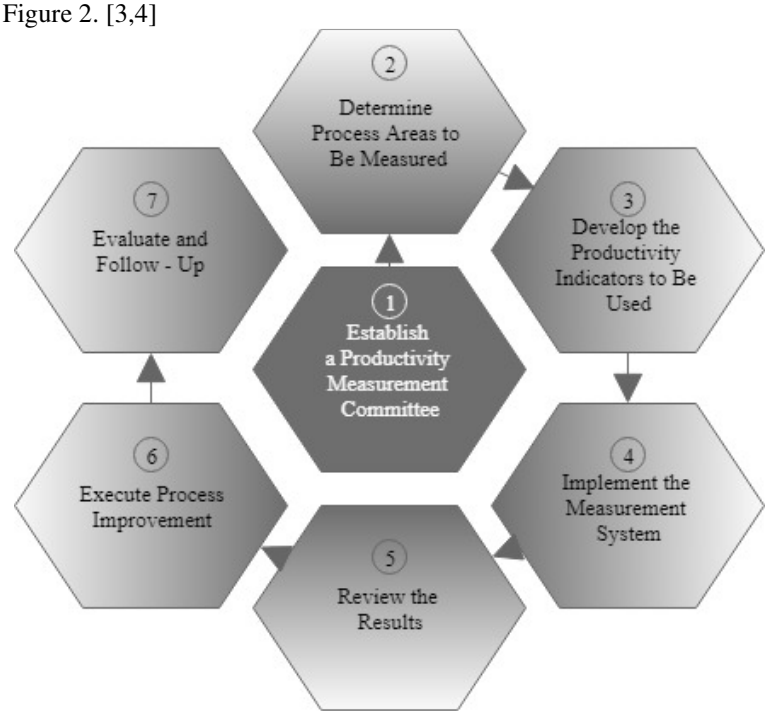

Figure 2. Productivity measurement system [4]

Phase of growth of company and performance is the best time for start of productivity programs, so the company has enough time and funding for this time of program. In a phase of decline in performance, the company is forced into a productivity boost program and the whole program runs in time stress and pressure. Productivity is then increased only by the simplest ways, such as reducing staff, cutting down standards without sufficiently detailed analysis, etc. At the company´s bankruptcy phase, when the company begins to experience Cash Flow and liquidity problems, in usually comes to crisis management, and to a sophisticated program to increase productivity is neither time nor resources. [1]

2. Productivity measurement system

Productivity in the company, where the proposal for a new productivity measurement system has been implemented has so far been measured as ration between measured timed and times of operation, where were included in this calculation were, for example, standard production time, prototype time, additional order, production of specials that require adjustment, overheads and trainings, and others. For some of these times, it is necessary to use the real time of production, not the time standard, because the given times are specific for each contract. The calculation also uses a 10%

share of the total service time, that includes the employee´s work in the warehouse and the time when employee does not work on the assembly of the components, thus there is a non-productive time. For proper growth and development of the company is important to measure productivity properly. Produced productivity measurement system is one of the solutions to this issue. The system will help map productivity at the company at the all levels of the organisational structure. [1]

2.1. Indicators of productivity

The indicators used in the system in consultation with the management of the company productivity department, these indicators are characterising below:

- Number of pieces produced - the sum of the pieces assembled at the appropriate level of the company´s organisational structure per the time period considered. The company using identification barcodes on all the components included in the production tracks this indicator.
- Worked hours – it is sum of all employee´s hours per relevant time period.
- Numbers of employees – the indicator is monitored through attendance records of employees at the all levels of the organisational structure and it is monitored per week.
- Labour costs – the sum of the wage costs of the employees in the production. This data is track only at the company level, and this data should be track at the lower levels.
- Value of buildings, machines and equipment's – it is the sum of all tied financial resources in the Company's tangible assets. The pointer is used to calculate partial capital productivity. This data is available to the parent company and not to the subsidiary, so it is currently not a concern to evaluate this indicator.
- Value of materials, semi-finished products and products the value is the sum of all the material used in the transformation manufacturing process. It is given in volume, weight or financial units and is used to calculate partial material productivity. In the company, this kind of productivity cannot be tracked because the company is not the owner of the material it uses in the process. Within group bonds the material is supplied by the parent company.
- Energy - the value of all energy consumed in a transformation process such as electricity, steam, diesel, gas, water and others. The company monitors the pointer only for the whole race, and it is appropriate to monitor it at all levels for the system's needs. [1]

All previous indicators are needed as inputs for calculating partial productivity from physical outputs, where the output of the produced products per the time considered. Thanks to a more thorough understanding of the entire assembly process of the company, suitable indicators of productivity monitoring were select for each level. The final list of indicators needed to create a productivity measurement system with regard to the organisational structure is in the Table 1. [1]

Table 1. List of indicators [1]

Organisational structure	**Partial productivity**
Section	PP work PP employee PP wage PP energy
Work place	PP work PP employee PP wage
Product group	PP work PP employee PP wage

The design solution of the system only includes indicators based on physical partial productivity. Since under the current conditions of the company it is not possible to objectively monitor the financial partial productivity. The overall productivity of the department will be express through multifactor productivity. [1]

2.2. Comparing productivity with previous period

When monitoring productivity at department level, the indicator is compared with average productivity from previous survey periods. With productivity at workplace and product group levels, it is necessary to monitor productivity differences in shorter time intervals, so it would be advisable to change the way of comparison. At these enterprise levels, productivity is comparing at weekly intervals, resulting in a percentage change in productivity. If the value is higher than one, it means an increase in productivity over the previous period. Conversely, if the value is lower than one, it becomes necessary to ascertain the reason for such a decrease and to apply appropriate corrective measures. [1]

2.3. Create the productivity measurement system

The following describes how to create a productivity measurement system in the Microsoft Excel software environment. The system consists of two sets, the first one measures and monitors productivity at the level of fine mechanics, and the other monitors productivity at the level of workplaces and product groups. The next diagram describes the principle of working with Microsoft Excel files and their connection (Figure 3). [1]

When creating a productivity measurement system, emphasis placed on user-friendliness in order to have a clear and distinctive message, and to use it as quickly as possible. [1]

In the sheets: WAGE data, PCS data, HOURS data, EMPLOYEE data, Outputs and Inputs are automatically linked from SAP software, and data is automatically loaded when the system is powered on. In other sheets, partial and multifactor productivity are automatically calculated over the reference period. To calculate partial productivity, a percentage of work placements is required, which is recalculate by a change in the proportion of workplaces among the four product groups. This

division is automatically colour-resolved, due to the more structured structure of the system, which was a prerequisite for its creation. It was also necessary to create a print area that is in the report sheet and to serve the attendance area of the results of the monitored productivity. [1]

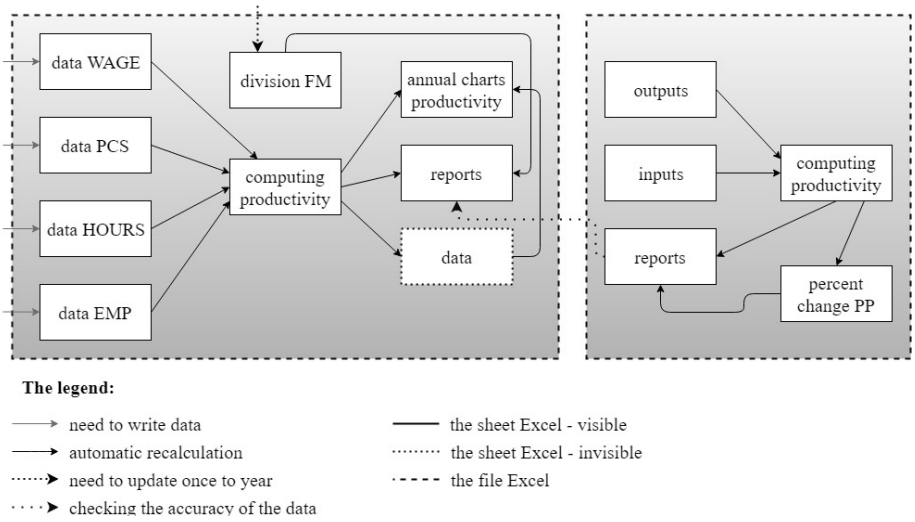

Figure 3. The principle of System operation [1]

In the sheet Division FM is a table with all the product groups and their distribution between the departments of the fine mechanic department (Table 2). After changing the workplace, the percentage of product groups in the workplace will also change. This spreadsheet also includes a spreadsheet that breaks down the manufactured products over a given time period into individual workplaces. [1]

Table 2. Workplaces and division FM[1]

Department	Number of product groups	The percentage ratio	Number of products
FM	19	59 %	77 696
MKV	6	19 %	24 535
RGS	1	3 %	4 089
Bytca	6	19 %	24 535
Sum	**32**	**100 %**	**130 855**

In the sheet Data PCS the date, product type, and quantity will be automatically uploaded to the spreadsheet, and the system will convert this data into calendar weeks and the quantity of products produced per week (the selected period), and the total number of products produced will also be included in the sheet. [1]
In the sheets data EMP and data HOURS is the manually written number of hours off and the number of employees in that calendar week. [1]
In the sheets data is the average super gross monthly wage per worker, which is automatically converted into weekly super gross wages and the amount of wage

costs required by all employees in that calendar week. Super gross wage can be characterised as the employer's total labour cost per employee. In the sheet Productivity calculation, according to calendar weeks, all necessary partial productivity and multifactor productivity are defined for division FM. In the sheet Computing FM – reports are a report-ready created that displays all the calculated partial productivity and total multifactor productivity of the fine mechanics and graphs that show how productivity is moving relative to average productivity. [1]

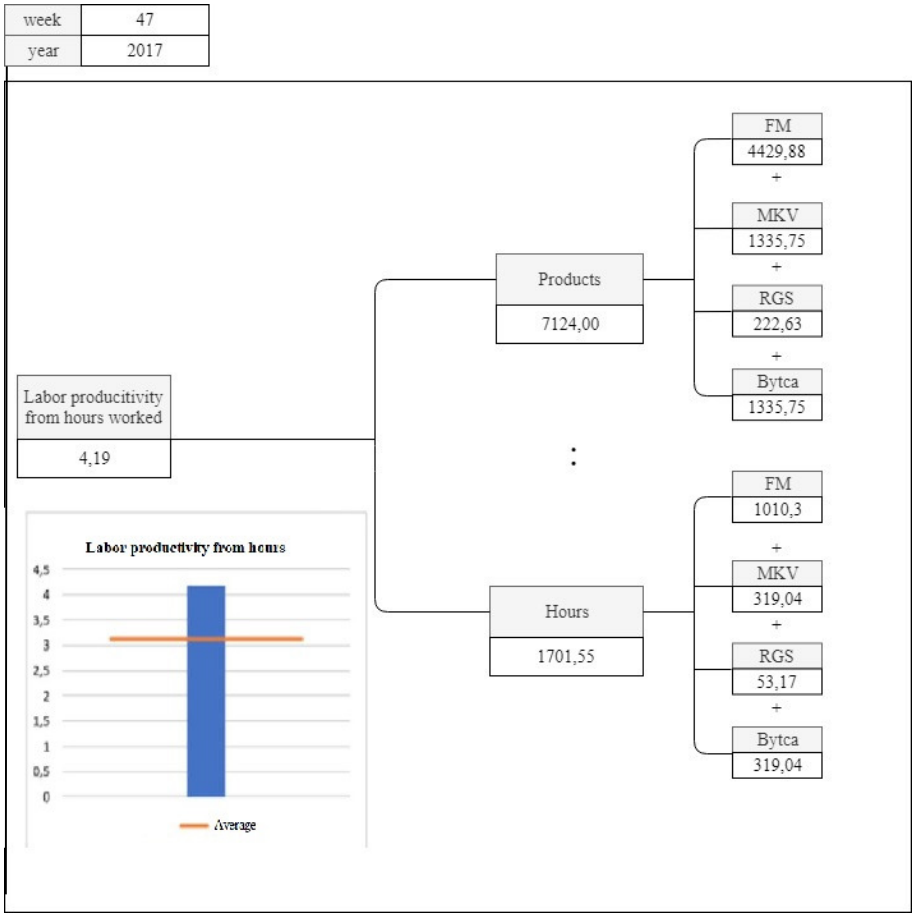

Figure 4. The sheet Computing FM – reports [1]

The system also illustrates the development of all types of productivity in the calendar year and the productivity trend. For illustration, the article only shows a graphical representation of total productivity and wage productivity (Figure 4). The data used to generate the chart was adjusted and converted by the coefficient. [1]

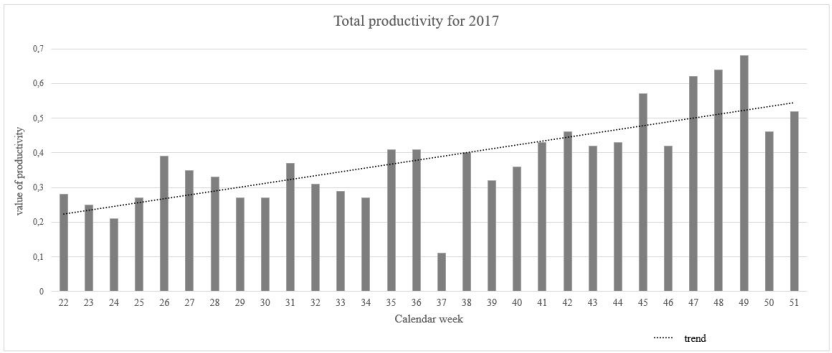

Figure 5. The sheet Annual productivity graphs [1]

The system consists of multiple .xlsx files, the Workspaces.xlsx file was created as a tool to demonstrate the complexity of the productivity measurement system (Figure 5). This file cannot currently be implemented in the enterprise because of missing data. The Excel Workspaces contain input data for calculations and productivity reporting reports at a lower level of enterprise structure. One of the sheets of a given file is the Graphs chart, which compares all kinds of calculated productivity with productivity from the previous period and their graphical display, which is important for proper productivity evaluation. Because the productivity percent calculation at lower levels of organisational structure has been chose to calculate the percentage of change in productivity in the Percentage of Changing PP Sheet, there is a graphical representation of these values (Figure 6). [1]

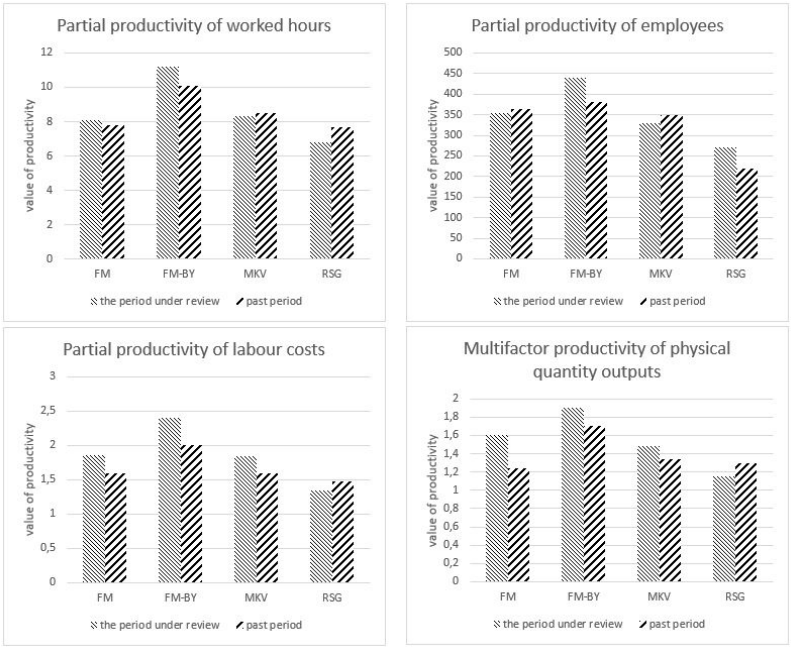

Figure 6. The sheet Graphs – workplaces [1]

The last file of the productivity measurement system is the set used to measure and monitor productivity at product group level. The graphs in the Figure 7 show the change in the productivity of the previous and the monitored period (week) of productivity measurement at product group level. [1]

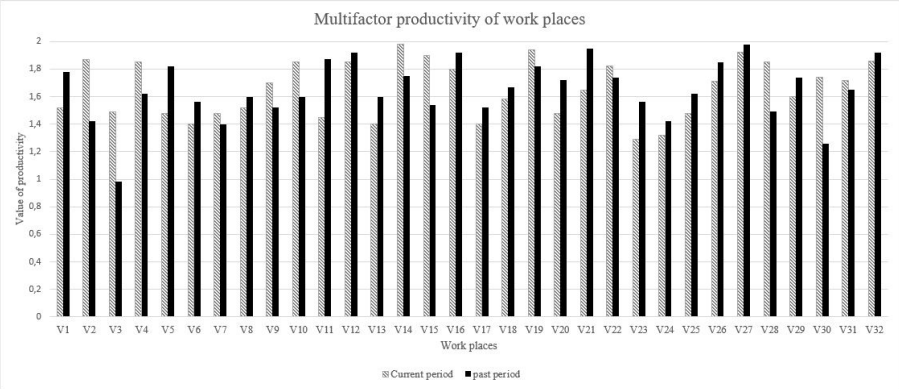

Figure 7. The sheet Graph – products group [1]

3. System benefits

The proposed productivity measurement system guarantees it is correct measurement at individual company levels and provides help in defining bottlenecks and barriers to growth. The logic and systematic approach to measuring productivity has been developed in the system. The system provides a place for data integration (storage). A measurement system has been created for everyone, an important factor for productivity, while at the same time offering the opportunity to track it is development. In the future, it is recommended to extend the measurement and evaluation of productivity to lower levels of society. It is also recommended to supplement the system (solved at the level of fine mechanics) with the other departments of production. It is advisable to ensure faster and easier use of the solution by automatically writing data from the attendance system and the SAP system within the Odd_file_mechanics.xlsm system. In the future, it is proposing to extend the measurement of productivity from both physical and financial. In order to measure partial energy productivity at lower levels of the enterprise, it is necessary to monitor the amount of energy consumed not only on a company-wide basis. In order to be able to measure and evaluate part-time building productivity in the future; machines and equipment, it is necessary to obtain input information for their calculation from the parent company. [1]

4. Conclusion

An enterprise productivity measurement system has been created to help you measure productivity properly and then identify bottlenecks or productivity barriers. And with

industrial engineering tools and techniques, these narrow spaces or barriers could be removed. The system is beneficial for the enterprise by systematically measuring productivity, created by logic, providing visual outputs that allow you to correctly identify constraints on productivity gains. The system is processed in the MS Excel software environment, where the necessary connections and functionalities have been created for the proper functioning of the system.

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