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# Cost analysis of human labour and the elimination of waste from the work standardization perspective 


#### Abstract

The starting point for definition of the costs of a product (a physical item or a service) in each company is the analysis of direct costs, and especially, the costs of material and human labour. Identification of the costs of direct labour is based on the development of technical work standards of manufacturing of one piece of product. Well defined time standards are the basis for the correct work division within each organizational unit, and rational organization of the work process, resulting in decreased cost of labour


Keywords: cost of labour, waste (muda) elimination, Kaizen, work standard, MTM methodology

## Introduction

Karol Adamiecki - the worldwide known management theorist at the beginning of the twentieth century, wrote that "although we manage an inexhaustible supply of time, which itself costs nothing, it is one of the most expensive 'materials', which we use when manufacturing industrial products. It would seem that anyone, anyone who is engaged in productive work, should feel and understand its value, but if we look closer at technical-industrial economy, we will see that with none kind of material or energy we deal as uneconomically as with time" [Martyniak 2001: 35]. Though time has passed, this words are still accurate and
management of the most valuable and resource which is time still lacks managers' attention.

The starting point for the definition of the cost of a product (a physical item or a service) in each company is identification of direct costs, including costs of materials and human labor. The aspect especially important is the opportunity of the cost definition (identification) and decrease. Definition of costs of direct labor is an important element of production costs analysis, based on the development of technical work standards referred to one product. This is the problem particularly important in those cases, where the share of direct labor in the cost of production is relatively high. Objectively defined labor standards result in proper organization and pace of work, and contribute to the full utilization of production capacity of people, machines and tools, and in many cases also to better utilization of materials and resources. Hence, giving the right rank to issues related to work organization and its standardization in the company contributes not only to reduction of the cost of direct labor, but also of the cost of materials and other costs of production [Kurek et al. 1974: 13].

## 1. Work standardization versus production costs

### 1.1. Costs of labor definition

In everyday life, a cost is the term used widely and having an extensive meaning. However, in the area of cost accounting it has a very specific meaning and is the term strictly defined. The cost is a necessary consumption of resources of business entity (materials, raw materials, work, equipment, machinery, buildings) by predefined processes of transformation performed in order to achieve a particular useful effect (a product meeting the requirements and needs of the customer) expressed in terms of value (in monetary units).

The cost of production can be referred to as funds that have been spent on the realization of the manufacturing process (of a product or a service). The realization of the production process comprises the following phases: from market analysis, through design, procurement processes, manufacturing, maintenance, to distribution and sales processes. Three basic methods can be applied for determining the costs of production, namely the indexing calculations, cost-plus pricing and calculation of the cost of operations. The production costs are a different category compared to the price of the product [Matuszek et al. 2011: 117]. Price of the product is shaped by the market, but also by the pricing policy of the company, while production costs are related mainly to the material used for production (material
costs), production methods, the scale of production, labor costs, or organizational effectiveness and efficiency of the company.

The condition for maintaining the competitiveness of the company in the market is to maintain the sales price higher than the cost of production (including profit). Hence, one of the most important issues of the analysis of production process is to determine the cost of the production process and its components. Each production process can be divided into activities related to manufacturing of products (activities, operations, actions), for which the realization costs are defined. Cost of production simply consists of the sum of the costs of activities related to its execution [Matuszek et al. 2011: 113].

The division of costs into two categories, namely direct costs and indirect costs [see Warnecke et al. 1993: 49] plays an important role in each business. Full knowledge of the direct and indirect costs allows their responsible and reasonable shaping. Direct costs in the company are the operating costs, which can be assigned to a specific costs driver, eg. a product (group of products), an individual product, a service, a separate phase of business. Classically calculated direct costs include the costs of materials and processing costs (the cost of direct labor and overheads, the direct cost of energy consumed, the cost of utilization and/or wearing of special tools). The formula for calculation of direct costs makes it the product of the number of units of resources used and the cost of the unit of a resource, hence, for example, direct labor cost is calculated as the product of cycle/ lead time (standard time to complete one piece of product) and the cost of one hour of human labor (wages). Indirect costs are complementary to the direct costs. They differ from the direct costs with the fact that they cannot be directly related and calculated with individual cost drivers (products), but the calculation is based on predefined allocation keys, which in a proportionate way divide the costs and assign them to the individual cost drivers.

The labor costs represent usually the major share of cost of producing the product (next to the cost of materials). The share of labor cost in total cost of production depends on the amount of time required to complete the product, and therefore of labor standards(standard time).The standard of work - based on a rational approach to the work analyzed - determines the execution time that is usually much shorter than the standard that has been set in the conditions of disordered organization. Thus, rationalization of working methods allows to determine the optimal labor standards, while the application of such standards creates conditions for increasing productivity. The less time included in the standard and the higher the performance, the smaller the share of labor cost in the cost of product, and thus the lower cost of the product. The application of rational working standards is usually associated with an increase in the efficiency [Mreła 1965: 253-254].

### 1.2. Labor standards

The essence of production management in every enterprise is a well-organized human labor. If human labor is poorly organized, it leads to pointless consumption of both means of production, and resources of the enterprise, including human labor, not bringing the effects commensurate with the investment. One of the primary factors of business management, rational organization of work and the starting point for calculation of production costs is the technical standardization of work, which is determining the optimum effort for the task execution in specific economic and technical conditions. Practically speaking, the work standardization can be applied to calculate the labor standard, that is, the amount of time necessary and sufficient for the execution of a specified operation by the employee (or a team) [Kurek et al. 1975: 10] in the given and most rational organizational and technological condition [Mreła 1975: 256]. And these conditions are as follows [Mreła 1975: 256]:

- rationally - economically and technically-designed division and course of the technological process, adapted to the means of production held and to technical requirements predefined for the manufactured product and intended for the operation,
- purposeful selection of basic equipment of work station and working conditions, devices and tools, providing achievement of a fully efficient operation and lowest cost of production, whilst complying with the qualitative conditions to be met by the manufactured product,
- the best possible workplace organization, understood as a specialization of workstations and equipping them with all the necessary auxiliary equipment, proper allocation of means and objects of labor and the allocation of employees, as well as selection of the best operating system for workstations,
- the optimum method of execution of the work by an employee, by which the correct order of operations and movements of the worker, the harmonized work of both hands etc. is meant, ensuring maximum utilization of working time,
- selection of an employee representing proper qualifications and skills,
- providing employees with any general conditions that will enable their efficient operation when performing a specific task, ie. for example determining the necessary time for physiological needs and including it into the standard time.

Definition and continuous analysis of labor standards(standard time) provides the data necessary for proper assessment of the organization of work, establishing conditions for further growth in productivity, assessment of cost of production, improvement of enterprise management, improvement of working conditions and elimination of waste in the process.

## 2. Elimination of waste

### 2.1. The Kaizen idea and the types of wastes

In Japanese "Kaizen" means continuous improvement, which applies to all, both managers and employees. Kaizen is a philosophy of management, in the center of which there is a continuous, systematic and implemented step by step improvement that takes place with the involvement of all employees [Grzelczak 2009: 40]. It is also a tool for individual workers to organize and manage their own work, leading to standardization which introduces reproducibility and order in the work performed. As a consequence this allows employees to identify problems easily and develop appropriate solutions [Pawłowski et al. 2010: 29].

According to the concept of Lean Management, company's objective is to seek to identify and completely eliminate or at least minimize any activities that do not add value to the product or service. According to P. Drucker, "there is nothing more senseless than the smooth implementation of the operations, which should not be performed at all" [Miller 2006: 93]. Activities generating value added for the customer are those for which the customer is willing to pay, and any action non-value adding from the point of view of the customer and operations absorbing too much of the resources in relation to the effects and the values they generate, are considered waste [Sobańska 2013: 40]. Taiichi Ohno (1988) lists seven types of waste (in Japanese "muda") [Grzelczak 2009: 41; Sobańska 2013: 40-41; Golińska-Dawson et al. 2015: 3].

Unnecessary transport is due to too long distances between the various stages of the production process. Thus, movement of materials, WIP and finished goods requires the involvement of means of transport, which is associated with additional costs, loss of time and generating damage during transport process.

Waiting times are associated with the occurrence of the "bottlenecks." In this case, employees are not doing their work, as they are unproductively waiting for the components coming from the previous production phase, and waiting does not bring added value.

Overproduction is the result of production planning that predicting the level of defects, absence of employees or equipment malfunctions, programs the level of production higher than what the market demands.

Improper processing is the result of poor design of production lines or incorrect selection of the technologies used, and also extends the working time required to produce a particular finished product. Production and repair of defects are associated with advanced automation of production processes and are the result of producing the batch of defective products. Repairing such products generates high costs, employs people without adding value from the customer's perspective.

Surplus inventories are closely linked with the problem of overproduction. Finished goods, work in progress or materials remaining in the company as inventories do not provide any value, what is more - generate high storage costs, as well as cause the funds freezing (cost of capital).

Unnecessary movements are due to poor organization of production and jobs. Operators working in such conditions carry unnecessary movements and needlessly move parts or components, without adding any value with these activities.

In addition to these seven types of waste, there is the eighth category which is incorporated more and more often, namely the one relating to the human factor -under-utilization of the potential of employees [Golińska-Dawson et al. 2015: 4].

### 2.2. Elimination of waste in a contemporary company

In order to see how the concept of Kaizen is seen in practice, the research was conducted to show the importance of this management concept for the company. The research was conducted with use of a questionnaire. The population analyzed consisted of employees in the Wielkopolska region (Poland). The sample size was 1200 people, and the responses obtained from 1050 respondents were analyzed. The sampling method was random, and the study was conducted in March and April of 2015.

The first question concerned the assessment of the significance of the types of waste above listed for a contemporary company. The results are shown in the diagram (Figure 1).


Figure 1. Importance of waste types for employees $(N=1050)$

[^0]According to the results of the research, the respondents believe that the most important type of waste that needs to be eliminated in contemporary companies is unnecessary transport ( $84.57 \%$ of responses "necessary to eliminate"), as well as improper processing ( $84.48 \%$ ) and under-utilization of the potential of people ( $82.19 \%$ ), followed by: unnecessary movements and waiting times. The fact that such a large percentage of respondents (almost $40 \%$ ) indicates the types of waste that are not relevant to contemporary companies, and they are: overproduction ( $39.81 \%$ of responses "does not matter," and $9.90 \%$ "no need to eliminate"), excessive inventories ( $38.38 \%$ and $21.24 \%$ ) and defects and their repair ( $29.04 \%$ and $13.81 \%$ ) is worth noticing. This may indicate either a lack of awareness of the hidden type of waste or the fact that many companies have already eliminated these losses, using the principles of JIT and TQM.

The second question was the identification of the type of waste, elimination of which is the most important for the company, which employs the respondent. The results are shown in the chart (Figure 2).


Figure 2. The most important type of waste according to employees ( $N=1050$ )
Source: own study.

Analysis of the results obtained leads to the conclusion that the most important type of waste to be eliminated in the enterprise is under-utilization of the potential of employees ( $16 \%$ of respondents indicated that type). The research therefore confirms the thesis so important these days when so much attention is paid to the qualifications and competences of employees. In the coming years learning organization will be gaining its importance, resulting in greater attention of managers paid to the use of the capacities and knowledge of workers.

On the second place, according to employees (16\%), there are two types of waste, namely unnecessary movements and improper processing. Obviously, these two factors in great extent contribute to the size of cost generated in a company.


Figure 3. Importance of waste types according to respondents employed in production companies ( $N=279$ )

Source: own study.


Figure 4. Importance of waste types according to respondents employed in trade and services companies $(N=533)$

Source: own study.

Unnecessary movements (even in micro scale, referred to elementary movements) and improper or unfitting processing method result in elongation of working time (work standard) for each individual task (single operation time), which in consequence influences the increase in direct labor costs. The shorter the time defined


Figure 5. Importance of waste types according to respondents employed in administrative units $(N=160)$

Source: own study.
in work standard, the lower the labor cost compared to product (service) cost, and finally the lower product (service) cost itself [see Mreła 1975: 254].

The data analyzed was divided according to the function criterion. The following groups were identified: the results which were obtained from respondents who work in production, trade and service and administrative units. The results are shown on the next three graphs (Figure 3, 4 and 5).

Analyzing the detail data obtained on the basis of research on various fields of activities of the surveyed companies, the consequence is noticed. Namely, according to employees of manufacturing companies, the most important type of waste that must be eliminated is unnecessary transport ( $96.41 \%$ of responses) and un-der-utilization of the potential of employees ( $83.87 \%$ ), followed by unnecessary movements ( $79.57 \%$ of responses), and improper processing (79.57\%). Research suggests, therefore, the need for working routines optimization. And here comes the huge field of possibilities for improving the work - and thereby eliminating waste - with the use of methods of testing and standardization of work.

The same research conducted among employees of trading and service companies also indicates that the most important type of waste to be eliminated is the under-utilization of the potential of employees $(83.45 \%$ of indications that it is necessary to eliminate), unnecessary transport ( $83.10 \%$ ) and improper processing $(81.03 \%)$. In the opinion of respondents for three following factors: excessive inventories ( $25.86 \%$ of responses), defects and their repair ( $21.89 \%$ ) and overproduction (13.38\%) do not have to be eliminated, which results from the nature of the trade and service companies surveyed.

The results of the survey conducted among employees of administrative units show that the most important type of waste, which is necessary to eliminate is the improper processing ( $90.00 \%$ of responses), unnecessary transport ( $86.88 \%$ ) and waiting times $(79.38 \%)$. Hence, the conclusion is that not only in manufacturing but also in administrative units and trading and service companies measures must be taken to analyze the organization of human labor and the use of working time, probably because there are enormous reserves hidden, where waste can be transformed into the value added. In the opinion of respondents the three following factors: the overproduction (50.00\% of responses), excessive inventory ( $43.75 \%$ ) and defects and their repair ( $36.25 \%$ ) do not matter, because of the nature of administrative operations.

## 3. Decrease of labor costs with MTM methodology

### 3.1. Analysis and standardization of work as a work organization improvement factor

One of the key factors to improve the organization of work is technical standardization of work, i.e. the determination of the optimal effort to perform a working task in certain organizational and technical conditions. Practically speaking, the standardization work is a set of actions leading to the determination of labor standards, which is the amount of time necessary and sufficient so that a specified operation was performed by the employee (or a team) [Kurek et al. 1974: 10]. This is done by analyzing the relationship between the various components of working time and work organization and working methods, the characteristics of the technological process and workstations equipment, as well as taking into account the principles of ergonomic design of workplaces. At the same time standardization of work provides an output data necessary to [Kurek et al. 1974: 10-11]:

- proper assessment of the level of organization of work,
- determining the conditions and possibilities for further improvement of labor efficiency,
- assessing the level of costs of production,
- improving the management organization,
- improving working conditions,
- developing and applying appropriate motivation and incentives to employees.

The standard technically justified does not mean subordination of humans to technical requirements of a job. On the contrary: the process of normalization takes into account the biological and psychological capabilities of a man and the
social objectives of the production company. The condition for the definition and implementation of appropriate labor standards is the optimization of the operating conditions in terms of organization, technics and ergonomics on individual workstations. Introduction of labor standards is reasonable only on the basis of the completed improvements. The introduction of appropriate labor standards does not mean the end of the process of improving the organization of work and production. Analysis of time standards meeting in terms of technical and organizational progress and the growth of qualification paves the way for further improvements in terms of organization, and technical and ergonomic aspects for individual workstations [Kurek et al. 1974: 11-12].

The attempts to improve human labor are focused on decrease of unit product or service cost and are always associated with necessity of analysis of the unit concerning its present or future functioning (designed work). Humans have always been striving for minimization of work efforts, starting with developing proper work conditions and improving technical aspects of work. Subsequently, as mechanization and automation were developed and work division deepened while work became more complex, the need to organize, plan, motivate and control (measure) work emerged [Słowiński 2008].

### 3.2. The MTM method introduction

Methods of times and elementary movements management are based on the standards to be fixed in advance. These standards are derived from the study of movement of limbs and eyes, and are made up of the elements lasting a fraction of a second. With these elements operations are built as with the building blocks. This is the analytical standard, which is very labor intensive. Methods of elementary times and movements can be applied to research on and plan an appropriate workplace organization and the organization of the implementation of the work itself. These methods are united in an element of movement and time. They are based on the finding that, when considering manual work, there are some specific elementary movements which combined in various way create every job. The division of work movements into elementary movements is just a starting point for these methods. Working movement is a short, introverted motion sequence, which in typical form occurs frequently and directly affects the course of work, or any action. Whereas the elementary movement is isolated part of the movement, which independently of the work is the result of the mechanics of the human body. F.B. Gilbreth on the basis of his experience established 17 elementary movements called - from an anagram of his name - therbligs [Wyrwicka, Grzelczak 2010: 23-25; Grzelczak 2013: 65-66].

Among the family of methods of elementary standards, the MTM method (Methods-Time Measurement), has gained the greatest popularity. This approach is based on the assumption that the time required to carry out a particular job depends on the method chosen for the implementation of activities. In short: the chosen method determines the time. MTM method was applied for the first time in 1948, and later modified several times. Its authors (H.B. Maynard, G.J. Stegemerton and J.L. Schwab) took as a basis [MTM 2004: 45-47]:

- 8 elementary hand movements: reaching, grasping, moving, combining and releasing(elementary and the most common movements, representing 70-80\% of the entire course of work) and pressing, separating and rotating,
- 2 visual functions: visual shifting and controlling,
- 9 movements of the body (legs and trunk), including the movement of the feet and legs, body movements with shifting and tilting the axis of the body.

Time values are determined on the basis of the movement analysis with the movie in the specific production conditions. The unit is TMU (Time Measurement Unit) which is equal to $1 / 100000$ part of an hour ( 0.036 seconds).

Work processes are, with the use of the MTM method, decomposed into elementary movements necessary for its implementation. For each elementary movement there are, depending on the input, the times set (units of time), from which it is possible to make a working method. Determinants for each elementary movement give specific attachment points for the development of methods of work and work processes, as well as jobs. Through a detailed analysis of the work tasks MTM method specifies the time, manner and quality of the work, thus giving a complete picture of the method of execution, together with a careful determination of the value generating activities, showing its bottlenecks, and indicating the direction of optimization. Analysis enables accurate determination of the optimization potential of the area. With MTM method it is possible to identify and implement opportunities to develop the entire value chain. MTM tools allow to determine the best methods of execution, which allows for maximizing productivity by simplifying or eliminating elementary movements which do not generate added value [Wyrwicka, Grzelczak 2010: 25; Grzelczak 2013: 67].

### 3.3. Elementary movements time and its shortening with MTM method

An important element of the elimination of waste in the workplace (and thus in the whole enterprise) is designing the correct spatial relations at the workplace, or to provide working man in convenient reach of the work (work area) and in a convenient position of the body so that he/she can traverse freely and without undue
effort, and thus without fatigue, safely and efficiently [Pacholski 1986: 110]. In the method of elementary movements the goal of shaping the course of movement is to find their simpler counterparts, ie. less aggravating and tiring, and to dense the movements by switching to two-handed operation, which is perceived by the employees as a more rhythmic and more enjoyable. A characteristic feature of the use of MTM in enterprises is a growing trend to non-investment rationalization, or improving the conditions of work systems at relatively low costs of investment for application of equipment, tools and other means of production, which is designed to reduce the burden of worker [MTM 2004: 367].

Taking movements (reaching, grasping and letting go) in the method of elementary movements depend primarily on the length of the movement, case of the movement and the type of course of the movement. A simplification of these movements is achieved by reducing the size of influence, which means that movements taking more time are to be converted into less time consuming.

Movement length reduction is achieved by pulling up (reducing the distance) to the objects of labor and tools to the site of action. For example, reaching a distance of 65 cm to the subject lying separately (traffic code R65B) requires 22.6 TMU time, and reaching for the same object lying at a distance of 30 cm (R30B) requires only 12.8 TMU . The reduction here is almost by half. Length of movements should be reduced enough to keep their natural rhythm. Too short movements lead to one-sided burdening and early fatigue of an employee.

Analyzing the impact of a case of a movement, which is attention needed (concentration) during movement, the opportunities to simplify the movement are also sought for. In case of a stretching movement at the same distance (for example. 30 cm ) there are five options of movement with the following time relation:

- "A" case - slight intensity of attention, the object is always in the welldefined place (code R30A) - 9,5 TMU time, taken as the base ( $100 \%$ ),
- "B" case - moderate intensity of attention, the subject is separated (R30B) - 12.8 TMU time ( $135 \%$ ),
- "C" and "D" cases - required attention, item mixed with some other objects (R30C) or small object (R30D) - 14.1 TMU time (148\%),
- " $E$ " - low intensity of attention, moving hand in the unmarked position (R30E) - 11.7 TMU time ( $123 \%$ ).

The simplification of the stretching movements is by transforming the movements C and D into the B or A . This can be done by making use of the forwarding mechanisms or defined location of the parts. The case " $D$ " concerns the movement for very small or difficult to handle objects, thus suitable configuration of an object could be helpful. A similar situation exists in the case of capture movement. A significant factor influencing the elementary movement of capture is the way of grasping, which results in the time required for movement (Figure 6).


Selective grip-grip of an item mixed with others $\mathrm{G} 4=7,6-12,9 \mathrm{TMU}$


Lifting grip-grip of an isolated object
$\mathrm{G1A}=2,0 \mathrm{TMU}$

Figure 6. Comparison of times required for grasping movement

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Source: [MTM 2004: 67].
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Selective grip of the object mixed with other objects (G4) is four times more time-consuming than grabbing separately lying object (G1A grip). Grips G4 can be converted into G1A and G1B cases through the use of gripper containers. Time saved is particularly evident when eliminating selective grip while doing ambidextrous activities. Sometimes grips G1 or G4 can be converted into the G5 (touching grip) by depositing parts and configuration of delivery device, allowing the ejection of individual items. The attention should also be paid to the correct location of the clamshell containers including the reach zones and the principles of economics of working movements.

In the case of placing movement (moving, combining) a method of elementary movements the movements simplifying can be achieved by similar methods as in the case of taking movements. Moving movements are affected by the size of force necessary, that must be reduced/eliminated especially in those cases where it leads to static load of an employee and occurs repeatedly. This can be accomplished by the use of cargo supporting equipment and the transport equipment.

Values that affect the elementary joining movement are: fitness class, symmetry conditions and manipulation. Simplifying this type of movement is always bound with the product shaping. Switching accuracy can be reduced by larger tolerance (clearance between the joined objects), the use of chamfer, restriction of movement (the guide rail, the use of the stop), or even elimination of the joining movement. The possibility of reducing the time by the symmetry conditions is to change the structure of the items to be combined. For example, combining objects with square profile (traffic code P2SSE) takes time of 19.7 TMU , and the same movement for the items of circular profile (P2SE) requires only 5.6 TMU (time savings of nearly $75 \%$ ).

### 3.4. Principles of movements economics and their influence on elimination of wastes with MTM method

Principle of movements made by a man economics can be reduced to such an organization of work in order to avoid unnecessary movements so that the path of necessary movement was as short as possible and that the movements followed each other in an optimal way in terms of the order, certainty and difficulties. These principles were formulated in 1911 by F. and L. Gilbreths and developed by R.M. Barnes. They can be divided into three groups [Mreła 1975: 55-58]:

- rules on human work (selection of movements), based on maximum utilization of potential of the human body,
- rules on the workstation,
- rules for the selection of tools and equipment.

Standardization of work methods consistent with the principles of elementary movement economics is focused on the execution of a task with a minimum number of moves, the least time-consuming, carried out simultaneously with both hands. These rules apply to the organization of work using the MTM method and is based on the following assumptions:

- simultaneity of movements - developing working methods in such a way that the work was carried out with both hands at the same time taking into account all the principles of ergonomics,
- simplification of movements - seeking to ensure that the necessary elementary movements were the least time-consuming to make,
- reduction of unnecessary movements - is to eliminate unnecessary movements that do not add value to the process; repeated move of taking and hanging up the same part can be the example,
- shortening the distance for movements of grabbing and moving - by creating the optimal position and working methods, combined with the principles of ergonomic design of work.


## Conclusions

The goal of each business activity is profit. One of the ways to reach the most benefits is cutting down the cost. In the following paper, the author focused on the issue of direct costs of labor and their relations to standards (and in the same time standardization) of work. Waste elimination was presented as the basic task within the cost decrease area. The research proved that the most important type of waste, according to employees of various companies - next to under-used potential of employees - are unnecessary movements of employees and incorrect processing
(methods of work), which are the results of the lack of standardization. To eliminate this type of waste at the workstation, various techniques of work analysis and standardization can be applied. Working time standards defined in the objective way are the basis for the correct work division within each organizational unit and rational organization of work processes result in decrease of costs of labor. Standards are the best way to develop objective criteria for planning, organizing and controlling all the activities, and especially production process. Hence, work standardization has the key role in managing the entire company and human labor as well. Attempts to improve human labor, striving for decrease of unit product or service cost result in decreasing cost of direct labor, and as a consequence, cost of product.

## References

Golińska-Dawson P., Kosacka M., Werner-Lewandowska K., 2015, How to find a potential for improvements? - Muda checklist as a lean tool for manufacturing companies, Logistyka, No. 2.
Grzelczak A., 2009, Ciągły proces ulepszania metodą optymalizacji procesów produkcyjnych, in: M.K. Wyrwicka (ed.), Marnotrawstwo. Przejawy i sposoby minimalizacji, Poznań: Wyd. Politechniki Poznańskiej.
Grzelczak A., 2013, Projektowanie procesów pracy, Poznań: Wyd. Politechniki Poznańskiej.
Kurek S., Lach J., Pronobis L., Grzeszczuk A., 1974, Metodyka technicznego normowania pracy. Poradnik, Blachownia: ODKKiS.
Martyniak Z., 1996, Metody organizowania procesów pracy, Warszawa: PWE.
Martyniak Z., 2001, Organizacja i zarzqdzanie. 70 problemów teorii i praktyki, Kraków - Kluczbork: Oficyna Wydawnicza Antykwa.
Matuszek J., Kołosowski M., Krokosz-Knypke Z., 2011, Rachunek kosztów dla inżynierów, Warszawa: PWE.
Mikołajczyk Z., 2001, Techniki organizatorskie w rozwiqzywaniu problemów zarzqdzania, Warszawa: WN PWN.
Miller K., 2006, We Don't Make Widgets: Overcoming the Myths that Keep Government from Radically Improving, Governing Books.
Mreła H., 1975, Technika organizowania pracy, Warszawa: Wiedza Powszechna.
MTM, 2004, MTM - Metoda podstawowa, Hamburg: Deutsche MTM-Vereinigung e.V.
MTM, 2004, MTM - Metoda UAS, Hamburg: Deutsche MTM-Vereinigung e.V.
Pacholski L. (ed.), 1986, Ergonomia, Poznań: Wyd. Politechniki Poznańskiej.
Pawłowski E., Pawłowski K., Trzcieliński S., 2010, Metody i narzędzia Lean Manufacturing, Poznań: Wyd. Politechniki Poznańskiej.
Penc J., 1997, Leksykon biznesu, Warszawa: Agencja Wydawnicza Placet.
Rzeszotarska-Wyrwicka M., 1998, Organizowanie systemów pracy, Poznań: Wyd. Politechniki Poznańskiej.
Seiwert L.J., 2001, Zarzqdzanie czasem, Warszawa: Agencja Wydawnicza Placet.
Słowiński B., 2008, Podstawy sprawnego działania, Koszalin: Wyd. Uczelniane Politechniki Koszalińskiej.

Sobańska I. (ed.), 2013, Lean Accounting - integralny element Lean Management, Warszawa: Wolters Kluwer Polska.
Warnecke H.J., Bullinger H.J., Hichert R., Voegele A., 1993, Rachunek kosztów dla inżynierów, Warszawa: WNT.
Wołk R., 1958, Analiza i normowanie czynności ręcznych według systemu MTM, Mechanik, No. 12.
Wyrwicka M.K., Grzelczak A.U., 2011, Audyt personalny, Poznań: Wyd. Politechniki Poznańskiej.

## Analiza kosztowa pracy czlowieka i eliminowanie marnotrawstwa przez pryzmat normowania pracy

Streszczenie. Punktem wyjścia do ustalania kosztów własnych produktu (wyrobu lub ustugi) w każdym przedsiębiorstwie sq koszty bezpośrednie, w tym w szczególności koszty materiatów i robocizny. Ustalenie kosztów robocizny bezpośredniej, jako ważnego elementu kosztów własnych produkcji, odbywa się w oparciu o opracowanie technicznych norm pracy na wykonanie jednostki produktu. Dobrze określone normy czasu pracy stanowiq podstawe prawidłowego podziału pracy w obrębie danej jednostki organizacyjnej i racjonalnej organizacji przebiegu pracy, a tym samym sprzyjajq obnizaniu kosztów pracy.

Stowa kluczowe: koszty robocizny, marnotrawstwo (muda) i jego eliminowanie, Kaizen, norma pracy, metoda MTM


[^0]:    Source: own study.

