RATIONALIZATION OF TECHNICAL CONTROL OF PRODUCTION

Eva Šlaichová

Technical University of Liberec
Faculty of Economics
Department of Business Administration
Studentská 2, 461 17 Liberec 1, Czech Republic
eva.slaichova@tul.cz

Abstract

The article deals with the possibility of utilization of the lean production method, in particular the methods of work measurement in the frame of rationalization of work of the technical control of production. The partial objective of the human resources management in the company is to ensure the effective human labour expenditure in the frame of technical control with the simultaneously providing for the continuous process of production. Just the methods for work measurement used in the frame of working process standardization are the effective tool for the managerial decision-making in the company. In the mentioned case study the particular method of work measurement in the frame of technical control may be applied to the data of a particular company. On the basis of the particular employee workload analysis it is possible to implement the decisions on the reduction or increase of the number of employees, or possibly on transferring particular working operations among the technical control employees in the enterprise.

Introduction

The introduction section of this article deals with general characteristics of different methods of time analysis and respective benefits of their use with regard to how this field is addressed in professional literature. The standardization of overhead work assists to shorten the running time of production; the methodology of its standardization must be adapted to specific needs of auxiliary and service works, especially work of the technical control department. Standard procedures should be replaced by new approaches in the study and work designing, analyses and standardization that comply with the specific conditions in these processes. The main tool for achieving this goal is the selection of an appropriate method of time analysis, which objectively evaluates time consumption of individual work tasks.

1 Role of the Technical Control Department in the Company

The main task of the technical control employees is to evaluate to which extent the condition of production is consistent with the requirements, then on the basis of these findings to apply the requirements for the necessary interventions and changes leading to the overall improvements of economic results and all company processes. The approach to the rationalization of taking care of quality is evident in the systemization, complexity and prevention. The intensification of prevention activities assumes the extension of analyzing activities, mainly economic costs analyses. The objective of efforts for the rationalization of taking care of the quality consists in: detecting and gradual eliminating of all factors leading to the deterioration of the quality of production. This activity should be permanently improved in order to increase the effects of quality and to use rationally the workforce in this sphere. The principal prerequisite of the work rationalization in the frame of the technical control is the selection of appropriate forms and methods of control as well as the corresponding equipment of the technical control workplaces. The decrease in the number of

controllers and improvement of the quality of production may be reached by means of the utilization of statistical control, mechanization and automation of controlling operations and reduction of interlinks and duplicities in the course of the control [3, p. 76].

Performance standards and standards for the quantity of employees are used in the frame of technical control. The methods for the standard determination depend, especially, on the degree of work repeatability according to the type of production. In the serial and mass productions where the number of kinds of controlling operations is relatively small it is possible to establish standards for such operations using the analysis-calculation method. Versatile controlling operations are appropriate to by analyzed by means of the time studies. Working day charts and results of instantaneous observations are being used for obtaining the survey of the time consumption of controllers and finding out possible reserves.

1.1 Procedure for Overhead Work Consumption Analysis

The term rationalization of work is to be understood mainly as ensuring the effective expend of human labour in the production process through:

- appropriate forms of work division,
- improvement of workplace organization and attendance,
- implementation of rational working methods and justified standards of work consumption based on these methods,
- taking care of preparation and increasing qualification of employees,
- selection of appropriate standards of remuneration.

Procedure for overhead work consumption analysis consists according to the professional literature from next several steps:

1) To carry out the process analysis.
2) To carry out an instantaneous observation.
3) To determine the frequency of particular activities being performed (in %).
4) To identify little frequented activities by means of frequency table or histogram.
5) To determine activities appropriate for analysis with the method of work consumption.

Increasing the work productivity in the field of activities of controllers can be assessed from the two aspects. From the extensive one, as a better utilization of time fund of employees, and from the intensive one, as a reduction of time consumption with measures of organizational nature. Methods of overhead rationalization (methods focused on the analysis of processes) assist to expose the wasting in the course of the process [3, p. 54].

Through these methods it is possible to acquire information about:

- production process timing (the degree of workforce, machinery and equipment utilization, frequency of requirements concerning the attendance, time structure of the shift),
- workplace arrangement and lay-out (workplace ergonomics),
- way of work execution (technological procedure observance),
- flow of information and material,
- work organization within working group.

These methods also concern the workload issues (sensual, physical) and working conditions with regard to the workplace hygiene and work safety. The advantage of these methods consists in obtaining quality information enabling the decision-making on changes, rationalization, etc.

Methods of work study are mainly oriented on the following range of issues:

1) Time studies (duration of action, frequency of requirements).
2) Motion studies (provide information on the way of work execution, the course of action).
3) Spatial studies (illustrate the workplace spatial lay-out).
4) Methods of multilateral observations.

1.2 Methods for Determining Labour Input and Work Structure

The time evaluation makes a very important part of each work consumption study. On the basis of obtained results the decisions on possible changes are made. Especially, in the context of the lean production principles the point is to find out the most effective solution with the lowest possible costs. Based on a detailed analysis of individual employee workload the decisions on the reduction or increasing the quantity of employees, as well as on transferring particular working operations from one employee to another may be implemented. The objective is to provide for the continuous process of attendance and simultaneously reaching the lowest possible costs for the attendance, etc. Following methods are used to monitor activities performed by a worker working, inclusive of measuring their time utilization.

The principle of Instant Monitoring is based on the probability theory and the theory of random choices lies in the time evaluation of a representative number of randomly selected short periods of time during a work shift. Evaluation of such samples corresponds with the results, providing that both comprehensive monitoring and all data collection are complete. Information obtained from randomly selected moments have the same value as information about the course and time scope of individual work stages recorded during uninterrupted observation and detailed evaluation. Frequencies of individual operations define the structure of the division of work operations throughout a work shift [1, p. 87].

Zonal and Multilateral Monitoring observe the worker's actual activity, operation of machinery or other production equipment, movement of work tools, quality of work, work management systems, etc. The aim is to simultaneously monitor and record activities of individual workers in different zones.

During continuous chronometry, the monitored operations are proportioned in sequences in which they occurred. In case of selective chronometry, the taking of measurements is repeated for each particular step of an operation [1, p. 112].

Instant Monitoring is a statistical method formed on a statistical sample survey represents a modification of instant monitoring that is suitable particularly for repair work. The observer performs random rounds, takes notes about every pre-specified event to which he/she subsequently assigns a point in time.

2 Implementation of Lean Principles in Setting Standards of Technical Control

Implementation of lean principals should improve the quality, transparency, and speed of service work. This can be displayed also to the process of setting of standards of service work.

In general waste elements are waiting, defects, overproduction, non-value added processing, unused employee knowledge. While they cannot all be eliminated completely, the objective of lean management is to minimize each of these wastes to the extent that is necessary and reasonable for the organization to be successful and to increase their competitive advantage [5, p. 34].

As lean manufacturing has become more widely applied in production, the extension of lean principles is beginning to spread also to auxiliary and service work. The aim of lean organization is to identify and eliminate waste across all processes – not only productive processes but also servicing processes. Lean management is a philosophy rather than a prescribed metric or process methodology. It looks for waste reduction and value maximization, but it does not require a complete change of an existing process. It rather complements than alternates, unlike other methodologies. Application of lean production principles and methods helps to identify and implement the most efficient and value added way to all service work. Companies have found that lean methods enable them to better understand how their processes work, to quickly identify and implement improvements. Another step is to build a culture of continuous improvement [2, p. 228].

2.1 The Principles of Lean Thinking

Lean methods are focused on identifying and eliminating these wastes. This is one of the most important resources for further decisions of the management. Nowadays there is a big emphasis on increase of productivity of labour and setting of standards for auxiliary and service work can be objective resource for possible savings of overhead costs. The partial aim of this article is also to show that implementation of lean management principles in setting standards of overhead work can should increase company´s competitive advantage.

The list below identifies common wastes in technical quality department:

- unnecessary approval cycles,
- overproduction, unneeded reports, doing work that is not requested,
- defects, data errors, missing information,
- unnecessary process steps.

The following steps should eliminate all these wastes:

- finding possibly shortest routes for all transportation,
- avoidance of overprocessing,
- elimination of waiting times,
- reduction of stock,
- quick and easy handling.

2.2 Elimination of Waste in the Work of Technical Control of Production

Waste in general meaning cause poor customer service, lost of business, higher than necessary service and maintenance costs and above all significant lost employee productivity [7, p. 145].

Waste can be characterized as an effort:

- that can be used to change a process without understanding consequences, and the effort required to adjust to or correct the consequences,

- required to work on an unnecessary or inappropriate task,
- expended by people working at crosspurposes they do not understand,
- required to correct the process output.

Especially by human resources is the elimination of waste very important. Talent leakage and low job satisfaction are the main reasons for inefficient work productivity. Another reason for waste by human resources is that employees spend time on repetitive tasks or they are working hard, but there is a better way to do the job. Typical causes are inadequately trained workers and missing or bad information. Motion waste is in every movement that does not add value, such as unnecessary walking and reaching. Waiting waste can be characterized by people waiting for information or a meeting. People can add no value to the product or service while they are waiting. Processing waste is also the result of inefficient work.

Information waste is generated by inefficient data flow between process steps and its owners. Missing information waste is effort (or bad results) driven by the absence of key information. Irrelevant information waste is effort (or bad results) caused by having to deal with unnecessary information. Inaccurate information waste is the effort (or bad results) caused by having to deal with bad information.

Method such as Value Stream Mapping can help to uncover waste in the process. One of the basic principles of lean thinking is to recognize that only a small fraction of the total time and effort in any organization actually adds value for the end customer. It is necessary to find all these activities in all departments. That means that also service and auxiliary work should be involved in to the process of continuous improvement [7, p. 228]. After mapping one or more value streams it should be analyzed the stream for sources of waste. The analysis may adapt and apply traditional efficiency techniques such as time-and-motion studies. More recent lean techniques for analyzing of time consumption are Basic MOST and for service work more appropriate Maxi MOST. To find the best method for time analysis of the service work is one of the aims of the thesis. Typically after first mapping of the value stream there can be found only 5% of activities that add value. According to recent researches this can rise to 45% in a service work. Eliminating this waste ensures that particular product or service flows to the customer without any interruption or waiting [6, p. 85].

3 Case Study

The primary objective in this case study was the selection of a suitable method for determining labour input and work structure focused on the following activities of the technical quality department employees. In the list below there are activities the controller is responsible for.

3.1 List of Quality Controller/Manager Activities

1) Control of parts from the serial production and recording the results of control measurements.
2) Blocking of defective products.
3) Release of production and the issue of workshop samples to the manufactured parts.
4) Ensuring the implementation of analyses and verification tests (corrective measures).
5) Production of internal complaint protocols.
6) Execution of internal complaints in cooperation with the heads of the departments concerned.

7) Cooperation in product audits implementation.
8) Execution of verification tests on material (in collaboration with input control).
9) Preparation and handover of particular department products for verification tests and measurements.
10) Check-up of gauges.
11) Defect identification in the scope of production technology.

Selected methods of time measurement were applied to data from a specific company with the view of verifying their applicability in working company conditions. The results showed that there is no universal method suitable for standardizing all types of indirect labour. In this case study method called Instant Monitoring was used as an example.

It is not possible to determine a universal method for setting indirect labour standards on the bases of the completed analysis. Technical control, much like other overhead activities, is affected by time variability and fluctuation of workload. For example it is possible to assume a certain level of repetition, and operating standards can be determined relatively easily. However, in a low-volume production where requirements for the control arise randomly it is necessary to assess to what extent would the setting of an operating standard disrupt or even prolong the standard for operating. The methods listed in the table are possible to select depending on specific conditions and on variation and repetition of performed work. Furthermore, both the necessity to select and duly adhere to appropriate work processes and the consistent compliance with work safety conditions must be taken into consideration [8, p. 111].

The aim of this particular part the article is to set a labour standard for the technical control department employees in the paintshop of the selected company in the Czech Republic. Firstly method for determining labour input and work structure were applied to get frequency statistics of the number of defects on the bumpers according to the colour of the paint. Monitored variable was a number of defects on the bumper (marked like *X*).

Statistical analysis of the defects on the selected production batch according to the colour of the bumper, number of defects and their frequency is presented in the table 1.

Tab. 1: *Statistical analysis of defects*

COLOUR	**Total number of OK bumpers**	**Total number of bumpers**	**Median**	**75% fractile**	**Modus**	**% OK bumpers of the particular colour**	**Standard deviation**	**Average number of defects on the bumper**
ATOL	34	48	1	3	1	71	1,12	1,86
CANDY WEISS	80	96	1	2	1	83	2,16	1,81
CAYENNE	39	44	2	2	2	89	0,63	2,00
DIAMANTSILBER	96	122	1	2	1	79	1,00	1,62
DYNAMIC BLAU	41	48	1	2	1	85	0,73	1,57
STONE GRAY	101	138	1	2	1	73	1,23	1,78
TIEFSEE BLAU	53	86	2	2	1	62	1,59	2,06
Sum	**444**	**582**						**1,83**

Source: Own

Initial production conditions for setting of the labour standard of technical control of production:

1) 90% utilization of workers.

2) From the previous analysis was found that:

   a) It takes 1 minute to check top quality bumper, the labour standard for this level of production was set to 54 pieces for one hour and 1 worker.

   b) It takes 2 minutes to check the bumper of low quality and scrap it, the labour standard for this level of production is 27 pieces for one hour and 1 worker.

   c) It takes 3 minutes to check and correct the bumper of an average level quality, the labour standard for this level of production is 18 pieces for one hour and 1 worker.

3.2 Methodology of the Labour Standard Calculation

Methodology of the Labour Standard Calculation is quoted in the monogram [3, p. 228].

Input data for the calculation of the labour standard:

N demand of the customer, total number of OK bumpers

d number of days of painting

h number of hours of painting per day

m shift work time in minutes

e expected utilization of the worker – 90 % of working time

Use of the paintshop facility brings the following production results:

x_1 % bumpers is scrap,

x_2 % bumpers need repainting,

x_3 % bumpers need correction.

Total time consumption to check 100 bumpers:

$X = 100\ (1 + x_1 + 2x_2 + 2x_3)$ minutes.

x_1 x 2 min/pcs + $(x_2 + x_3)$ x 3 min/pcs + $(1 - x_1 - x_2 - x_3)$ x 1 min/pcs =

$= 1 + x_1 + 2x_2 + 2x_3$ min/pcs.

Total time consumption of production of 100 bumpers:

$$N \times X / 100 \text{ minutes} \tag{1}$$

According to the effective time fund

$$\frac{N \cdot X}{m \cdot 100} \tag{2}$$

working hours are needed to fulfill the customer demand.

Labour standard due to number of working hours and initial production condition is according to the equation (3):

$$\frac{N \cdot X}{m \cdot 100} \cdot \frac{1}{d} \cdot \frac{1}{h} \cdot \frac{1}{e} \cdot \text{workers.} \tag{3}$$

Calculation of the labour standard on the particular example:

Weekly demand of the customer: **28 910** top quality bumpers.

Input production data:

6 days of production,

21.6 hours effective time of painting,

54 minutes effective working fund regarding 90 % utilization of workers,

5 % scrap, 10 % repainting of the bumpers, 15 % corrections of the bumpers,

(0,05 x 2 min x 100pcs/h + 0,25 x 3 min x 100pcs/h + 0,7 x 1 min x 100pcs/h = 155 Nmin/100pcs = 1,55 Nmin/pcs).

Time consumption needed for production of 28 910 top quality bumpers is 44 810.5 minutes.

According to the effective time fund $\frac{44810.5}{54} = 829.83$ working hours are needed to fulfill the customer demand.

Labour standard due to number of working hours and initial production condition is 7 workers $\left(\frac{44810.5}{60 \cdot 0.9} \cdot \frac{1}{6} \cdot \frac{1}{21.6} = 6.4 \right)$.

Conclusion

Nowadays there is a big emphasis on increase of productivity of labour and setting of standards for auxiliary and service work can be objective resource for possible savings of overhead costs. Working process design oriented methods are focused on the following range of issues: time consumption determination, number of employees determination, workplace arrangement (lay-out) and working procedure determination. The aim of this article was to show that implementation of lean management principles, especially methods for time measurement, in setting standards of overhead work can should increase company's competitive advantage. Key elements of this effort are quality, involvement of all employees, willingness to change and communication. Continuous improvement in setting standards in quality department refers to all activities that continually improve all functions and involves all employees from the chief executives to the assembly line workers. Lean methodology should be introduced in all areas through a comprehensive employee training program designed to program acceptance, create more efficient job processes and generate better job satisfaction through job improvements. However demand for organizational, operational or behavioral changes may often meet with resistance from workers, managers in all levels of the organizational structure.

Literature

[1] HŰTTLOVÁ, E.: *Organizace práce v podniku.* 1st edition. Prague: Vysoká škola ekonomická, 1999. 128 pgs. ISBN 80-7079-778-9.

[2] IMAI, M.: *Gemba Kaizen*. McGraw-Hill, 1997, 314 pgs., ISBN 0-07-031446-2.

[3] KROUPA, V.: *Racionalizace pomocných a obslužných procesů výroby*. 1st edition. Prague: SNTL, 1985. 251 pgs.

[4] LHOTSKÝ, O.: *Organizace a normování práce v podniku*. 1st ed. Prague: Aspi, 2005. 85 pgs. ISBN 80-7357-095-5.

[5] MAŠÍN, I.; KOŠTURIAK J.; DEBNÁR P.: *Zlepšování nevýrobních procesů*. 1. vyd. Liberec: Institut technologií a managementu, 2007, 134 pgs. ISBN 80-903533-3-9.

[6] NIEBEL, B.: *Motion and Time Study*. 9th edition. McGraw-Hill Higher Education, 1992, 880 pgs. ISBN-13: 9780256092486.

[7] OHNO, T.: *Toyota Production System: Beyond Large-Scale Production*. Productivity Press, 1988, ISBN 0-915299-14-3.

[8] ŠLAICHOVÁ, E.: *Metody plánování kapacit režijní práce s přihlédnutím ke specifikům plastikářského průmyslu.* Liberec, 2011, 123 pgs. Disertation thesis (Ph.D.) Technická univerzita v Liberci, Ekonomická fakulta.

[9] WESTERKAMP, T. A.: *How to Use Work Measurement for High-Productivity Maintenance Operations* [online]. [accessed 2010-08-01]. Available from WWW: <http://www.pninc.com/maint/articles/MaintWkMeas0102.pdf>.

[10] WOMACK, J. P.: (1998) *Lean Thinking.* 3rd edition. Free Press, 1998, ISBN 0-7432-4927-5.

[11] ZANDIN, K.B.: *MOST Work Measurement System*. 3rd edition: CRC Press, 2003. 758 pgs. ISBN 0-8247-0953-5.

Ing. Eva Šlaichová, Ph.D.

RACIONALIZACE TECHNICKÉ KONTROLY VÝROBY

Článek sleduje možnosti využití metod štíhlé výroby, konkrétně metod měření práce v rámci racionalizace práce technické kontroly výroby. Dílčím cílem řízení personálních zdrojů v podniku je zajištění efektivního vynakládání lidské práce technické kontroly při současném zabezpečení plynulého procesu výroby. Účinným nástrojem manažerského rozhodování jsou právě metody měření práce používané v rámci standardizace pracovních procesů. V uvedené případové studii byla vybraná metoda měření práce aplikována na konkrétní pracovní postupy spojené s kontrolní činností v podniku. Na základě takto provedené časové analýzy vytížení jednotlivých pracovníků pak mohou být v podniku realizována rozhodnutí o redukci, navýšení počtu pracovníků nebo případně o přesunu určitých pracovních operací mezi pracovníky technické kontroly výroby.

DIE RATIONALISIERUNG DER TECHNISCHEN PRODUKTIONSKONTROLLE

Dieser Artikel beobachtet die Möglichkeiten der Nutzung der Methoden der schlanken Kontrolle, genauer gesagt der Methoden der Arbeitsmessung im Rahmen der Rationalisierung der Arbeit der technischen Produktionskontrolle. Teilziel der Führung der personellen Quellen in einem Betrieb ist die Sicherstellung einer effektiven Aufwendung der menschlichen Arbeitskraft bei der technischen Kontrolle bei gleichzeitiger Sicherung eines flüssigen Produktionsprozesses. Als wirksames Instrument der Managemententscheidung erweisen sich gerade die Methoden der Arbeitsmessung, die im Rahmen der Standardisierung der Arbeitsprozesse verwendet werden. In der angeführten Fallstudie wurde eine ausgewählte Methode der Arbeitsmessung auf konkrete, mit der Kontrolltätigkeit im Betrieb verbundene Arbeitsvorgänge angewendet. Auf Grundlage der auf diese Weise durchgeführten zeitlichen Auslastungsanalyse der einzelnen Arbeitnehmer können hernach im Betrieb Entscheidungen über Reduktion, Erhöhung der Zahl der Arbeitskräfte oder gegebenenfalls über eine Verschiebung gewisser Arbeitsoperationen innerhalb der Arbeitskräfte der technischen Produktionskontrolle getroffen werden.

RACJONALIZACJA TECHNICZNEJ KONTROLI PRODUKCJI

W artykule opisano możliwości wykorzystania metod „szczupłej produkcji”, ściślej metod pomiaru pracy w ramach racjonalizacji pracy technicznej kontroli produkcji. Cząstkowym celem zarządzania personelem w przedsiębiorstwie jest zapewnienie efektywnej pracy ludzkiej w ramach kontroli technicznej przy jednoczesnym zapewnieniu płynności procesu produkcji. Skutecznym instrumentem w procesach decyzyjnych są właśnie metody pomiaru pracy stosowane w ramach standaryzacji procesów pracy. W przedstawionym studium przypadku wybrano metodę pomiaru pracy stosowaną dla konkretnych procedur pracy związanych z czynnościami kontrolnymi w przedsiębiorstwie. W oparciu o w ten sposób przeprowadzoną analizę czasu zaangażowania poszczególnych pracowników można w przedsiębiorstwie podejmować decyzje w sprawie redukcji, zwiększenia liczby pracowników, względnie w sprawie przesunięcia pewnych operacji pomiędzy pracownikami kontroli technicznej produkcji.