ANNALS OF THE ORADEA UNIVERSITY
Fascicle of Management and Technological Engineering
ISSUE #1, MAY 2013, http://www.imtuoradea.ro/auo.fmte/

WORKLOAD ASPECTS IN THE ROMANIAN AUTOMOTIVE INDUSTRY

Gabriela NEGRU-STRAUTI, Aurica GASPAR[2], Sorin-Ioan MAISTOR[3]
[1]"Politehnica" University Timisoara, gstrauti@yahoo.com
[2]"Politehnica" University Timisoara, gaspar.aurica@gmail.com
[3]"Politehnica" University Timisoara, sorin.maistor@yahoo.com

***Abstract*—**This paper is intended to be an applied research concerning the workload in the automotive industry companies in Romania. The managing staff from these organizations believes of utmost importance aspects regarding both the efficient allocation of existing human resources, and those related to the productivity of operators. To highlight these issues, the work process from a workstation within a production line was analyzed, and the results of three different operators were compared. In the first stage of the research, the timing of the operations was performed and the causes and issues that cause downtime were identified. At the same time, an analysis was carried out based on the model BasicMOST; based on this analysis, work procedures were highlighted, which lead to the possibility of obtaining high productivity.

***Keywords*—**human resource, workload, MOST, work productivity

I. INTRODUCTION

CURRENT trends in contemporary economic environment, characterized by turbulence and competition, induce a state of "alert" among industrial organizations, which are required to meet in the shortest time possible, requests from customers, while also respecting quality norms. This situation must be analyzed from two perspectives, namely (1) to increase the volume of activities, where challenges are related to the programming of activities and resources, and (2) to lower the volume of activities, in which case, the issue of substantial restructuring comes into question. All these pose new challenges to industrial organizations operating in the automotive industry in Romania. The managers of these organizations realize that the aspects related to the efficient allocation of existing human resources and workload, and those related to the productivity of operators get new connotations.

In order to provide a more rapid and accurate adjustment on a certain level of demand, which at the same time should generate results, one must know and apply analytical methods of the work process which enable a forecast of the time needed to accomplish work tasks. According to the glossaries of terms examined, the term *workload* can be considered as an "analytical research activity of the work process, using appropriate methods and procedures of establishing real workload required to perform work under normal conditions and under the conditions of observing quality requirements for operations, works, services or other useful activities." [1].

Knowing the time required to perform certain tasks, allows the manager to achieve and maintain a high degree of use of staff, materials and equipment, rationalizing at the same time the costs involved. This will lead directly to efficiency of activities and to sustainable growth of the organization.

II. RESEARCH METHODOLOGY

The research presented highlights the analysis of time required for the specific operations of each job, applying the workload model Basic MOST.

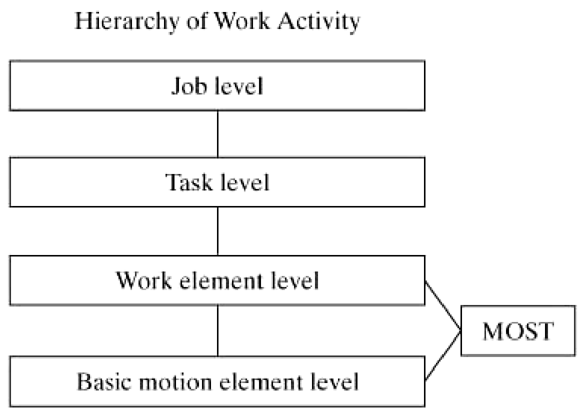

Fig. 1. Position of the Basic MOST activity sequence model [2]

It is a work measurement technique that focuses on objects' movement, being used to analyze the activity and to determine the normal time needed to perform a specific process / operation; the method is placed in the hierarchy of work activities at primary levels, as shown in Fig. 1.

It was originally developed by H. B. Maynard & Company Inc. and has three versions: Basic MOST (for the activities between 20 s to 2 min.), Mini MOST (for the activities shorter than 20 s) and Maxi MOST (for the activities above 2 min.).[3] The Maynard Operation Sequence Technique (MOST) is actually a set of "measurement techniques of the work in a job system in the structure of a manufacturing process". [4]

In the method, primary operations are not considered basic moves, but fundamental activities that concern and analyze the whole event of moving objects from one location to another. These activities are described as "basic parameters" in a specific sequence of activities.

Analyzing data for certain operations indicate that certain sequences of moves constantly repeat, these being organized as basic elements of the method MOST. The most common activity is the movement of objects in space.

For BasicMOST three models of sequences of moves were established: the general move, the controlled move, and use of tools and tooling.

The model based on the general movement refers to moving objects from one location to another freely through the air. This activity is represented by the following sequence of sub-activities:

A B G A B P A

A – Action distance (mainly horizontal),
B – Body move (mainly vertical),
G – Gain control
P – Placement

The values that are assigned to each sub-activity in part are based on the conditions offered by that job and the methods specific to the operator; they are specific indexed values (e.g. A_0 - any movement of the fingers, hands and / or feet over a distance less than or equal to 5cm will have as value index 0).

The model is based on controlled movement when the object retains during the entire duration of movement the contact with another object, a model similar to that of general movement:

A B G M X I A

M – Move controlled,
X – Process time,
I – Alignment.

The model based on the use of tools and tooling does not define a third basic activity, these being a combination of the models mentioned above. [5]

The unit of time used in MOST is based on hours and parts of hours called TMU (Time Measured Units), being equivalent to 0.00001 hours, 0.0006 minutes, 0.036 seconds. [6]

The research was conducted in an automotive company from Romania, and the values obtained were analyzed in terms of execution times of work tasks, at 3 production operators.

III. Study Results

The analysis Basic MOST was performed on a workstation "AM" of a production line that produces contact cables for the safety system of the driver (airbag system). The normal working hours or pace for the analyzed workstation is 40 pieces / hour. Analyzing the situation of actual data identified at that workstation, it was found that this load is not achieved by the responsible staff, significant differences being identified within the workstation depending on the operator in a specific work shift. This situation asks for a detailed analysis.

In this respect, in the first phase the execution times were timed, and the data for all 3 operators employed on the workstation was monitored and registered. At the same time, working methods were identified. Lack of standardization in terms of the sequence of operations performed makes that for each operator there must be a different working method.

According to the appropriate number of work shift and workstation name, the 3 operators can be considered as follows: Operator 1-AM, Operator 2-AM, Operator 3-AM. The results, expressed in the number of pieces obtained by each operator, in the analyzed period, are presented in table I.

TABLE I
Real Productivity of Operators on Workstation "AM"

Employee	1-AM	2-AM	3-AM
Pieces	309	189	188

For a detailed analysis of the work process, it was divided into a sequence of stages / steps to be performed by the operator. The analysis of time for each for the 3 operators is shown in Table II.

TABLE II
Average Time for Operators on Workstation "AM"

Stage (sec.)	Employee	1-AM	2-AM	3-AM
Installing cable 1		11.0	19.8	23.7
Pushing device lever		1.2	1.5	1.4
Placing springs		7.6	15.2	10.0
Installing cable 2		16.9	31.4	20.7
Matting		45.3	68.1	81.8
Pulling device lever		1.2	1.5	1.5
Removing part		4.1	4.8	4.2
Total – effective process		87.3	142.3	143.2
Total process (timed)		82.7	156.0	172.9

Table II contains the arithmetic averages of the time series calculated for each stage and for each operator. The table also contains the total values obtained by timing operators in terms of the total effective process time, and the standard timed values in the job description of each operator.

By calculating the difference between the two values, one can identify the existence of production downtime, presented in table III.

TABLE III
OPERATORS' PRODUCTION DOWNTIME ON WORKSTATION "AM"

Employee	1-AM	2-AM	3-AM
Production downtime (sec.)	+4.7	-13.7	-29.7

As shown in Table III, in the case of employee 1-AM, there is a positive time variation, which should be considered as downtime. Production downtime means inefficiency in production, which leads to low productivity, which in turn causes a decrease in turnover, and inevitably a reduction of the company's revenue. The other two employees, 2-AM and 3-AM do not show downtime, which may cause a decrease in rhythm, and hence its failure.

Even if operators in the shifts 2 and 3 do not have downtime, being apparently in a favorable position as they execute workload in a shorter time than the normal one, the time calculated for the operator in shift 1 is much smaller, resulting a daily productivity of 309 pieces (table IV), which requires a more detailed analysis of these times.

TABLE IV
OPERATORS' DAILY PRODUCTIVITY

Productivity/ day (pieces)	Employee	1-AM	2-AM	3-AM
Forecasted production		326	173	156
Production obtained		309	189	188
Production minuses		-17	+16	+32

To have a higher rhythm, the main causes of loss of time must be identified, and solutions must be found to eliminate them.

From Table IV, one can notice that the operator 1-AM has the greatest productivity, but also according to the effective rhythm, has less production of 17 pieces. Significant differences are seen in the case of operators 2 and 3 which get extra production, but which is mainly due to a higher timing of the times on each stage; in their case, the additional experience is obvious. This requires a change in the normal time for the two operators, and an analysis of the downtime identified in the case of the operator in the shift 1, with the purpose of decreasing it.

The most frequent downtimes are due to the following identified causes:

- the need for the operator to leave their job for supplies;
- the existence of a single insulating tape cutter for two workstations;

The analysis MOST Basic for the work done at the workstation "AM" has 3 options, since the work methods are different for the 3 operators. This difference is in a single stage, during matting, being considered a decisive step in calculating the work time.

TABLE V
WORK METHOD OF OPERATOR 1 AT THE WORKSTATION "AM"

Nr.	**Method**	**Fr.**
1	Cable 1 – taking and installing the cable N-g1	1
2	installing N-g2	1
3	installing N-g3	1
4	pushing device lever	1
5	A.a. – taking 3 springs	1
6	installing spring 1	1
7	installing spring 2	1
8	installing spring 3	1
9	Cable 2 – taking and installing the cable N-g1	1
10	installing N-g2	1
11	installing N-g3	1
12	Matting – collecting tape 4 pieces	4
13	collecting tape 4 pieces	4
14	collecting and installing 3 pieces	3
15	pulling device lever	1
16	removing part	1

TABLE VI
SEQUENCE MODEL OF OPERATOR 1 ON WORKSTATION "AM"

Nr.	**Sequence model**	**TMU**
1	$A_1\,B_0\,G_3\,A_1\,B_0\,P_3\,A_1$	90
2	$A_0\,B_0\,G_0\,A_0\,B_0\,P_3\,A_0$	30
3	$A_1B_0\,G_0\,A_0\,B_0\,P_3\,A_0$	40
4	$A_1\,B_0\,G_0\,A_0\,B_0\,P_1\,A_0$	20
5	$A_1\,B_0\,G_3\,A_1\,B_0\,P_0\,A_0$	50
6	$A_0\,B_0\,G_1\,A_1\,B_0\,P_3\,A_1$	60
7	$A_0\,B_0\,G_1\,A_1\,B_0\,P_3\,A_1$	60
8	$A_0\,B_0\,G_1\,A_1\,B_0\,P_3\,A_1$	60
9	$A_1\,B_0\,G_3\,A_1\,B_0\,P_6\,A_0$	110
10	$A_0\,B_0\,G_0\,A_0\,B_0\,P_6A_0$	60
11	$A_1B_0\,G_0\,A_0\,B_0\,P_3\,A_0$	70
12	$A_1\,(B_0\,G_0\,M_1\,X_1\,I_0\,A_0)$	90
13	$A_1(B_0\,G_0\,A_0\,B_0\,P_6A_0)$	250
14	$A_1\,B_0\,G_0\,M_3\,X_1\,I_{16}\,A_0$	630
15	$A_1B_0\,G_1A_0\,B_0\,P_0A_0$	20
16	$A_1B_0\,G_3A_1B_0\,P_3A_1$	90
	TIME = 62.28	**1730**

The worksheet specific to the BasicMOST method was filled with the values assigned to each stage for the operator in shift 1, the operator 1-AM being the one who performs the whole process in the shortest time. This data can be found in Tables V and VI, and the method specific to the matting operator is highlighted (collecting tape 4 pcs., mounting tape 4 pcs., collecting and installing tape 3 pcs.).

The total duration of the process of the operator in shift 1 is 62.28 seconds. Values were determined for the other two operators, taking into account the specific methods of conducting the operation of matting. The results indicate that the 2-AM operator performs the process in 2230 TMU, meaning 80.28 seconds, and the operator 3-AM in 1530 TMU, or 55.08 seconds. The differences are significant, mainly due to the matting method of the 3rd operator. According to the analysis of the model, this gets the shortest time to perform the operations, which proves the possibility of reducing the operation time of matting for other operators as well.

After the analysis performed, we notice that the working procedures of the operator 2-AM are faster, this one being more effective than others. According to the analysis MOST, the daily production of each operator should look like in Table VII.

TABLE VII
ANTICIPATED PRODUCTION ACCORDING TO MOST ANALYSIS

Productivity/ day (pieces)	Employee	1-AM	2-AM	3-AM
Anticipated production MOST		433	336	490
Production obtained		309	189	188
Production minuses		-124	-147	-302

The method used by the operator 3 is the one which must be used by every operator for matting operations; a new benchmark is given in terms of daily productivity need to be timed for this workstation. The workload consists of 490 parts, meaning about 65 parts to be manufactured per hour.

IV. CONCLUSION

The standards generated by using the workload method BasicMOST indicate the possibilities for further development of the company through standardization of work and superior training of operators. Of course, meeting these standards may be conditioned by the acquisition of auxiliary devices, the creation of conditions favorable to the activities performed, and the motivation of staff, which should be at least satisfactory.

The research revealed how BasicMOST analysis can be applied precisely in an automotive company; there were also identified the main causes of loss of time and the solutions to eliminate them.

By identifying these solutions, the manager will be able to achieve and maintain a high degree of use of personnel, materials and equipment, all of these accompanied by a rationalization of the costs involved, enabling thus a sustainable growth of the organization.

In order to obtain meaningful results, it is absolutely necessary to use the system for all workstations, with general standards of work, whose application only at the level of certain operations offers minor impact results.

A future application, with high importance, may be using MOST system methods to define standards for maintenance activities, which may lead to a possible integration of activities at organizational level.

REFERENCES

[1] Stentor Consulting, „Standard ocupational NORMATOR – glosar de termeni" http://www.stentor-consulting.ro/Images/FCK/file/Glosar-Termeni-normarea-muncii-Stentor-Consulting.pdf, *accessed at: 25.01.2013*

[2] Predetermined Motion Time Systems (PMTS), Chapter 10 PowerPoint presentation, http://faculty.kfupm.edu.sa/SE/atahir/SE%20323/Chapter-10-Predetermined-Motion-Time-Systems.ppt, *accessed at: 30.02.2013*

[3] R. M. Belokar, et.all "Optimization of Time by Elimination of Unproductive Activities through 'MOST'" *International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-1, Issue-1, June 2012*.

[4] C.D. Dumitrescu, "Creşterea nivelului calităţii proceselor de fabricare prin utilizarea procedurilor moderne de normare" http://www.tehimpuls.ro/files/File/UPT-C.%20Dumitrescu.pdf *accessed at: 30.02.2013*

[5] JMA Consultants Inc., "Standard time setting using MOST", http://www.jmacglobal.com/monodzukuri/service/images/pdf/pd07.pdf, *accessed at: 13.01.2013*

[6] Pramandra Kumar Gupta, et.all "To improve work force productivity in a medium size manufacturing enterprise by MOST Technique" *IOSR Journal of Engineering (IOSRJEN) e-ISSN: 2250-3021, p-ISSN: 2278-8719, www.iosrjen.org Volume 2, Issue 10 (October 2012), PP 08-15*.