THE QUANTITATIVE CHARACTERISTICS OF THE ELEMENTS OF STANDARDIZED WORK SHEET

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РЕФЕРАТ

СТАНДАРТИЗИРОВАННАЯ РАБОТА, СТАНДАРТИЗИРОВАННЫЙ РАБОЧИЙ ЛИСТ, БЕРЕЖЛИВОЕ ПРОИЗВОДСТВО

Исследование посвящено выявлению наиболеважных элементов стандартизации рабочих листов для анализируемого процесса. В ходе исследования были идентифицированы 45 компонентов. Эти элементы содержат информацию, которая необходима, чтобы возглавить процесс эффективно и без каких-либо сбоев. Полученные результаты показывают, что некоторые элементы, определенные в стандартных листах, повторяются: шаблоны, представленные в литературе, а также применяемые в компании. Однако представляется, что частота отдельных элементов неодинакова в обоих источниках. Компоненты с высокой частотой появления в литературе не используются в компаниии наоборот. Проверка возникновения элементов, используемых в стандартных рабочих листах в каждом источнике, является предметом данной статьи.

ABSTRACT

STANDARDIZED WORK, STANDARDIZED WORK SHEET, LEAN MANUFACTURING

The study concerns identification of the most important elements of Standardized Work Sheet for the process. During the study were identified 45 components. Those elements contain information which are necessary to lead the process effectively and without any disruptions. The obtained results show that some elements identified in Standardized Work Sheet are repeated in both: the templates presented in the literature, as well as applied in the company. However it appears that the frequency of individual elements is not the same in both sources. Components with high frequency of appearing in the literature are not used in the company and vice versa. Verification of occurrence of elements used in Standardized Work Sheet in each sources is the subject of this paper.

1. INTRODUCTION

Within Polish organizations, standardized work has been known for several dozen years. Initially, the organizations were applying the approach which is focused on controlling worker's efficiency. However, the emergence of new management concepts (such as Toyota Production System or Lean Manufacturing) allowed applying the new approach to the standardized work. As part of this study the authors examined one of the main tools of standardized work - Standardized Work Sheet and identified the main elements of this document. This knowledge allows to effective implementing the standardized work by knowing what kind of information isnecessaryto lead the process and where can be found.

2. STANDARDIZED WORK

Standard means a "widely recognized norm, widely recognized type, model or product that meets specific requirements, something employed as a model of authority" (based on the Polish Academy of Science Polish Language Dictionary of 1992). Standards are employed in a range of fields, including organization of work, where a certain fixed behaviour pattern is deemed standard provides that it does not depart from general expectations of employees, employees' supervisors, and, also, customers who, as a result of certain work, receive a service or a product they have ordered [5]. Pursuant to the definition by the International Organization for Standardization, standardization means a certain activity aimed at achieving an optimum degree of order with regard to actual or potential problems, and common norms [8].

The term "standardized work" entered the literature almost 100 years ago. In the 1920s, Henry Ford introduced first elements of standardization

into his manufacturing plants, claiming that "... today's standardization [...] is the necessary foundation on which tomorrow's improvement will be based. If you think of "standardization" as the best you know today, but which is to be improved tomorrow – you get somewhere. But if you think of standards as confining, then progress stops" [5]. Regrettably, in this very case, the theory did fail to match the practice. Standardized work actually led to standards imposed by order from superior authority, which standards should be strictly adhered to by all employees. Under Frederic Taylor's (Western approach), the duty of setting standards is with managers who draw on their knowledge and experience, without resorting to any suggestions from affected workers. Workers, therefore, have no influence on a final version of any standards although they do have hands-on knowledge of the process flow at their workplace and multi-year experience in executing given tasks. Feeling ignored and underestimated, workers no longer feel the need for their active engagement in the process of implementing any work methods that have been set. Workers accept imposed standards, although frequently they are aware that these fail to reflect an actual situation on a production line. Observations performed in some organizations for the purpose of creating work norms show that some tasks have more time allotted there to than required for their actual execution; therefore, the existing standards lead to significant excess time [6].

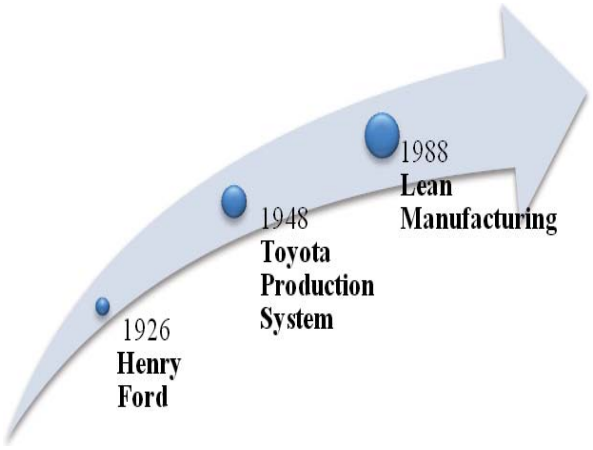

Figure 1 – Development of standardized work

(source: self study)

Completely different assumptions are made by the Lean Manufacturing (LM) concept which is primarily focused on team work of all people within an organization. And therefore, lean organizations have delegated most duties from managers to their subordinates. In such situation, subordinates feel responsible for tasks, which they execute, and are more motivated to streamline the execution of such tasks. These are also work standards that are formulated with the participation of production workers as well as managers in different levels of the hierarchy, process engineers, and, sometimes even presidents. In sum, participant in the standard creation process is anyone who possesses suitable knowledge and experience [6]. The aforementioned approach is also called a Japanese approach or perspective. Strong growth of the Toyota Production System (TPS) and of the Lean Manufacturing concept combined with dissemination of that knowledge in foreign countries, allow taking a broader perspective on standardized work. W. Feld and P. Dennis see standardized work as best working methods used by workers, and define it as "documentation of the agreed (approved) best way of executing a certain task, for the purpose of communication, training, and streamlining processes in a manufacturing unit [2]. The approach taken by Japanese companies (including an automotive company Toyota) has extended standardized work to include other areas of the manufacturing process, and perceives standardized work as "processes that are safest and easiest for workers, and are the most-effective and productive way for the company to assure quality for the Customer" [4].In practice, these processes consist in uninterrupted smooth management of the company's essential resources, which include: personnel, capital, information (knowledge), and materials, by way of maintenance and continuous revision (improvement) of the existing standards through the Kaizen activities/efforts.

3. DOCUMENTATION OF STANDARDIZEDWORK

The development of the Toyota Production System affected on increased application of standardized work in the manufacturing enterprises. TaichiOhno claims that to effective implementation it is necessary to implement three key documents (listed in «The Toyota Way. Fieldbook. A practical guide for implementing

Toyota's 4P») [7], which are:

1. Standardized Work Sheet (for operations) which is used to identify and eliminate the wastes in the manufacturing process.

2. Standardized Work Combination Sheet (sequence of operations) which shows the time dependence of two or more operations performed at the same time (for instance two or more operators performed their work at the same time or in case of bothmanual and machine workat the same time)

3. Production Capacity Sheet (for machines) which determines the capacity of the machines at the workplace

The most popular and frequently used by manufacturing enterprises is the Standardized Work Sheet. The main purpose of this document is to identify all tasks performed at the workstation and gain related information. The majority of information contained in Standardized Work Sheet are included in other documents used at the individual workstation but they play different role in the process. Toyota Production System strongly recommends to use standardized work documents because they are strictly focused on improving production processes. The example of Standardized Work Sheet is shown on Figure 2.

StandardizedWorkSheet

Job Name	Part Name:	T/L:	SIP Stock:
Grupa:	Part #:	G/L:	Takt Time: 76 [sec]

#	WorkElements	Work Time	Walk time
1	Pickupbracket A	1	2
2	Load in fixture	6	2
3	Pickupbracket B	1	3
4	Load in fixture	5	3
5	Pickupsidesupport	1	1
6	Load in fixture	3	1
7	Pickupstiffener	1	2
8	Load in fixture	8	2
9	Pickupbrace	1	3
10	Load in fixture	5	3
11	Start Robot cycle	1	1
	Total	33	23

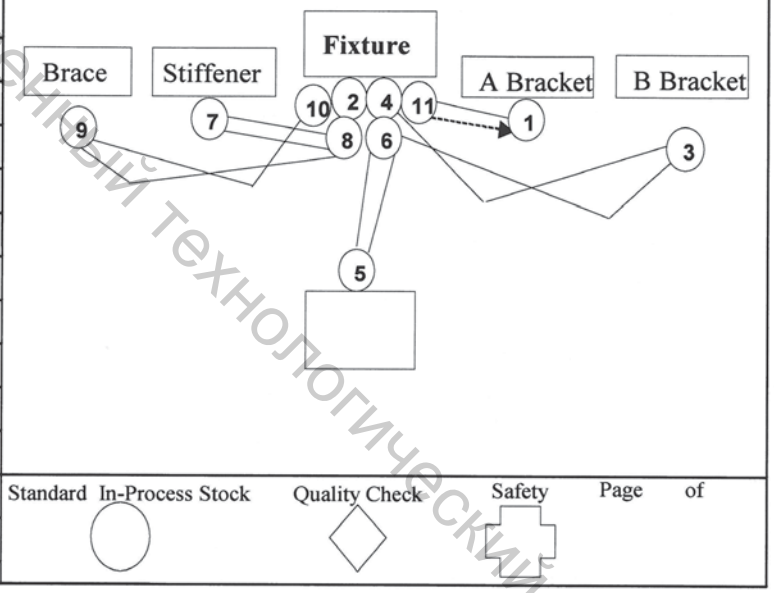

Figure 2- The example of Standardized Work Sheet

(source: [7])

4. DESCRIPTION OF RESEARCH

The research described in the article were conducted for six months (in the period July - December 2012) during the research project at the Warsaw University of Technology, Faculty of Management. Study concerns manufacturing enterprises and companies that carry out the implementation of Lean Manufacturing in their businesses. That kind of companies offer the ability to use applications that facilitate the implementation of Lean Manufacturing, as well as professional care throughout the implementation process. The study used publicly applications, including templates and examples of solutions implemented in different companies.

The subject of the conducted research was Standardized Work Sheet. It turns out that the majority of companies using standardized work documentationdoapplicate different sheets. Enterprises create sheets based on the experience

of Toyota Production System but with longer use of the documents they evolve, leading to significant deviations from the original design. The authors decided to identify the key elements of Standardized Work Sheet occurring both in literature and in documents used by manufacturing enterprises. The quantitative characteristics of the frequency of elements allow to classify most commonly used – maybe the most importantones. The authors focusedalsoon the elements that appear sporadically in the documentation because they suspect that those elements may also contain information which are important for the process.

The execution of the research included both a literature analysis of the documents (authors such as: Dennis, Liker and Meier, Niederstadt and The Productivity Press Development Team) as well as an analysis of documents used by manufacturing companies (15 sheets). Based on the collected results the authors identified:

– 23 elements of the Standardized Work Sheet contained in the literature,

– 43 Elements of the Standardized Work Sheet contained in enterprises.

Authors pay particular attention to high discrepancies number of elements, identified in both sheets (used by enterprises and presented in literature).

The identified elements of Standardized Work Sheet with their percentage share of the occurrence in all examined documents are shown in the Table 1.

5. The results of the research

The results of the literature's research suggest that in all analyzed documents (the participation rate of 100 %) are presented an overview of the process, such as organizational unit name, the name of the test process, as well as key points, indicating the specific aspects of quality, safety performance of each task. The relatively high share of 80 % present items that contain detailed information about the process, such as a list of the operations performed, takt time, cycle time and date of issue, which, according to the concept of Lean Manufacturing,are the basis to improve production processes in the enterprise.

Thelowestlevelofparticipationarecharacterized by indirect information about the analyzed process, such as: the name of the process executed before and after the analyzed process, the data that identify the operator or shift. It should be noticed that some elements such as name of a part and the total cycle time are also characterized by a low frequency of occurrence in the templates presented in the literature. However, this situation may be caused by occurrence corresponding information in different form of presentation. That's why the document uses only one data in order not to duplicate the information and maintain the readability of the document.

The results obtained from the research performed on manufacturing enterprise's documents suggest that in all the analyzed documents appear general informationofthe process, such as: the name of company or the organizational unit. Most companies (share of 73 %) placed in their sheets details information about analyzed process, such as: cycle time, date of issue, a list of the performed tasks, the duration of the tasks performed by the employee, work flow chart or key points, which are the six elements as may be necessary to use each sheet of the Standard Work Sheet. The particular attention was also drown by the authors on elements of the documentation, characterized by a low percentage (less than 13 %), which data are presented in Table 2.

During the analysis the authors pointed out that the vast majority of this information was not included in the templates described in the literature but there are extremely useful to determine the appropriate method of operation during the process. Actually, some of the data contains general information about the process, such asname of workstation or number of worked shifts.

However, among these elements were also information on the detailed description of the performed tasks (contains valuable information about how to perform specific tasks), duration of expectations time (from the point of view of the process is a waste - necessary to eliminate in the first place during the improving process) or frequency of repeated tasks (information important in ensuring safeand comfortable working conditions). From the point of view of the management it is very important to identify the tasks which add or not the "value". During the performance of value-added tasks (VA) there is a fundamental transformation of the input material (for example: material processing, changing

Table 1 – The identified elements of Standardized Work Sheet

The elements of documentation		Percentage share element in the documents [%]	
		Literature'sresearch	Enterprice'sresearch
1	Documentname	100	93
2	Enterprise name	100	93
3	Department/Location	100	93
4	Processname	100	67
5	Pre-processname	20	20
6	Next-processname	20	20
7	Workcell	0	7
8	Identification number of the operator	20	7
9	Identification number of work shift	20	0
10	Number of workshift	0	7
11	Team Leadername	40	7
12	Supervisorname	40	0
13	Person who conduct the research	40	33
14	Jigs/ Tools	0	7
15	Part number/ Product name	20	33
16	Units per shift	0	33
17	Takt time	80	73
18	Cycletime	80	47
19	Availableworktime	0	7
20	Standard In-Process Stock	40	20
21	Date of preparingdocument	80	73
22	Number of document's version	60	20
23	Revisions of the document	0	20
24	Date of lastmodification	0	7
25	Person who verify the document	0	7
26	Person responsible for compliance standard	0	33
27	Work/ Operationelements	80	73
28	Description of operation step	0	7
29	Workinstructionscomments	0	27
30	Drawings/Photos of process stages	0	13
31	Othertasks	0	13
32	Manual Time	50	73
33	Machine Time	0	47
34	Walking Time	40	53
35	Waiting Time	0	7
36	Total Time of work	20	33
37	Frequency of task'srepetition	0	7

Table 1 – The identified elements of Standardized Work Sheet

38	Worktimecoursegraph	0	13
39	Workflow diagram	60	73
40	VA and NVA task's division	0	13
41	Value Add Chart	0	7
42	Critical Points	100	73
43	Processimprovementideas	0	7
44	OperatorsLoad Chart	0	13
45	Suggestednumber of operators	0	13

(source: selfstudy)

physical and chemical properties of material or packaging of the finished product), crucial to meet the needs and expectations of the customer. In the process, there are also tasks non-value-added (NVA) of two kinds: the first are necessary to ensure the proper conduct of the process (such as quality control, handling the product or filling in the documentation), the second arean obvious loss or waste (such as waiting for operation of the machine by the employee and long times of transition for workers between tasks performed in a sequence).

The authors pointed out that a relatively large number of elements not present in the templates provided in the literature, but they appear in the document used by the surveyed companies. Some items are not included because of the repetition of the information–the phenomenon described above – such as:

– the required volume of production (convertible with the cycle time),

– the person responsible for compliance with the standard (in most companies, this obligation rests with the Team Leader),

– the name of the workstation (identified with the name of the current process).

However, some elements indicates a high utility in practical use (confirmed by the relatively high rate of over 13 % share), but they are not presented in the existing publications.All elements important for the company and not included in the Standardized Work Sheets included in the literature arepresented in Table 3.

Table 2 – The elements of Standardized Work Sheet with low percentage share

	The elements of documentation	Percentage share element in the documents [%]	
		Literature' sresearch	Enterprice' sresearch
1	Workcell	0	7
2	Identification number of the operator	20	7
3	Number of workshift	0	7
4	Team Leadername	40	7
5	Jigs/ Tools	0	7
6	Availableworktime	0	7
7	Date of lastmodification	0	7
8	Person who verify the document	0	7
9	**Description of operation step**	**0**	**7**
10	Drawings/Photos of process stages	0	13
11	Othertasks	0	13
12	**Waiting Time**	**0**	**7**
13	**Frequency of task'srepetition**	**0**	**7**
14	Worktimecoursegraph	0	13
15	**VA and NVA task's division**	**0**	**13**
16	Value Add Chart	0	7
17	**Processimprovementideas**	**0**	**7**
18	OperatorsLoad Chart	0	13
19	Suggestednumber of operators	0	13

(source: selfstudy)

Table 3 - The elements of Standardized Work Sheet not included in literature

The elements of documentation		Percentage share element in the documents [%]	
		Literature' sresearch	Enterprice' sresearch
1	Availableworktime	0	7
2	Revisions of the dokument	0	20
3	Description of operation step	0	7
4	**Workinstruc-tionscomments**	**0**	**27**
5	Drawings/Photos of process stages	0	13
6	Othertasks	0	13
7	**Machine Time**	**0**	**47**
8	Waiting Time	0	7
9	Frequency of task'srepetition	0	7
10	Worktimecoursegraph	0	13
11	VA and NVA tasks division	0	13
12	Value Add Chart	0	7
13	Processimprovementideas	0	7
14	OperatorsLoad Chart	0	13
15	Suggestednumber of operators	0	13

(source: selfstudy)

The analysis of the results presented in Table 3 shows that there are two elements with high percentage share: the duration of the tasks performed by machine (percentage share at the level of 47 %) and instructions on how to perform the tasks (percentage share at the level of 27%). The subject of further research will be analyze what kind of information carry those elements and why enterprises use this elements in the template, despite the lack of guidance in the literature. Theoretically most of these elements are available in other documents at the workplace, for example in operational instructions or normative of the machine but for some reason enterprises decided to use theme in the documentation of standardized work. The authors can only suppose that this is related totheirhigh utility in the implementation of process improvements. The assumptions will be considered in future research by the authors.

6. CONCLUSIONS

The obtained results show that some elements identified in the Standardized Work Sheetare repeated in both: the templates presented in the literature as well as applied in the company. However, the authors drew a particular attention to the elements that prove the large discrepancies between information included in both sources (literature and enterprises). This situation can be caused by lack of knowledge the employee who create the sheet for the first timeanddo not have a knowledge what kind of elements should be included in the document. However, it may also result from the knowledge and long experience in the application of those document by the employee who knows how to develop the template by new concepts supporting application of standardized work during the years.These considerations will be the subject of further research.

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