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RELATIONSHIPS BETWEEN SELECTED LEAN MANAGEMENT TOOLS AND INNOVATIONS

Summary. The publication focuses on the presentation of analysis about lean selected lean management tools and innovations. We selected seven main tools of lean management and compare it's effects from various innovations point of view.

Keywords: lean management, innovations, product innovations, organizational innovations, 5S, Kaizen, TPM.

RELACJE POMIĘDZY WYBRANYMI NARZĘDZIAMI LEAN MANAGEMENT A INNOWACJAMI

Streszczenie. Publikacja koncentruje się na prezentacji analiz w zakresie relacji pomiędzy wybranymi narzędziami lean management a innowacyjnością. Przedstawiono w niej siedem najistotniejszych narzędzi innowacyjności i dokonano analizy wpływu ich zastosowania na poszczególne rodzaje innowacji.

Słowa kluczowe: szczupłe zarządzanie, innowacje, innowacje produktowe, innowacje organizacyjne, 5S, Kaizen, TPM.

1. Introduction

Now the innovativeness is an important part of many management conception from traditional management to new CSR conception [17, 18, 19, 20, 21, 22, 53]. The application of Lean tools in the production enterprise leads to a number of positive effects. As a result, we obtain the so-called weight loss many organizational processes, the result of which can significantly reduce waste. Use of tools belonging to Lean production also is very useful for the development of many innovative solutions that include both process and organizational

innovation. This publication has been included in the presentation tools of Lean production, highlighting their role in shaping the various types of innovation. The scope of the publication is to analyze relationships between selected seven lean management tools and innovations.

2. Selected tolls of lean management

The word "lean" has the Anglo-American origins and means to adapt and slender in relation to the body of man. In the case of the management / production, the term "lean" means "slimming", "slimming" management / production in terms of rules of conduct / needed material resources, captive stocks of finished goods and work in progress and production facilities used space [2, 3, 6, 8, 15].

In this paper we can't describe all lean management tools. The paper concentrate only on selected ones. We think, the most important, mentioned in the literature Lean production tools include [4]:

- 5S,
- Kaizen,
- Just in Time,
- Kanban,
- SMED - Single Minute Exchange or Die,
- TPM - Total Productive Maintenance - Comprehensive Maintenance Productivity,
- VSM - Value Stream Mapping - Value Stream Mapping.

5S is a systematic method of learning, discipline, standardization, and the pursuit of excellence. The method name is an acronym for five Japanese words [12, 29, 31]:

- Seiri - sort - is to separate any material on the job, such as tools, instructions, since these necessary and to remove (shift, throwing) unnecessary things.
- Seiton - straighten means labelling the parts and tools and setting for them in which they are to be available. Every part of the tool, the user should be assigned to a place where you want to be. Items used most frequently should be within reach of the employee, and be readily available.
- Seiso – sweep/scrub - means removing dirt, waste production, cleaning, renew the workplace and its environment.
- Seiketsu - standardize - is a constant maintenance of order, cleanliness and neatness, both in the workplace and in the environment.
- Shitsuke - sustain - get into the habit compliance with the above principles. The use of them and taking care of it, to observe their colleagues.

Kaizen is a continuous changes and improvements in small steps [5, 11, 13, 50, 52, 54, 55, 56]. In this method, there is very impotent the continuous analysis of individual repetitive tasks that make up the support for the chosen sphere of business activity [25, 26, 27, 32, 33, 34, 35, 36, 46].

Kanban is a self-regulating production control operating tool. This method involves control of production by events occurring directly on the production processes (and not on the basis of the plan). The method is focused on providing the following benefits:

- a short processing time,
- low inventories while timely implementation, and hence:
  - the volume should be adjusted to the number of orders,
  - the quality control should be at all stages of the process.

SMED is an acronym for "Single Minute Exchange of Die," which literally means one-minute exchange of molds or tools. Nominal target for the duration of each changeover is 10 minutes or less. In practice, the SMED method is used to reduce machine changeover time.

The rules of SMED applications are developed by Shigeo Shingo. The reduction of time during the changeover is achieved by eliminating the external elements, replacement of some of the elements of internal and external gradual reduction of the duration of the other internal components. The result of carrying out the process SMED is often more than 50% reduction in the time of exchange of the mold or tool [16, 23].

TPM method in Polish literature is called the Comprehensive maintained by Productivity. It is a resource management strategy, which emphasizes the collaboration between the departments - operating and use, with a view to striving to reduce defects and waste. The TPM method seeks to activation of all the employees of an organization. Employees should be at various levels in order to maximize the overall efficiency of production resources. As a result, you can improve existing processes and the availability of resources by reducing mistakes and accidents [1, 41, 42, 43, 44, 45, 47].

VSA - Value Stream Mapping is a tool for visualization of the manufacturing process and flow of information for the selected product family. Creating a Current State Map allows you to identify waste in processes and alignment of strategic transformation plan based on the Pull System, which enables the production of only what has been consumed by another process [7, 24, 25, 49, 51].

Value Stream Mapping is primarily a way to find these elements companies that are not functioning properly. Even if it seems that all areas of the company are working perfectly, the mapping value streams, indicate any discontinuity, disruption in the flow of information and materials. Frequently such problems lead to the conclusion that the seemingly successful company, does not bring the expected profit [9, 10, 14, 30, 39, 40].

3. Selected lean production tools and innovation

In the literature [23, 38] there is a description of various case studies that suggest that many of the tools of Lean management makes the company become more innovative. For example the Toyota Company is widely perceived as an organization characterized by a high degree of innovation. So the mere fact is that the positive impact of the application of Lean production and the individual tools used for innovation is not subject to discussion.

In the literature, the most common division is the division of innovation is:

- product innovations,
- process innovations,
- service innovations.

These types can be defined as follows [41]:

- Product innovation is the launch of the product when the technological characteristics or intended use differs significantly from previously manufactured products or the operation of which has been substantially improved, and at the same time it can provide the consumer with objectively new or increased benefits.
- A process innovation is the adoption of new or significantly improved methods of manufacturing or delivery of products. This might involve changes in the organization, technology, human resources, working methods, hardware, or a combination of such changes.
- Service innovation is the launch of a service that is new or is perceived by someone as new. It is therefore a service that offers consumers a new benefit or value. Such innovation is the change of an existing service, or proposes a new one. Innovation in services is defined by multiple divisions including product innovation.

Product and process innovations can be collectively called technical innovations. In addition to technical innovations in the literature there is also the concept of organizational innovation. The concept of organizational innovation can be understood as a project related to changes in the organization of production departments, jobs and auxiliary departments (internal transport, storage, etc.), Including realization within their own inventions and project work related to the purchase of computer software, the introduction of computers to control and regulation of production processes, as well as the installation of computer networks.

Another division of innovation is promoted in the manual Guidelines for Collecting and Interpreting Technological Innovation Data. According to it's there are four types of innovation [37]:

- product innovation,
- process innovations,

- organizational innovations,
- marketing innovations.

(marketing innovations will not be discussed here, since they do not lie on the issues discussed in this paper).

The last division of innovation that is worth mentioning in this publication is a division of innovation from the point of view of the situation that leads to the occurrence of the innovation. In this case, we can distinguish three types of innovation [48]:

- routine innovation - involve the introduction of some changes in the products or services that are designed to maintain the attractiveness of the product,
- forced innovation - rely on the introduction of changes due to the critical situation (economic crisis, or when the product or service are declining),
- innovations resulting from the way - are usually implemented by companies that can devote significant resources in research - development. This led to the company replace existing products, expand its services, refine production processes - technology.

In Tables 1 and 2 we made the statement showing what types of innovations is the result of the use of the Lean production. Wherein respectively, Table 1 shows the distribution of the innovation with regard to their type, and in Table 2 in terms of the situation, which leads to the occurrence. The generic division focuses on three types of innovation - the most important from the production processes point of view (product innovation, process innovation and organizational innovation). The analysis of the data contained in Table 1 shows that Lean production (with the sole exception of Kaizen) allows you to get the process and organizational innovation, and not used to obtain product innovations.

By using methods such as Value Stream Mapping we can analyze accurately operation carried out on the manufacturing and provide better execution of production processes, but this will not translate directly to the emergence of new products. It is clear that Lean production is a concept that is used to improve the products that are already implemented by the organization, rather than inventing new ones. In order to develop new products to be used entirely different methods, such as: QFD and Kano in the field of quality management, which are not the subject of this paper.

Table 1

The influence of the lean production on innovations with regard to their type

Method	**Types of innovation**		
	Product innovations	**Process innovations**	**Organisational innovations**
5S		+	+++
Kaizen	++	++	++

con. table 1

Just in Time		+++	+
Kanban		++	++
SMED		+++	++
TPM		++	++
VSM		+++	+++

Source: Author's own work.

Taking into account the distribution of innovation we can see that Lean production is best suited for the development of innovation routine. The tools using in lean production can be applied to solve common problems that occur in every day practice in manufacturing companies. To some extent, their use may also be forced by external circumstances for example crisis. In contrast, practically they do not apply in the field of innovation resulting from the occasion that are created quickly and rely heavily on introducing innovative solutions. In this regard, in place of detailed analysis that occurs with the methods of Lean production methods should be used to stimulate creative thinking and facilitate the generation of new ideas, such as TRIZ, brainstorming, etc.

Table 2

The influence of the lean production on innovations in terms of the situation

Method	**Types of innovation**		
	Routine innovations	**Forced innovations**	**Innovations resulting from the way**
5S	+++		
Kaizen	++	+	
Just in Time	+	++	+
Kanban	++	++	+
SMED	++	++	+
TPM	++	++	+
VSM	+++	++	

Source: Author's own work.

3. Summary

As a result of the experience of global companies especially Toyota Lean production methods are found as an important way in the practice of production management improvement of industrial enterprises. These methods are used to eliminate waste within the organization; they also help create new, innovative solutions.

At the same time, as shown in this publication, directly themselves Lean production methods do not directly contribute to the formation of product innovation. Because they focus on analyzing and improving the existing production processes. Therefore, they arise mainly as a result of process innovations and organizational innovations. From the viewpoint of those methods set divisions encourage innovation generation routine, to some extent we can use them to create innovation forced but their applicability in this terms is very limited.

Bibliography

1. Beau K., Drew L.: *The complete lean enterprise. Value stream mapping*, Productivity Press, New York 2004.
2. Biały W.: *Innowacyjne narzędzia do wyznaczania właściwości mechanicznych węgla.* „Przegląd Górniczy" nr 6/2013, s. 17-26.
3. Biały W.: *New devices used in determining and assessing mechanical characteristic of coal.* 13th SGEM GeoConference on Science and Technologies In Geology, Exploration and Mining, SGEM2013 Conference Proceedings, June 16-22, 2013, Vol. 1, Bułgaria, s. 547-554.
4. Bicheno J.: *The Lean Toolbox.* PICSIE Books, 2000.
5. Burtan A., Wolniak R.: *Decission process based on attribute control charts in the automotive industry.* „Technická Diagnostyka", nr 1, 2013.
6. Cholewicka-Goździk K.: *Metoda LEAN - doskonalenie procesów i produktów*, „Problemy Jakości" 2001.
7. Czerska J.: *Doskonalenie strumienia wartości.* Difin, Warszawa 2012.
8. Czerska J.: *Pozwól płynąc swojemu produktowi. Tworzenie ciągłego przepływu.* Placet, Warszawa 2012.
9. Dolcemascolo D.: *Improving the extended value stream.* Productivity Press, New York 2006.
10. Duggan K.J.: *Creating Mixed model Value Streams. Practical Lean Techniques for Building to Demand.* Productivity Press, USA 2003.
11. Gajdzik B., Sitko J.: *An analysis of the causes of complaints about steel sheets in metallurgical product quality management systems.* „Metalurgija" 2014 vol. 53, iss. 1, s. 135-138.
12. Gala B., Wolniak R.: *Problems of implementation 5S practices in an industrial company.* „Management Systems in Production Engineering", nr 4, 2013, s. 8-14.
13. Gulati R.: Maintenance and Reliability best practices. Industrial Press, New York 2009.
14. GUS, Warszawa 2002.
15. Hobbs H.: *Lean Manufacturing Implementation.* J. Ross Publishing 2003.

16. http://www.leanvision.com/pl/smed
17. Hys K.: *Evaluation of public sector workers for assistance Method of Mystery Shopping.* Proceedings in: Advanced Research in Scientific Areas (ARSA-2013), M. Mokrys, S. Badura, A. Lieskovsky (Ed.), Slovakia, Zilina 2013.
18. Hys K., Hawrysz L.: *(Dis)Advantages of quality management systems in the light of accredited certification bodies in Poland*, [w:] Integration in management. E. Skrzypek (Ed.), Wydawnictwo UMCS w Lublinie, Lublin 2012, s. 197-209.
19. Hys K., Hawrysz L.: *Corporate Social Responsibility Reporting.* "China-USA Business Review", Vol. 11, No. 11, 2012, s. 1515-1524.
20. Hys K., Hawrysz L.: *CSR in Poland as a important foundations of modern societies.* "Management Study", Vol. 1, No. 1, 2013, s. 27-33.
21. Hys K., Hawrysz L.: *Semantic differential as an assessment tool of (dis)advantages of QMS in the light of accredited certification in Poland*. Chinese Business Review, Vol. 13, No. 1, 2014, s. 42-52.
22. Hys K.: *Semantic profile as a tool for assessment of competence public sector workers.* Conference Proceedings in: International Masaryk Conference for Ph.D. Students and Young Researchers 2013 (MMK 2013). Hradec Králové, The Czech Republic: MAGNANIMITAS. Vol. IV. 2013.
23. Jagoda-Sobalak D., Knosala R.: *Zastosowanie techniki twórczego myślenia de Bono w procesie wdrażania metody SMED na przykładzie praktycznym.* „Zarządzanie Przedsiębiorstwem", 2, 2011, s. 13-21.
24. Jonas D., Wormak J.P.: *Zobaczyć całość. Mapowanie rozszerzonych strumieni wartości,* Lean Enterprise Institute, Warszawa 2002.
25. Łazicki A.: *System zarządzania przedsiębiorstwem. Techniki lean management i kaizen.* Wiedza i Praktyka, Warszawa 2011.
26. Ligarski M.J.: *Podejście systemowe do zarządzania jakością w organizacji*. Monografia, Wyd. Politechniki Śląskiej, Gliwice 2010.
27. Ligarski M.J.: *Problem identification method in certified quality management systems.* "Quality & Quantity", 2012, 46, p. 315-321.
28. Locher D.: *Value Stream Mapping for Lean Development*, Taylor & Francis, USA 2008.
29. Łuczak J., Matuszak-Flejszman A.: *Metody i technika zarządzania jakością. Kompendium wiedzy*, Quality Progress, Poznań 2007.
30. Luyster T., Shuker T., Tapping D.: *Value Stream Management. Eight Steps to Planning, Mapping and Sustaining Lean Improvements*, Productivity Press, USA 2002.
31. Maciejec L.: *„Produkcja szczupła".* CIO 2/2006, IDG Poland.
32. Masaaki I.: *Kaizen – Klucz do konkurencyjnego sukcesu Japonii.* MT Biznes, Kraków 2007.

33. Midor K.: *An innovative approach to the evaluation of a quality management system in a production enterprise.* "Scientific Journals Maritime University of Szczecin", 2013, nr 34, s. 73-79.
34. Midor K.: *Metody zarządzania jakością w systemie WCM, studium przypadku* w: Zarządzanie jakością wybranych procesów. Praca zbiorowa pod red. J. Żuchowskiego, Wydawnictwo Naukowe Instytutu Technologii Eksploatacji w Radomiu, 2010, nr 1, s. 116-136.
35. Molenda M.: *Effectiveness of planning internal audits of the quality system*, „Zeszyty Naukowe Akademii Morskiej w Szczecinie", Szczecin 2012, nr 32, z. 1, s. 48-54.
36. Molenda M.: *Znaczenie wartości organizacyjnych w rozwoju kultury jakości,* „Zeszyty Naukowe Politechniki Śląskiej, Seria: Organizacja i Zarządzanie" z. 63a, Politechnika Śląska, Gliwice 2012, s. 201-2019
37. Oslo, *Manual. Guidelines for Collecting and Interpreting Technological Innovation Data*, 3rd Edition, OECD/Eurostat, Paris 2005.
38. Pająk E.: *Zastosowanie koncepcji lean project podczas działań innowacyjnych.* „Zarządzanie Przedsiębiorstwem", 2, 2011, s. 51-56.
39. Quaterman L., Snyder B.: *Value stream & process mapping.* Enna Product, Canada 2007.
40. Rother M., Shook J.: *Learning to See. Value stream mapping to create value and eliminate muda.* Lean Enterprise Institute Brooklin, Massachusetts 1999.
41. Shimokawa K.: *Lean management – narodziny systemu zarządzania*. Lean Enterprise Institute, Warszawa 2011.
42. Sitko J.: *Basics of control system material in iron found.* "Archive of Foundry Engineering", 2011 vol. 11, iss. 3, s. 189-192.
43. Skotnicka-Zasadzień B., Biały W.: *Analiza możliwości wykorzystania narzędzia Pareto-Lorenza do oceny awaryjności urządzeń górniczych. "*Eksploatacja i Niezawodność" 2011 nr 3, s. 51-55.
44. Szczęśniak B.: *Linking EPC models – an alternative approach.* "Scientific Journals Maritime University of Szczecin", 34(106), 2013, s. 79-84
45. Szczęśniak B.: „*Koncepcja zastosowania arkusza kalkulacyjnego do wspomagania tworzenia dokumentów w procesie produkcji taśm blachy* w: Systemy Wspomagania w Inżynierii Produkcji. Innowacyjność, Jakość, Zarządzanie. Monografia. Red. Witold Biały, Katarzyna Midor. Wydawnictwo PA NOVA, Gliwice 2013, s. 133-151.
46. Szymańska-Brałkowska M.: *Kaizen – metoda zwiększenia produktywności przedsiębiorstwa*, [w] Zarządzanie jakością – doskonalenie organizacji, [red.] T. Sikora, Wydawnictwo PTTŻ, Kraków 2010, tom 1, s. 603-613.
47. Thomas J.: President of ean Masters Consulting Group, Inc, USA – materiały informacyjne, 1999.
48. Webber R.A.: *Zasady zarządzan*a *organizacjami.* PWE, Warszawa 1996.

49. Wolniak R, Skotnicka-Zasadzień B.: *The use of value stream mapping to introduction of organizational innovation in industry.* "Metalurgija" vol. 53 (4), 2014, s. 709-713.
50. Wolniak R.: *Wykorzystanie Kaizen w przedsiębiorstwie produkcyjnym.* „Problemy Jakości" nr 3, 2013, s. 27-31.
51. Wolniak R., Skotnicka-Zasadzierń B.: *Zastosowanie mapowania strumienia wartości w przemyśle*, [w:] Systemy wspomagania w Inżynierii Produkcji. Innowacyjność, jakość, zarządzanie, [red.] W. Biały, K. Midor, 2013, s. 180-190.
52. Wolniak R.: *Effectivency of use of FMEA method in an industrial enterprise.* „Technická Diagnostyka", nr 1 2013.
53. Wolniak R.: *Raportowanie społecznej odpowiedzialności biznesu zgodnie ze standardem Grenelle II.* Zeszyty Naukowe Politechniki Śląskiej. Seria Organizacja i Zarządzanie, z. 73, Gliwice 2014, s. 651-662.
54. Wolniak R.: The use of the MTM method for the analysis of production process. „Technická Diagnostyka", nr 1 2014.
55. Zasadzień M.: The analysis of work performance ability of maintenance workers as exemplified of an enterprise of automobile industry. "Scientific Journals Maritime University of Szczecin", 24, 2011, p. 119-124.
56. Zasadzień M.: *Using the Pareto diagram and FMEA (Failure Mode and Effects Analysis) to identify key defects in a product.* "Management Systems in Production Engineering", no. 4, 2014, p. 153-156. DOI: DOI 10.12914/MSPE-02-04-2014.

Omówienie

W artykule przedstawiono kwestie dotyczące roli narzędzi lean production w zakresie kształtowania różnego rodzaju innowacji. W analizie uwzględniono siedem narzędzi lean production: 5S, Kaizen, Just in Time, Kanban, SMED, TPM, VSM. W zakresie innowacji zaprezentowano dwa podziały innowacji: innowacje produktowe, innowacje organizacyjne i innowacje procesowe, oraz drugi podział: innowacje rutynowe, innowacje wymuszone, a także innowacje wynikające z okazji. Z analiz wynika, że bezpośrednio metody lean production nie przyczyniają się do powstania innowacji produktowych, mogą natomiast być bardzo korzystne w zakresie generowania innowacji procesowych i organizacyjnych.