LEAN LOGISTICS CONCEPT IN THE CZECH ENGINEERING COMPANIES

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Abstract

Lean Logistics concept is a very useful method to gain a competitive advantage and achieve profitability in the global environment. The paper deals with the situation of using Lean Logistics concept in the Czech engineering companies. For these purposes was carried out empirical research in order to analyze the situation of the introduction of Lean Logistics concept in the Czech engineering companies. The paper presents data of quantitative research conducted on the sample of 167 Czech engineering companies. The data are divided into four categories by the size of company: a micro company, a small company, a medium company and a large enterprise.

Keywords: Lean logistics, engineering companies, questionnaire survey

1.   LEAN LOGISTICS

Lean logistics is an important part of lean company concept. There are many sources and literature about lean logistics as for example [2], [3], [7] or [8] which provide a detailed overview about lean logistics principles and methods and tools of industrial engineering, specifying the characteristics and benefits of the various methods and instruments.

Concept of lean logistics was introduced as a part of lean company concept at Toyota automotive company in 50-60 of the 20th century. The main basic of lean logistics concept is the lean philosophy. The lean philosophy is based on a single principle: all forms of wasting should be identified and eliminated. This seems simplistic, but it is not because recognizing true areas of waste is difficult [5].

It is necessary focus on the intent of the process. Eliminate all the parts of the process which do not contribute to meeting the intent, all those that do not contribute to value. Then look at each remaining part and work continually to lower its cost, make it timelier, and improve the quality of results. This focus on eliminating all wasteful effort, the fat that did not contribute to achieving the desired outcome, resulted in Toyota´s lean production system [6].

Just-in-time (JIT) is very important method which was also used in Toyota production system (TPS). Just-in-time is a method, which organizes the logistics flows so as to minimize transport and storage costs. Myerson discusses the need to apply some of the important techniques for cost reduction, including JIT and illustrates how beneficial they are for achieving leanness [8].

The objectives of lean logistics can therefore be stated according to Baudin [2] as follows:
- delivering the materials when needed in the exact quantity,
- without degrading delivery, pursue the elimination of waste in the logistics process.

2.   METHODOLOGY OF RESEARCH

The main aim of the research was to determine the current state of the introduction of lean logistics concept in the Czech engineering companies. The questionnaire was designed in a structured way due to simplicity, speed and ease of data acquisition processing so the respondent could answer only on the basis of the available options.

The main objectives of the research are follows:

- find out the state in training of lean logistics concept,
- ascertain the rate of introduction of lean logistics concept,
- find out types of wasting in logistics processes,
- identify methods and tools of industrial engineering used by companies,
- find out dependencies among data.

Main hypotheses of empirical research:

- H1: Part of the Czech engineering companies is interested in the concept of lean logistics.
- H2: There is a potential for using of ICT to support Lean Company concept in the Czech engineering companies.
- H3: There is a lack of experts for lean logistics in the Czech engineering companies.
- H4: Knowledge of lean logistics is dependent on the size of the engineering company.
- H5: Knowledge of lean logistics is not dependent on the region where company operates.

Data were obtained using a questionnaire survey in the Czech engineering companies. It was received data from 167 different companies which are analyzed in next sections "Basic results of research" and "Categorical data analysis".

The data could be separated into many categories according to:

- the company size (number of employees),
- the distribution by region,
- the knowledge of lean logistics,
- the training of lean logistics,
- the level of implementation of lean logistics concept,
- the using ICT to support lean company concept,
- the using of expert for lean logistics.

Companies could be divided according their size as: a micro company, a small company, a medium company and a large enterprise. For many categories such as the knowledge of lean logistics, the training of lean logistics are possible only positive or negative answers "yes" or "no". Level of implementation of lean logistics concept could be one of following: fully implemented, partially implemented, will be implemented, will be not implemented.

There were used for data analyzing these software applications: Microsoft Excel for basic analysis and specialized statistical software IBM SPSS Statistics for categorical data analysis and for finding dependencies among data. SPSS is capable of performing almost all common types of analysis. This makes the software particularly suitable for analyzing data obtained from questionnaires [4].

We can consider according to Agresti [1] the null hypothesis H0 that cell probabilities equal certain fixed values (π_{ij}). For a sample of size n with cells counts (n_{ij}), the values ($\mu_{ij} = n\pi_{ij}$) are expected frequencies. They represent the values of the expectations (E(n_{ij})) when H0 is true. Pearsons chi-squared statistic for testing H0 is defined as the following equation: This statistics takes its minimum value of zero when all $n_{ij} = \mu_{ij}$. For a fixed sample size, greater differences ($n_{ij} - \mu_{ij}$) produce larger χ2 values and stronger evidence against H0 [1].

$$\chi^2 = \sum \frac{(n_{ij} - \mu_{ij})^2}{\mu_{ij}} \tag{1}$$

3.   BASIC RESULTS OF RESEARCH

The basic statistics includes overview about the rate of knowledge of lean logistics concept in Czech engineering companies, the training in lean logistics concept, the rate of implementation of lean logistics concept, areas of greatest waste in logistics processes, the most used methods and tools of industrial engineering, application of ICT to support lean company concept, experts for lean logistics concept.

Knowledge of lean logistics concept

Based on the research, it was found that 76 companies from total 167 (45.5 %) have a basic knowledge about lean logistics concept and 91 companies (54.5 %) do not have a basic knowledge about lean logistics concept. In **Table 1** we can see situation about knowledge of lean logistics concept according to a size of company.

Table 1 Knowledge of lean logistics concept according to a size of company

		Knowledge of lean logistics		Total
		YES	NO	
Employees	1 - 9	3	24	27
	10 - 99	20	49	69
	100 - 499	33	14	47
	500+	20	4	24
Total		76	91	167

Source: Output from SPSS, data based on own questionnaire survey, N=167

The table shows that bigger companies have better knowledge of lean logistics concept than smaller. If we analyze small companies with 1 - 99 employees so we will see that there is only 24 % of companies which know lean logistics concept and 76 % of companies do not know this concept. For enterprises with 100 and more employees is the situation different because 74.6 % of companies know lean logistics concept and only 25.4 % of companies do not know this concept.

Training of lean logistics concept

Training of lean logistics concept was realized in only 27.5 % of the companies. There is significant difference according to company size. Training of lean logistics concept was realized more in bigger companies.

The implementation of lean logistics concept

One of the main questions was focused on the rate of implementation of lean logistics concept. The concept of lean logistics is fully implemented in only 6.5 % of companies, partly is implemented in 18.2 %, implementation is planned in case of 17.1 % of enterprises. We can summarize that in 41.8 % of companies was lean logistics concept implemented or will be implemented in the future. Hypothesis H1 is approved: Part of the Czech
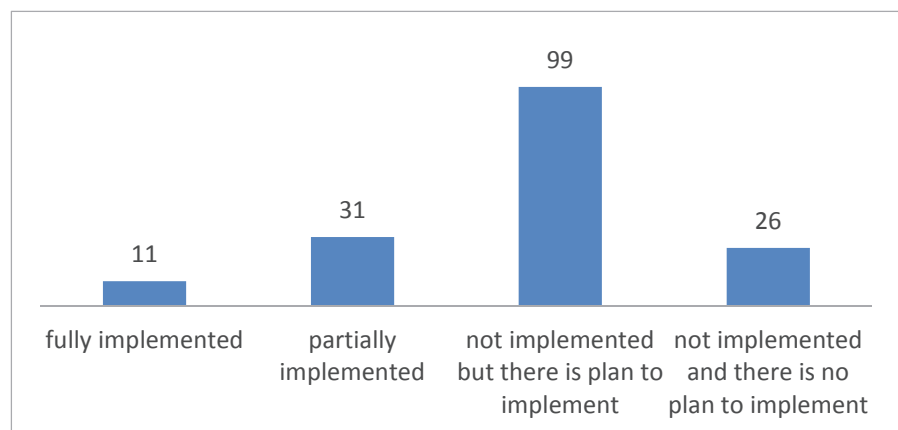

Fig. 1 Concept of lean logistics in the Czech engineering companies, N=167

engineering companies is interested in the concept of lean logistics. The rate of introduction of concept is displayed in **Fig. 1**.

**Areas of wasting in logistics processes**

There were found following areas of greatest waste in logistics processes: waiting, communication and transport. The minimal wasting was found in the following processes: inventory, not used human resource creativity and motion. The frequency of different types of waste in logistics processes based on data from 167 engineering companies is shown in **Fig. 2**.
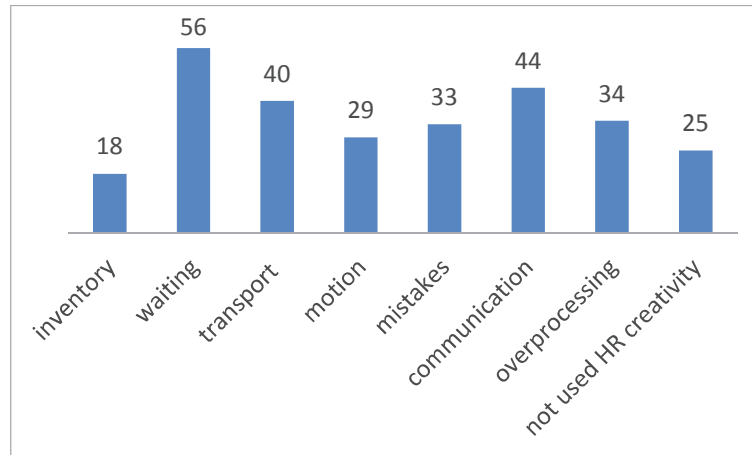
Fig. 2 Wasting in logistics in the Czech engineering companies, N=167

Methods and Tools of Industrial Engineering

Industrial engineering is an important tool to achieve higher business productivity and to avoid excessive wastage in the company. These methods and tools of industrial engineering were used in the research: CEZ, KANBAN, MOST, OPF, Poka-yoke, Process analysis, 5S method, Six Sigma and DMAIC, SMED, TOC, TPM, VSM and workshops. Based on research are the most used methods and tools of industrial engineering following: 5S method, workshops, process analysis and Kanban. The frequency of different methods and tools of industrial engineering is shown in **Fig. 3**.
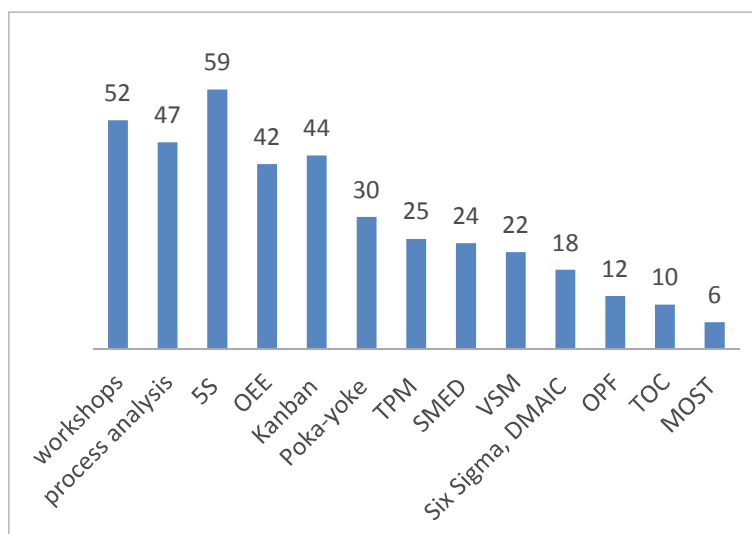
Fig. 3 Methods and Tools of Industrial Engineering in the Czech engineering companies, N=167

Application of ICT to support Lean Company

Specific ICT application to support Lean Company is used by only 4.8 % of companies. Hypothesis H2 is confirmed: There is a potential for the use of ICT to support Lean Company concept in the Czech engineering companies.

Experts for lean logistics

There is an expert in the field of lean logistics only in 19.2 % of companies. We can conclude that there is a lack of experts for lean logistics in the Czech engineering companies because there is 41.8 % of companies when was lean logistics concept implemented or will be implemented in the future. Hypothesis H3 is confirmed: There is a lack of experts for lean logistics in the Czech engineering companies.

4. CATEGORICAL DATA ANALYIS

There will be described categorical data analysis of the data acquired from research. It was used IMB SPSS Statistics software to find out dependencies among data. Main task of categorical data analysis was to test the following hypotheses: knowledge of lean logistics is dependent on the size of the engineering company (H4) and knowledge of lean logistics is not dependent on the region in which the engineering company operates (H5).

Table 2 Chi-Square Tests for dependency the knowledge of lean logistics and a size of company

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	45.892a	3	.000
Likelihood Ratio	49.368	3	.000

Source: Output from SPSS, data based on own questionnaire survey, N=167

We can see in **Table 2** very strong dependency between variable "size of company" and variable "knowledge of lean logistics". It was used the 0.05 probability level as a critical value. We can see that Asymp. Sig. (2-sided) value is 0.000 and it is less than the 0.05 value so we reject H0 about independence of variables and we except alternative hypothesis HA about dependence between variables. Hypotheses H4 and H5 were confirmed. It was found that the implementation of lean logistics is dependent on the size of the company. There is no dependency between the knowledge of lean logistics and the region in which the engineering company operates.

5. CONCLUSION

Logistics is an important factor of production in addition to the competitiveness of each company. The goal of managers should be to reduce waste in all logistics processes. Effective tool to reduce this wastage is concept of lean logistics, which represents an application of the principles of lean manufacturing to logistics processes. This article discusses the situation of introducing lean logistics concept. The situation of the introduction of lean logistics describes questionnaire survey, which was conducted in the Czech engineering companies. The research confirms that the biggest problem is a lack of experts for lean logistics concept. Results of survey also confirm very low using of ICT tools for supporting Lean Company concept (just 4.8 % of companies use ICT tools for supporting Lean Company). There were also confirmed hypothesis about dependency between knowledge of lean logistics concept and size of company. It was found that there is no dependency between knowledge of lean logistics and regions where the engineering companies operate.

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