AN APPROACH TO DETERMINING THE COMPETITIVENESS OF LOGISTICS EQUIPMENT

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Abstract. An approach for determining the competitiveness of logistics material handling machines is proposed. It consists of seven stages, including The Emotional model and forecasting of three types of parameters – quantitative, qualitative and relative. The approach is then tested by determining the competitiveness of forklift-trucks.

Keywords: logistics, forecasting, competitiveness, logistical equipment, emotional model

1. Introduction

The modern global market is characterized by it's orientation towards the client. This lead to high individual requirements towards the design, manufacturing and delivery of the goods, to high competitiveness, optimization of the ratio between price and quality and full satisfaction of the clients' needs. The severity of the modern user grows constantly and rapidly, the life-cycle of the products is reduced and the level of service is raised. This as well as the presence of the Economic crisis imposes high requirements to the management of the production. In order for it to be successful it is necessary for the managers to apply forecasting for determination of future parameters of a particular product and subsequent logistical planning of the service.

2. Application field

The particular realization of the competitiveness is made with comparing the parameters of different types of logistics equipment with the clients' needs, defined by the requirements of the market. The requirements towards a machine dictate its architecture. These requirements are also determined by the so called client parameters which also define the usefulness. These parameters are dynamic and can fluctuate through a certain range.

3. Research of the problem

The globalization and economic crisis set the competitiveness as the most important economic problem. There are different works on this problem. In [1] different financial indicators, affecting competitiveness of the products in the process of innovation are shown. By the means of weight coefficients, a summary of the expected usefulness of the company's process innovations is conducted. In [2, 3] the authors analyze the company competitiveness and point out a range of financial indicators. In [4] the object of examination is a company which needs evaluation of its competitiveness. An important moment is the evaluation of the reliability of every one of the manufactured products. This is why statistical data has been gathered, the clients' expectations were determined and the reliability parameters were calculated. The results were then analyzed and a general assessment of the reliability as a factor for the competitiveness of the company was made.

4. Methodology

In the current work an approach to defining the competitiveness of logistics equipment is proposed which we will illustrate with assessing certain parameters of forklift trucks. This approach is meant to be in aid of the designers of such type of machinery by leading them in their work.

Different types of classification of logistics equipment parameters exist and in particular of forklift-trucks [5, 6]. When reviewing the machines we will determine three types of parameters which will be the base of building the methodology for their assessment:

- Qualitative parameters – weight, power, speed, etc.
- Quantitative parameters – symbolical (also linguistic)
- Relative parameters – mass of the cargo to the mass of the machine, energy consumption to the mass of the cargo, etc.

In order to obtain objectivity and real results we need to work with the relative parameters also. The relative parameter of the whole machine is a function of the analogical parameters of its elements.

On the other hand the parameters we could divide into primary – towards which the forecast is made and secondary – used for classification, sorting and other operations aiding the building of the forecast model.

Every logistics machine consists of a number of parameters, some of which are primary (obligatory) and other are functionally related to them. The primary parameters define the model and purpose of the machine as well as the regulation requirements of every market.

The competitiveness is a comparative value of the machines, involved in a particular market. This is why in order to obtain an objective and correct of its value, we need to assess the parameters which in this proposed model theoretically could adopt a value in the range from 0 to 1.

5. Model of a system for assessing the competitiveness of logistics equipment

Here a methodology for obtaining the needed competitiveness of a logistical machine, consisting of seven main stages is proposed, shown on Figure 1.

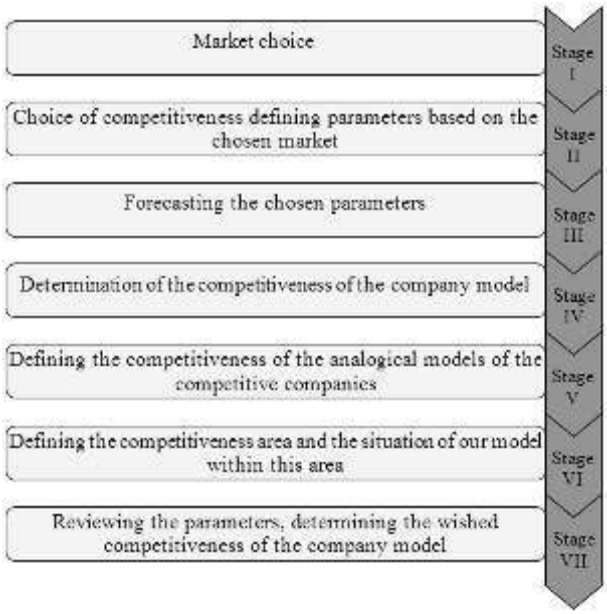

Figure 1. Stages of the algorithm for achieving the desired competitiveness of a machine

Stage I. Choosing the country and region of the market where the machine would be sold. This is related to the specific climate and ergonomic requirements, regulations, etc

Stage II. Choosing the parameters, which would determine the competitiveness. These parameters are consistent with the standards, requirements and biggest preferences of this particular market and clients.

Stage III. Forecasting the chosen parameters.

Stage IV. With the so forecasted parameters the competitiveness of the product using the Emotional model is determined.

Stage V. Obtaining the competitiveness of an analogical model of a different, competitive make.

Stage VI. Defining the competitive area, by the maximum and minimum competitiveness of all company's models (Figure 2).

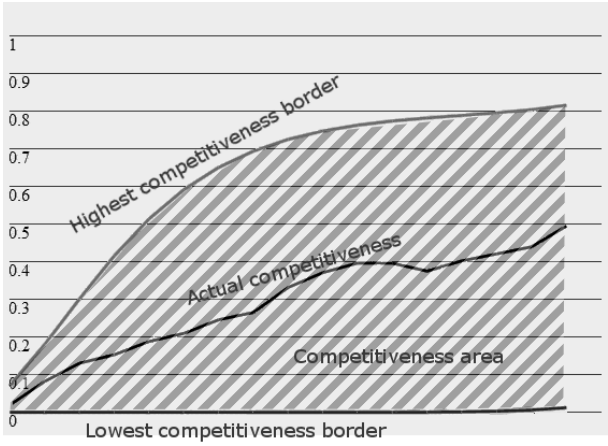

Figure 2. Competitiveness area, based on the assessment with the emotional model

Stage VII. Comparing and defining the company's competitiveness and changing the values of the parameters of the proposed model in order to reach the needed level.

When complexly assessing the competitiveness of the machine, the approach offers defining the primary parameters, based on which a filter is applied and the areas where the parameters' values fall are defined. The mathematical expression of the meaning of each parameter is defined by weight coefficients.

For testing the developed method two studies were made. First, the chosen parameters of a particular model logistics equipment were forecasted, using the exponential method and after that Stages IV – VII using the emotional method were applied.

For achieving accurate results, the parameters of the competitive models are forecasted for the same period of time. In order to test the method it was applied towards one of the most universal types of logistics equipment – the counterbalanced forklift truck. These machines are very widespread and a big amount of technical data is available.

Forklift trucks are a basic group of logistics material handling machines using a variety of energy sources which makes them independent and suitable for use in different types of manufacture.

They were placed alternative requirements that affect their characteristics and parameters. Guiding parameters for choosing a forklift are the max. lift

weight, max. lifting height, the number of supports, the location of the center of gravity and type of engine. On this basis, all other parameters fall within certain limits, depending on the construction of the machine, the type of engine, the equipment etc.

6. Determining the competitiveness using the developed model

To solve the task, the following parameters were used: mass ratio, gear ratio, engine power, length of the machine, warranty period. The focus is on the machine parameters, avoiding the financial, environmental and ergonomic ones. This simplification affects only the first two stages, and no significant impact on the verification of the approach.

For the purpose of the study data were collected for trucks with internal combustion engines, load capacity 2500 kg, lifting height of 3,000 to 4,800 mm (duplex and triplex masts) produced between 1998 and 2013 and manufactured by the companies Nissan, Jungheinrich, Komatsu, Linde, Mitsubishi, Toyota, Hyundai, Artison, Cesab, Clark, Doosan, OMG, Tailift, Yale, Cheuklift, Goodsense, GP, Maximal, Nissan, Shangli, UN.

Forecasting of the above parameters was performed with the exponential method where α - exponential constant, equal to 0.2. Figure 3 shows the results of predicting the mass ratio.

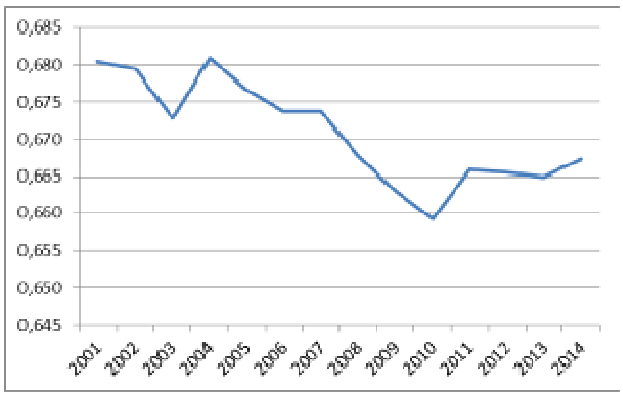

Figure 3. Forecasted values of the mass coefficient

It is known that the parameter "mass ratio" is expressed by the ratio of the capacity of the machine to its own mass, namely:

$$k_m = \frac{M_T}{M} \quad (1)$$

Another relative parameter determining the quality of logistics equipment is gear ratio i.e.:

$$k_V = \frac{V}{V_{\max}} \quad (2)$$

where:

V - travel speed of the machine,

$V_{\max}$ – max. travel speed throughout all the observed models, including the one of the analyzed model.

Figure 4 shows the forecasted values of the speed coefficient which clearly show an increasing trend. Therefore an increase of the productivity of the machines could be expected.

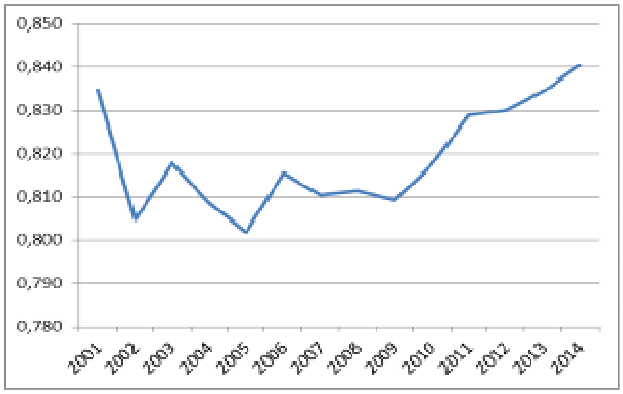

Figure 4. Forecasted values of the speed coefficient

For analyzing the competitiveness an emotional model web software [7,8] was applied in which, using HTML, XML, VML, VB Script and Java Script is designed a Web application. It allows users to create emotional patterns after entering values for emotions at different time points (scanning), the values of feelings and moods, and perform changes graphically. The application also allows the determination of the basic parameters of the graphical representation of the results: sizes and colors.

The following emotions (parameters) were chosen NE =5:

- Mass coefficient
- Speed coefficient
- Engine power
- Warranty period
- Length of the machine.

It can be seen that some of these parameters are evaluated by different users, and others are calculated based on the analysis of their change.

The corresponding feelings (characteristics) $N^F = 5$:

- Quality of construction
- Dynamics and maneuverability
- Economy
- Reliability
- Quality of design

The values of emotions, calculated based on these feelings and mood (competitiveness) are defined and shown in Figure 5.

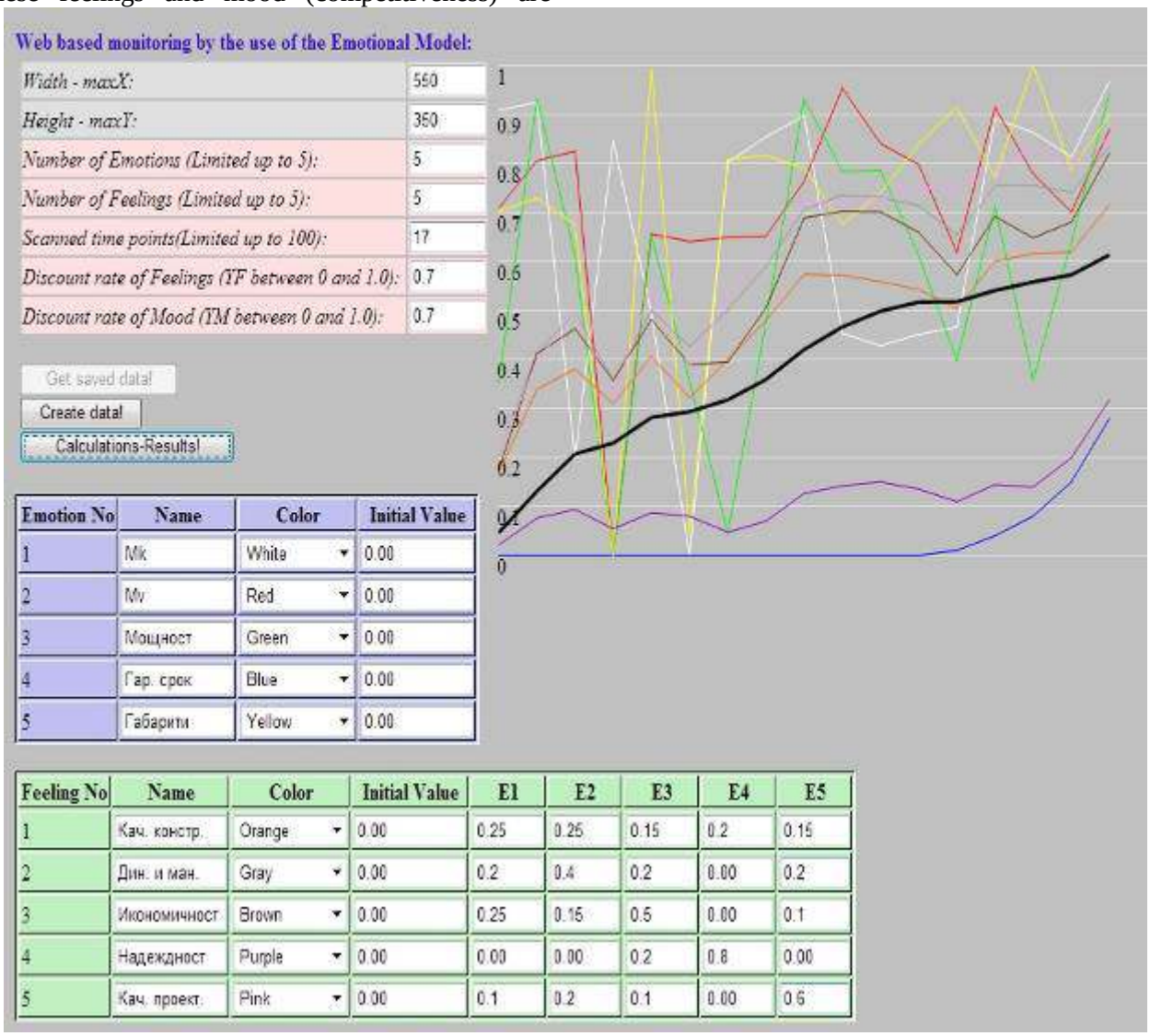

Figure 5. Work-screen of the web-based software for assessing competitiveness based on the Emotional model, where the black line shows the curve of the competitiveness

7. Comparing the competitiveness of a particular brand with the general

To test stage VII of the approach, a comparison of the competitiveness of a particular brand in general was performed. Toyota forklift brand with analogical parameters was selected for the research.

The database contains available models manufactured in 2001, 2002, 2004, 2005, 2009 and 2012. In order to compare correctly the general competitiveness, as well as that of the brand Toyota for these particular years was determined.

The competitiveness of Toyota forklifts is shown in Figure 6. The graph shows a stable level of competitiveness during the past 15 years with a slight increase.

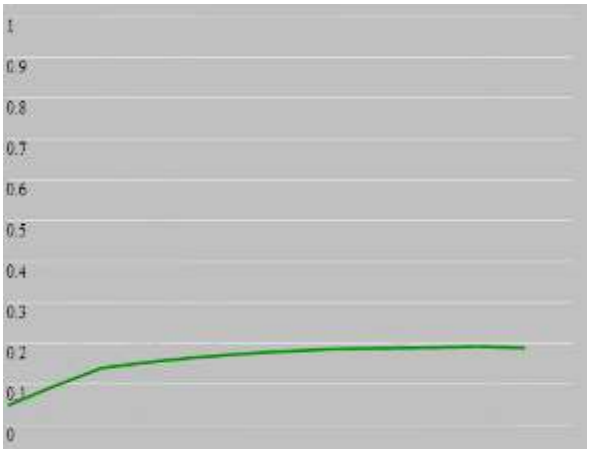

Figure 6. Competitiveness graph of Toyota forklifts.

8. Conclusions

1. Created approach to determine the competitiveness of logistics equipment, consisting of seven stages, including predicting three types of parameters, quantitative, qualitative and relative.

2. The approach is verified by determining the competitiveness of trucks with internal combustion engines, load 2500 kg, lifting height of 3000 to 4800 mm (duplex and triplex masts) produced between 1998 and 2013, models of companies Nissan, Jungheinrich, Komatsu, Linde, Mitsubishi, Toyota, Hyundai, Artison, Cesab, Clark, Doosan, OMG, Tailift, Yale, Cheuklift, Goodsense, GP, Maximal, Nissan, Shangli, UN.

3. The comparison of the competitiveness of the products of Toyota shows that their competitiveness as measured by the model described above is higher than that of competing producers, which complies with their status as the World leader in sales [8].

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