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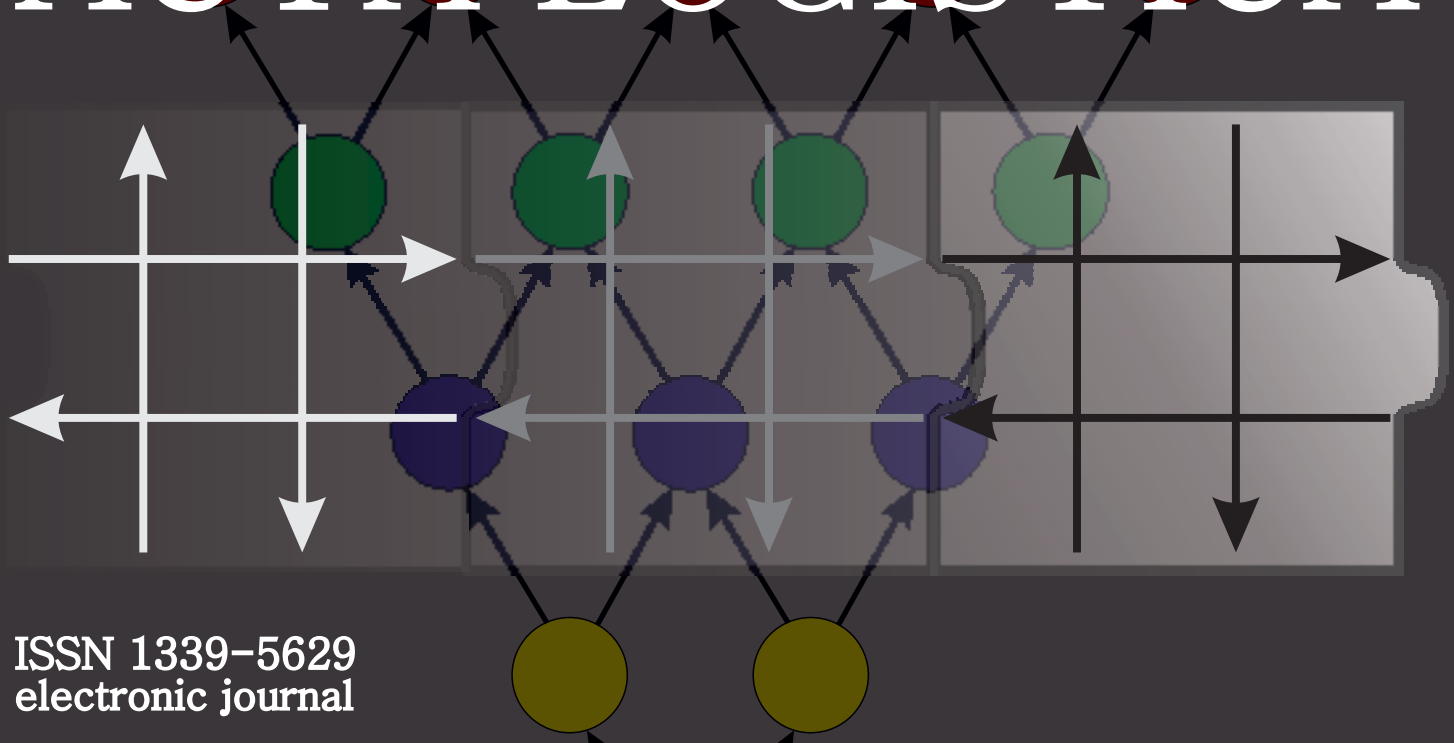

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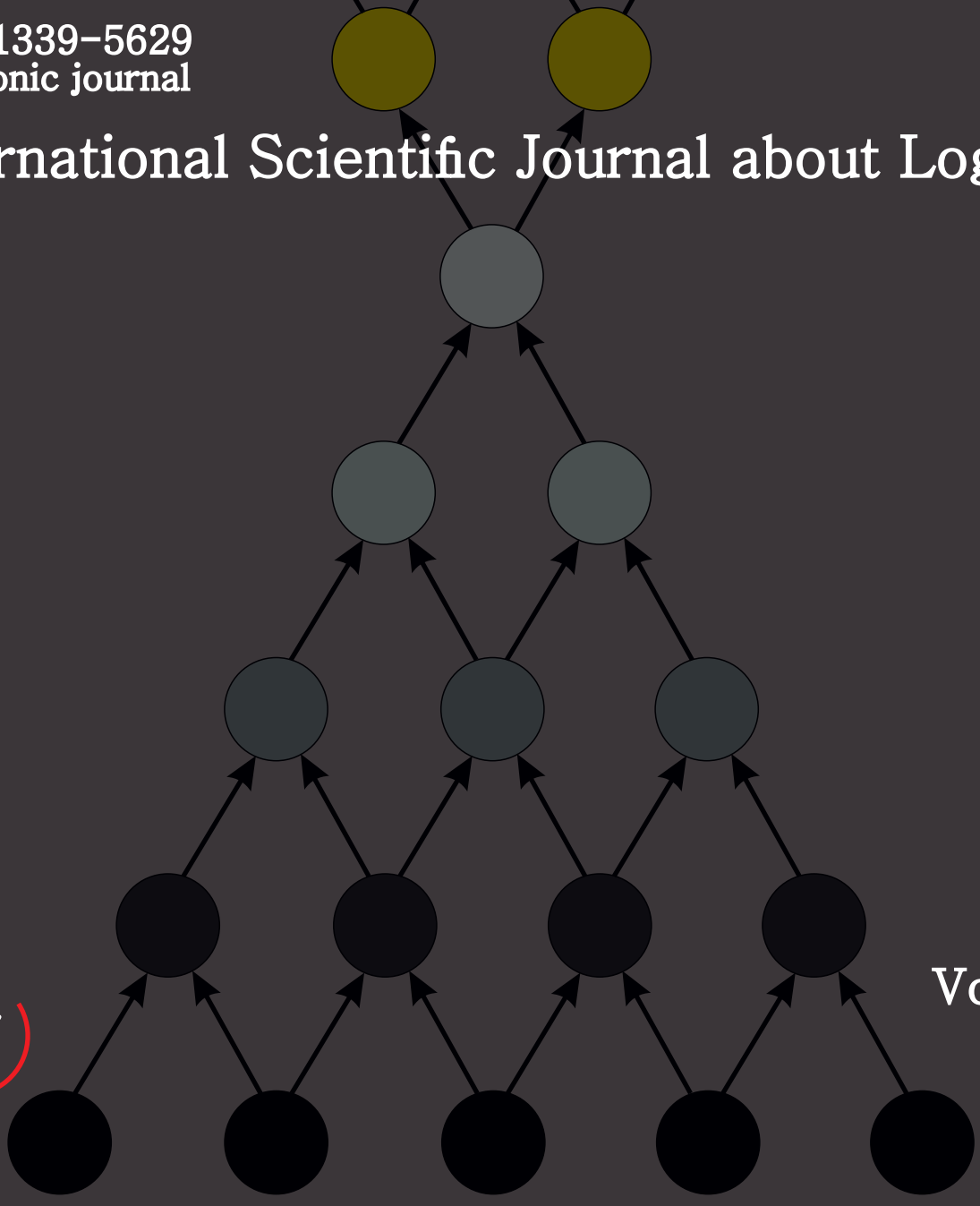

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LOGISTICS AND PRODUCTION PROCESSES TODAY AND TOMORROW

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Keywords: logistics, global objectives, intermittent production, continuous production, industry 4.0
Abstract: The production process consists of activities that are required in transforming an input set to valuable outputs. Input set includes human resources, raw materials, components, equipments, energy, money, information, etc. Market globalization, increasing global competition, and more complex products result in application of new production and logistics technologies, methods and business processes. Fast changing market environment and fluctuating customer demands require efficient operation of production and logistics processes. In this study the intermitted and continuous production processes are introduced. The essence of Industry 4.0 conception is also detailed.

1 Introduction

Production systems are those activities of a manufacturing company, where resources flowing in a defined system, which resources are combined and transformed based on logic to add value.

Logistics is a common word nowadays, since it is an essential component in supply chains and also in the competition of the economic operators.

Therefore, the goal of logistics is to provide things in adequate quality and quantity at a given destination, in an appropriate time, from an appropriate origin, with an appropriate method and equipment, and with an appropriate minimal cost.

The quality and availability of the offered services by the logistics sector are of capital importance for the economical growth and for increasing employment potentials.

Globalization, enhanced competition in the global market, more complex products with shorter lifecycle and fluctuating customer demands gave rise to new technologies, business processes and the application of global supply chains. Therefore, the logistic sector is currently meeting and will meet in the future new practical challenges, and the fast respond to them is the key of success for the economic operators.

2 Introduction of the development objectives in global production and logistics

The production and logistic goals are originated from general corporate goals, of which maximal customer satisfaction is one of the most important. Actually all the other goals can be derived from this, which are listed in the following paragraph (logistic goals are underlined) [1-4].

With shorter lead time the customer would get the ordered product in the shortest time possible. Economical and profitable corporate operation can be achieved by utilizing the maximal production (or service) and logistic capacities, which includes the optimal utilization of human sources and equipments. Flexible production (or service) and logistics is needed to answer the demands of the rapidly changing economics and dynamic customer demands. The development of business processes can by realized only by high transparency and by the continuous monitoring of the efficiency of the systems, since which process can be measured is can be improved.

Ensuring and enhancing the quality of the processes is of priority for customer complacence. Nowadays sustainability and the use of environmental-friendly materials and technologies are also defined as a goal, as well as green waste management and recycling. In terms of cost reduction the main goal is to decrease stocks and to operate production and service processes efficiently throughout the whole supply chain and at each individual party in the supply chain. The optimal construction of the global, intercontinental supply chains can also be an element for success in competitiveness.

3 Today's production processes

Production is an organized activity which has an objective, which is to transform various inputs to useful outputs.

Production processes can be divided into two categories [5, 6]:

- Made to stock (Push) production processes (traditional mass production), and
- Made to order (Pull) production processes (production of unique products).

The traditional mass production is replaced by unique production (or smaller batches), or from the philosophical point of view the 'Push' approach is replaced by 'Pull' approach.

In case of push philosophy production planning is based of forecasted data (not actual customer demand), so that the result is high amount of products, including unsalable stock is created. On the contrary, the uniqueness of production with pull philosophy lies in the fact, that production starts only when an actual customer demand appears (with detailed specification), which starts acquisition and manufacturing processes.

Production processes can be divided into two categories in aspect of continuity (Figure 1) [5, 6]:

- Intermitted production systems, and
- Continuous production systems.

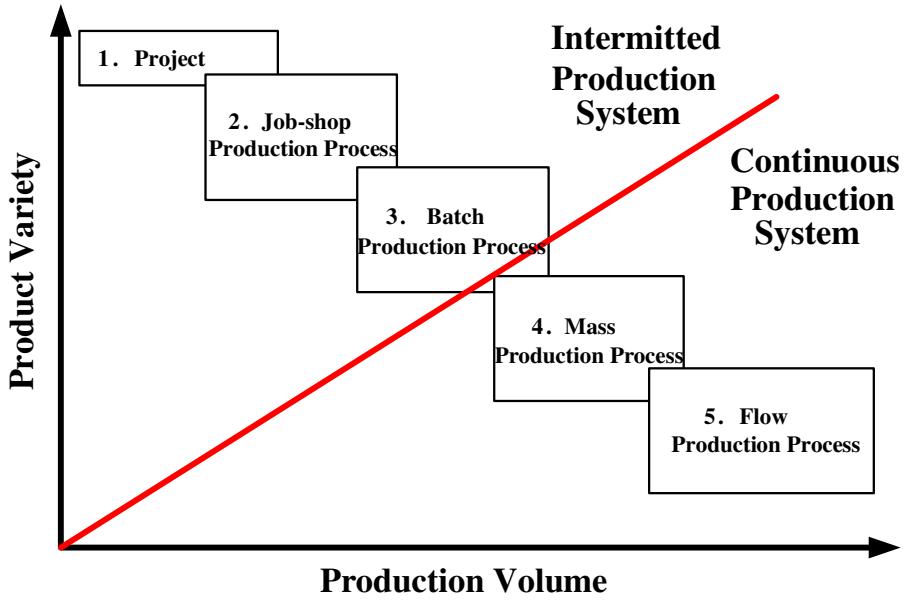

Figure 1 Types of Production Processes

3.1 Intermitted production systems

General characteristics of the intermittent production are the followings:

- production system is flexible,
- design of the product can be changed flexible,
- general purpose machines and equipment are used,
- production is not continuous,
- volume of the production is small,
- product variety can be high.

1. Project production

Main characteristics of the project production are the followings: the production is a complex process, low volume, high customization, the sequence of operations is unique to each project/product, fixed position layout.

2. Job-shop production

Main characteristics of the job-shop production are the followings: manufacturing of one or few quantity of products, low volume and high variety of products, general-purpose machines arranged into different departments, each job requires unique technological requirements and machines, requires highly skilled operators and high inventories.

3. Batch production

Batch means a single production run, the batch size means the quantity produced in a single production run (may be less than 100 units or up to a few 1000 units).

Main characteristics of the batch production are the followings: shorter production runs, plant and machinery are flexible, manufacturing lead time and costs are lower compared to job-shop production.

3.2 Continuous production systems

General characteristics of the continuous production are the followings:

- process flow is a predetermined sequence of operations,
- production system is not flexible,
- design of the product can not be changed flexible,
- production is mostly continuous,
- volume of the production is high,
- product variety can be small.

1. Mass production

Mass production is a manufacturing process of discrete parts using a continuous process.

Main characteristics of the mass production are the followings: manufacturing of small variety (mostly only one) and huge volume of products, machines are arranged in a line or product layout, product and process sequence are standardized, cycle time of the production is short, low inventory, balanced production lines, high productivity.

2. Flow/Process production

Flow production is characterized by the manufacturing of a single product. The flexibility of this kind of plants is almost zero. Only one type of product can be produced.

Main characteristics of the flow production are the followings: manufacturing of small variety (mostly only one) and huge volume of products, special purpose machines in a fix sequence, manufacturing cycle time is zero.

4 Tomorrow's production processes – Industry 4.0 conception

The tendencies of the 21st century – such as the s life-cycles of products are shorter while consumers demand more complex, unique products in larger quantities – poses many challenges to the production.

There are many sings that show that the current practices in the utilization of resources is not sustainable, which will limit the production.

The industrial sector is going through a paradigm shift, which will change the production drastically. The traditional centrally controlled and monitored processes will be replaced by decentralized control, which is built on the self-regulating ability of products and workpieces that communicate with each other.

The essence of Industry 4.0 conception is the introduction of network-linked intelligent systems, which realize self-regulating production: people, machines, equipments and products will communicate to one another.

This paradigm shift includes the conception of Industry 4.0, which is widely used in Europe, especially in Germany. The name of the conception forecasts the upcoming 4th industrial revolution, because according to the theory of the conception the 1st industrial revolution introduced automation, the 2nd mass production, the 3rd is the utilization of robots. Industry 4.0 will bring intelligent production robots.

The goal of the conception is to make flexible, custom production economical, and to use resources efficiently. It requires each equipment that takes part in the production to communicate with one another. The organization of information flow is executed by a central production control system.

Products control their own production, since to communicate with unique product codes with the machines and equipments, which mean virtual and actual reality merges together during the production. The scheduling of the production will be also controlled by the communicating products. Factories will be self-regulating and optimize their own operation. [7, 8]

4.1 The 5 main components of networked production

The 5 main elements of the networked production can be defined by the following [9]:

1. digital workpieces,
2. intelligent machines,
3. vertical network connection,
4. horizontal network connection,
5. smart workpieces.

1. Digital workpieces

The dimensions, quality requirements and the order of technological processing is given for the digital workpieces.

2. Intelligent machine

Intelligent machines communicate simultaneously with the production control system and the workpiece under processing, so that the machine coordinates, control and optimize itself.

3. Vertical network connection

When processing the unique specifications given by the customer for the product to be manufactured the production control system forwards the digital workpiece created by automated rules to the equipments. The products control their own manufacturing process, since they communicate with the equipments, devices and the other workpieces about the conditions of the production.

4. Horizontal network connection

The communication is realized not only within one factory, but also in the whole supply chain; between the suppliers, manufacturers and service providers. The main purpose is to enhance the efficiency of production and to utilize the resources in a more economical way.

5. Smart workpiece

The product to be manufactured senses the production environment with internal sensors and controls and monitors its own production process in order to meet the production standards, since it is able to communicate with the equipments as well as the components already incorporated and to be incorporated.

4.2 The main technologies of Industry 4.0

The importance of production arranged in global network is that the manufacturing process can flexibly adapt to the unique costumer demands, to the activity of the other parties of the supply chain and to the rapidly changing economic environment.

The term Industry 4.0 is getting global recognition and the survey of PWC [10] from 2016 defines three main areas, where it affects the corporate world:

- integration and digitalization of horizontal and vertical value chains
- digitalization of products and services,
- the formation of digital business model and costumer relations

This framework and the connected new technologies are shown in Figure 2.

Figure 2 The main technologies of Industry 4.0 [11]

The production technology of Industry 4.0 is not a technology from the far-away future. In July 2015 the Changing Precision Technology (Dongguan, China) became the first factory where only robots work. Each labour process is executed by machines: the production is done my computer operated robots, the transport is implemented by self-driven vehicles and even the storage process is completely automatic.

According to experts there is 20-30% growth potential in intelligent production networks, and the companies that refuse to follow the development and modernization will fall behind in the global competition. In the near future companies will become digital corporations, which will allow them to realize custom production with maximum efficiency according to the costumers' demands. The prior condition for this is to allow every equipment, device, workpiece to communicate with each other. Although in the near future human resource will still remain the key and essential factor in production.

Conclusions

Globalization, changing economic environment and customers' demands and the ever increasing competition in the market emerged the need for new manufacturing technologies and business processes. These changes constantly confront the practice of logistic with new challenges. This study describes the recently used general production and logistics aims and processes.

The industrial sector is going through a paradigm shift, which will change the production drastically. The traditional centrally controlled and monitored processes will be replaced by decentralized control, which is built on the self-regulating ability of products and workpieces that communicate with each other.

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THE ANALYSIS OF THE COMMODITY PRICE FORECASTING SUCCESS CONSIDERING DIFFERENT NUMERICAL MODELS SENSITIVITY TO PROGNOSIS ERROR

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Keywords: exponential approximation, numerical modelling, price forecasting, commodity exchange
Abstract: In the paper the numerical model based on the exponential approximation of commodity stock exchanges was derived. The price prognoses of aluminium on the London Metal Exchange were determined as numerical solution of the Cauchy initial problem for the 1st order ordinary differential equation. To make the numerical model more accurate the idea of the modification of the initial condition value by the stock exchange was realized. The derived numerical model was observed to determine the accuracy of forecast prices with regard to two size setting of the limiting value error causing the modification of the initial condition value by chosen stock exchange. The advantage of chosen sizes of the limiting value error 7 % and 8 % with regard to different lengths of the initial condition drift within movements of aluminium prices was studied. By having analyzed obtained results, it was found out that the limiting value error 7 % was more advantageous for commodity price forecasting.

1 Introduction

Observing trends and forecasting movements of metal prices is still a current problem. There are a lot of approaches to forecasting price movements. Some of them are based on mathematical models [1], [2], [3], [4], [5], [6], [8]. Forecasting prices on commodity exchanges often uses the statistical methods that need to process a large number of historical market data [1], [8]. The quantity of needed market data can sometimes be a disadvantage.

In our prognostic models numerical methods were used. Derived numerical models for forecasting prices were based on the numerical solution of the Cauchy initial problem for the 1st order ordinary differential equations [3], [4], [5], [6].

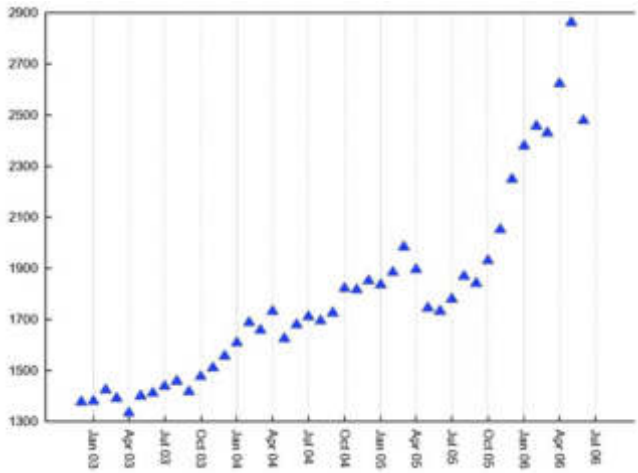

Figure 1 Course of the aluminium prices on LME in the years 2003 – 2006

The aluminium prices presented on the London Metal Exchange (LME) were worked on. We dealt with the monthly averages of the daily closing aluminium prices "Cash Seller&Settlement price" in the period from December 2002 to June 2006. The market data were obtained from the official web page of the London Metal Exchange [9]. The course of the aluminium prices on LME (in US dollars per tonne) within the observing period is presented in Figure 1.

2 Mathematical model

We considered the Cauchy initial problem in the form

$$y' = a_1 y, \quad y(x_0) = y_0 . \qquad (1)$$

The particular solution of the problem (1) is in the form $y = k\, e^{a_1 x}$, where $k = y_0\, e^{-a_1 x_0}$. The considered exponential trend was chosen according to the test criterion of the time series' trend suitability. The values $\ln(Y_{i+1}) - \ln(Y_i)$, for $i = 0, 1, ..., 42$ have approximately constant course, where Y_i is the aluminium price (stock exchange) on LME in the month x_i. The price prognoses were created by the following steps:

The 1st step: Approximation of the values – the values of the approximation term were approximated by the least squares method. The exponential function in the form $\tilde{y} = a_0 e^{a_1 x}$ was used. When observing the influence of the approximation term length on the prognoses accuracy, we found out that the prognoses obtained by longer approximation terms are more accurate [3]. Let us consider two different variants.

Variant B: The values from the period January 2003 –

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June 2003 were approximated. The next approximation terms were created by sequential extension of this period by 3 months. Thus the duration of the approximation terms was extended (the n^{th} approximation term has $6+3(n-1)$ stock exchanges) (Figure 2).

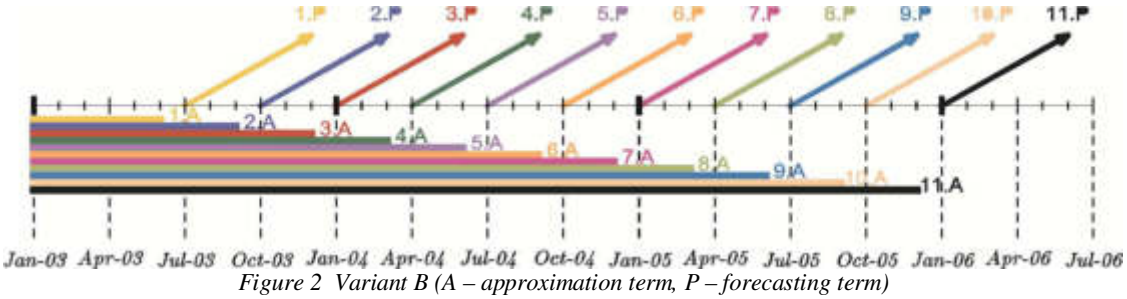

Figure 2 Variant B (A – approximation term, P – forecasting term)

Variant E: We approximated values within 12 months and each term was shifted by 1 month (Figure 3). (The first approximation term was January 2003 – December 2003.)

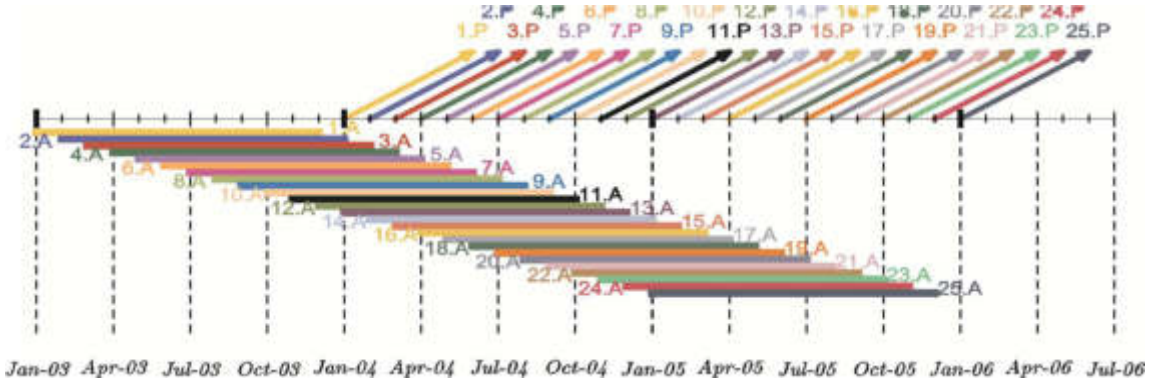

Figure 3 Variant E (A – approximation term, P – forecasting term)

36 forecasting terms of the original model in both variants B and E were observed. From among all forecasting terms, 11 of them belonged to variant B and 25 ones were part of variant E.

The 2nd step: Formulating the Cauchy initial problem – according to the acquired approximation function $\tilde{y}$, the Cauchy initial problem (1) was written in the form

$$y' = a_1 y, \quad y(x_i) = Y_i, \tag{2}$$

where $x_i = i$ and Y_i is the aluminium price on LME in the month x_i, which is the last month of the approximation term.

The 3rd step: Computing the prognoses – the formulated Cauchy initial problem (2) was solved by the numerical method based on the exponential approximation of the solution. A detailed solution method is seen in [7]. The method uses the following numerical formulae

$$x_{i+1} = x_i + h,$$

$$y_{i+1} = y_i + bh + Qe^{vx_i}\left(e^{vh} - 1\right),$$

for $i = 1, 2, 3, \ldots$, where $h = x_{i+1} - x_i$ is the constant size step. The unknown coefficients are calculated by means of these formulae $v = \dfrac{f''(x_i, y_i)}{f'(x_i, y_i)}$,

$$Q = \frac{f'(x_i, y_i) - f''(x_i, y_i)}{(1-v)\, v^2 e^{vx_i}}, \quad b = f(x_i, y_i) - \frac{f'(x_i, y_i)}{v}.$$

If we consider the Cauchy initial problem (2), the function $f(x_i, y_i)$ has the form $f(x_i, y_i) = a_1 y_i$ and then $f'(x_i, y_i) = a_1 y'(x_i) = a_1^2 y_i$,

$f''(x_i, y_i) = = a_1^2 y'(x_i) = a_1^3 y_i$.

We calculated the prognoses within six months that follow the end of the approximation term in this way:

- **The first month prognosis** was determined by solving the Cauchy initial problem in the form (2). The interval $\langle x_i, x_{i+1} \rangle$ of the length $h = 1$ month was divided into n parts, where n is the number of trading days on LME in the month x_{i+1}. We got the sequence of the division points $x_{i0} = x_i$, $x_{ij} = x_i + \dfrac{h}{n} j$, for $j = 1, 2, \ldots, n$, where $x_{in} = x_{i+1}$.

  For each point of the subdivision of the interval, the Cauchy initial problem in the form (2) was solved by the chosen numerical method. In this way we

obtained the prognoses of the aluminium prices on single trading days y_{ij}. By calculating the arithmetic mean of the daily prognoses we obtained the monthly prognosis of the aluminium price in the month x_{i+1}. So, $y_{i+1} = \frac{\sum_{j=1}^{n} y_{ij}}{n}$.

- **The prognoses for the following five months** were calculated after modification of the initial condition value. The initial condition value in the month x_{i+s}, $s = 1,2,3,4,5$ was replaced either by the calculated monthly prognosis y_{i+s} (the original model) or in case of higher absolute percentage error of given monthly prognosis y_{i+s} by some aluminium stock exchange (the modified model). The Cauchy initial problem $y' = a_1 y,\ y(x_{i+s}) = y_{i+s}$, or $y' = a_1 y,\ y(x_{i+s}) = Y_p$ (where Y_p is chosen aluminium stock exchange) was used for calculating daily prognoses and their arithmetic mean served to define the monthly price prognosis y_{i+s+1} for the month x_{i+s+1}.

By comparing the calculated prognosis y_s in the month x_s with the real stock exchange Y_s, the absolute percentage error $|p_s| = \frac{|y_s - Y_s|}{Y_s}.100\,\%$ was determined. The price prognosis y_s in the month x_s is acceptable in practice, if $|p_s| < 10\,\%$. Otherwise, it is called the critical forecasting value of. To compare the accuracy of the forecasting of all forecasting terms, the mean absolute percentage error (MAPE) $\bar{p} = \frac{\sum_{s=1}^{t} |p_s|}{t}$ was determined, where, in our case, $t = 6$.

The modification of the initial condition value by the real aluminium stock exchange price was called the initial condition drift. Let us name the selected minimal absolute percentage error of the prognosis, causing the initial condition drift, the limiting value error. The month in which the absolute percentage error of the prognosis had at least the limiting value error was considered as the limiting month.

The limiting value errors 7 % and 8 % were chosen. Three types of the initial condition drift with regard to their length were considered, namely one-month drift, drift before the limiting month and drift to the limiting month. One-month drift was the shortest chosen initial condition drift, where the initial condition value was replaced by the stock exchange Y_{i+p}, $p = 1,2,3,4,5$ in the month x_{i+p}, where x_i was the last month of the approximation term and p was the initial condition drift order in the forecasting term. Using drift before the limiting month, the initial condition value was replaced by the stock exchange Y_{L-1} in the month x_{L-1}, where x_L was the limiting month and by means of drift to the limiting month the stock exchange Y_L in the month x_L changed the initial condition value.

3 Results

3.1 *The success rate of the chosen sizes of the limiting value error at the commodity price forecasting*

Within the studied group of 36 forecasting terms, the forecasting within 14 of them was so accurate that the initial condition drift did not occur. The initial condition values were replaced just by calculated monthly prognoses. Since in the remaining 22 forecasting terms the forecasting was less accurate, some of the prognoses gained the absolute percentage error higher than chosen limiting value error, and the initial condition drift occurred. Therefore the forecasting results differ from the original model.

We observed the accuracy of the forecast prices with regard to two different size setting of the limiting value error. Within each forecasting term three different lengths of the initial condition drift were taken into account. For each length of the initial condition drift we defined the limiting value error, 7 % or 8 %, to obtain the most accurate forecasting results (the lowest MAPE of the forecasting term). Thus, we considered 66 groups of the forecasting results. The following tables show the number of the forecasting terms in which the forecasting by the determined types of the initial condition drift was the most accurate.

Table 1 The success rate of chosen types of the initial condition drift – variant B

Initial condition drift's length	Identical results for both chosen limiting value errors	More accurate forecasting by means of limiting value error	
		7 %	8 %
One-month drift	3	4	0
Drift before the limiting month	4	3	0
Drift to the limiting month	2	4	1
Total	9	11	1

Table 2 The success rate of chosen types of the initial condition drift – variant E

Initial condition drift's length	Identical results for both chosen limiting value errors	More accurate forecasting by means of limiting value error	
		7 %	8 %
One-month drift	9	3	3
Drift before the limiting month	10	4	1
Drift to the limiting month	7	7	1
Total	26	14	5

The tables clearly show that the forecasting results differed at the determined limiting value errors, and that more accurate prognoses were gained by means of the lower value 7 %. This limiting value error was more advantageous for the forecasting. In the variant B, the success rate of the limiting value error 7 % (11 times) was comparable with the appearance of indentical results for both chosen limiting value errors (9 times). In the variant E within the forecasting terms in which the initial condition drift occurred (15 terms), identical results for both chosen limiting value errors were the most often found (26 times).

The observed variants B and E had different lengths of the approximation terms. In the variant B, the approximation terms were longer, so the forecasting did not react so strongly to fluctuations in the price evolution. Moderately increasing prognoses often acquired the absolute percentage error from the interval $\langle 7\%, 8\% \rangle$, so the forecasting results with regard to the chosen limiting value errors differed. The lower limiting value error initialized the initial condition drift earlier, and the forecasting was more accurate. On the contrary, the forecasting in the variant E was based on shorter approximation terms which steeply responded to changes in the price evolution. Steeply increasing or decreasing prognoses often obtained, especially within the changes in price course, the absolute percentage error $\geq 8\%$. Thus, the forecasting results were often identical for both chosen limiting value errors.

The results were more obvious if for each forecasting term, in which the initial condition drift occurred, the most accurate type of the drift's length was considered. For this length of the initial condition drift we defined the limiting value errors 7 % or 8 %, for which the lowest MAPE of the observed forecasting term was obtained (Table 3).

Table 3 The success rate of the chosen types of the initial condition drift for the most accurate length of the drift in the observed forecasting term

Variant	Identical results for both chosen limiting value errors	More accurate forecasting by means of limiting value error	
		7 %	8 %
B	3	4	0
E	8	7	0
Total	11	11	0

If in the forecasting term the most successful initial condition drift's length was considered, the limiting value error 7 % was more advantageous for the forecasting. When it used, the prognosis accuracy was always higher than at forecasting by means of the limiting value error 8 %. The identical forecasting results for both chosen limiting value errors were achieved with the same success as when using the limiting value error 7 %.

The success rate of the determined sizes of the limiting value error was analyzed within different moves of the aluminium price course and was demonstrated at the specific forecasting terms while considering commodity price evolution.

3.2 The forecasting success of lower limiting value error 7 % at the commodity price forecasting

The limiting value error 7 % was more advantageous than higher limiting value error 8 %. It acquired the most accurate results within most price movements. We recommend to use it, especially within the stable increasing price course, and also when the price evolution changes significantly.

- **stable price increase**

Within the stable price course the forecasting by means of the limiting value error 7 % was always more accurate than the forecasting at the limiting value error 8 %. Higher forecasting success at the limiting value error 7 % was achieved by a larger number of the initial condition drift. Thereby the prognoses could better approach increasing stock exchanges, and the forecasting became more accurate. Another advantage of lower limiting value error 7 % is the fact that the next drift occurred earlier than at the limiting value error 8 %.

If the increase was moderate, the prognoses errors were lower. Thereby the initial condition drift occurred only at the limiting value error 7 % at all drift's lenghts. Within a steep increase, the forecasting using the longest initial condition drift was the most accurate [4]. Thereby the absolute percentage prognosis errors were mostly from the interval $\langle 7\%, 8\% \rangle$, and the initial condition drift occurred only at the limiting value error 7 %. At shorter

initial condition drifts, the initial condition value was replaced by stock exchange price that was more distant from real increasing prices. Thereby the prognosis error was higher. Thus, the size of the absolute percentage error often caused initialization of the initial condition drift for both limiting value errors. Within a steep increase, the forecasting using the shortest drift was made more accurate because of frequent initial condition drift at the limiting value error 7 %.

In the forecasting term *October 2003 – March 2004* the initial condition drift was caused by the prognosis in the third month of the term (December 2003, the percentage prognosis error was -8,24 %). Since the price increase continued, increasing prognoses errors initialized the next initial condition drift. The advantage of lower limiting value error 7 % was the fact that the next drift occurred earlier than at the limiting value error 8 % (one-month drift: 7 %: the fourth month (-7,99 %), 8 %: the fifth month (-12,08 %); drift to the limiting month: 7 %: the fifth month (-7,27 %), 8 %: the next drift did not occur), (Figure 4, Figure 5).

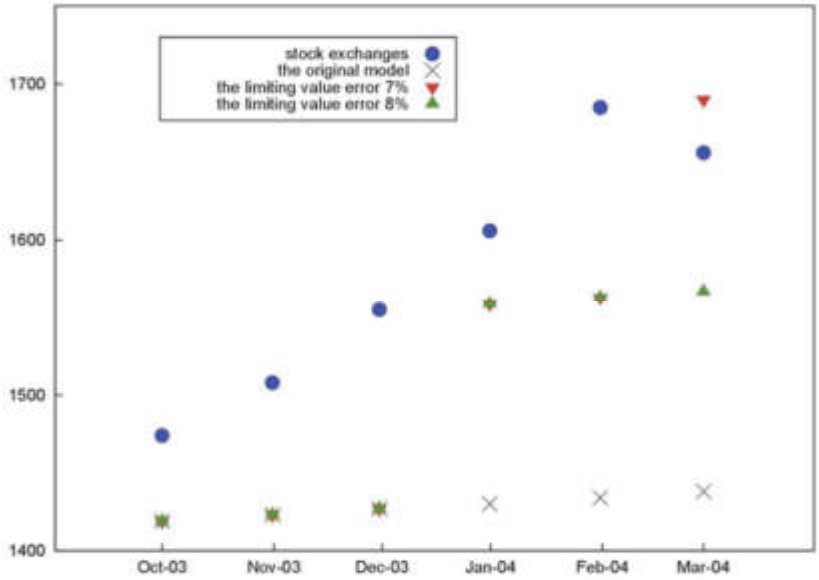

Figure 4 The forecasting by drift to the limiting month within October 2003 – March 2004 (variant B)

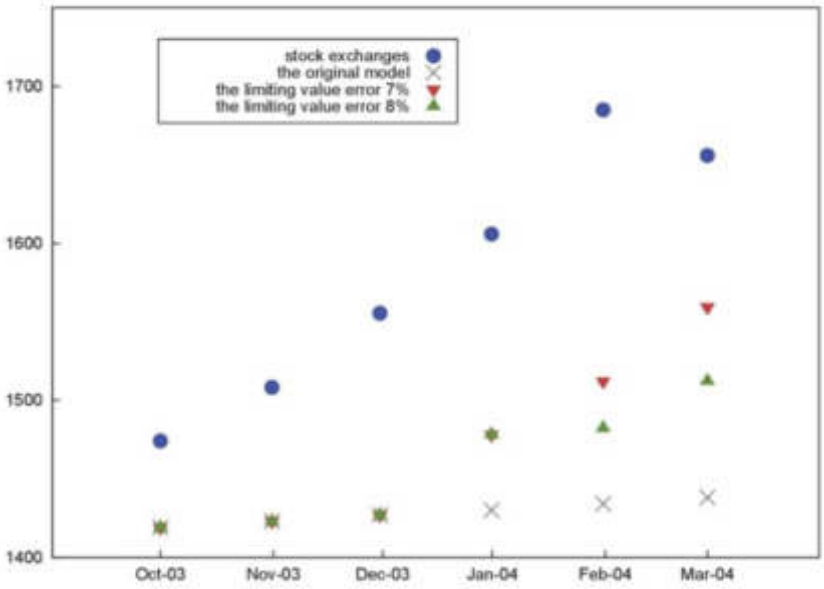

Figure 5 The forecasting by one-month drift within October 2003 – March 2004 (variant B)

Using the medium initial condition drift, the same forecasting results for both limiting value errors were acquired (Figure 6).

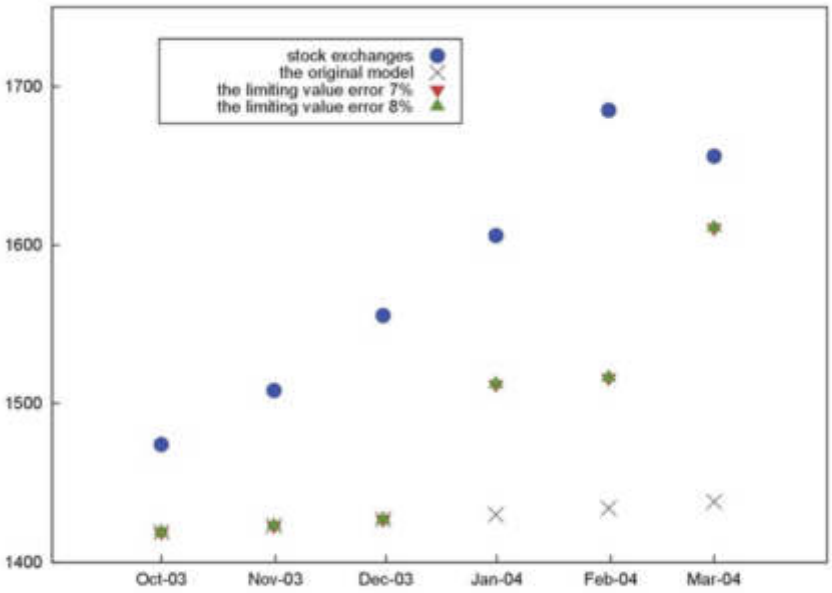

Figure 6 The forecasting by drift before the limiting month within October 2003 – March 2004 (variant B)

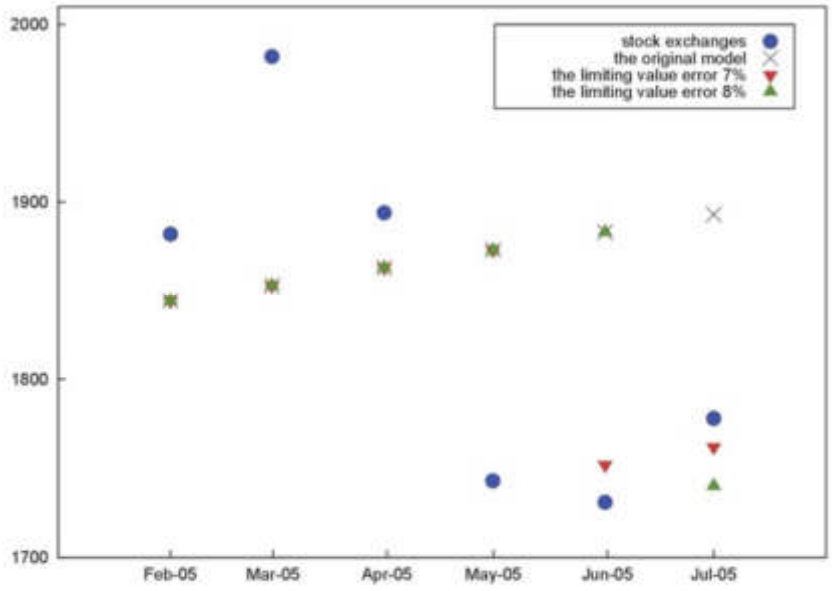

Figure 7 The forecasting by drift to the limiting month within February 2005 – July 2005 (variant E)

It was due to the fact that within price increase longer drift was more advantageous in comparison to shorter drift [5]. Thus the price prognosis in the fourth month was more accurate than when using the shortest drift (with percentage error -5,86 %). Thereby the next initial condition drift occurred not sooner than in the fifth month (the prognosis with percentage error -10,05 %). The size of the absolute percentage prognosis error caused the initialization of the drift for both limiting value errors.

- **changes in price evolution**

Within changes in the commodity price evolution the forecasting was the most problematic considering previous opposite price movement within the approximation term [4]. The prognoses with absolute percentage error ≥ 8% were most frequent, so for both chosen limiting value errors the same forecasting results were obtained. At the longest drift, the initial condition value acquired size near the price evolution, so no further

drifts were usually needed in the next forecasting. The advantage of the limiting value error 7 % was occurred only if the absolute percentage prognosis error causing the initial condition drift was from the interval $\langle 7\%, 8\% \rangle$. Using shorter drifts, which were less accurate within changes in price evolution, the forecasting by means of the limiting value error 8 % obtained better results.

Within the forecasting term *February 2005 – July 2005*, when there was a steep price decline after a price increase, the absolute percentage prognosis error in May 2005 was only 7,46 % (the lowest from all forecasting terms interfering with the price decline). Thus the initial condition drift at the limiting value error 7 % occurred earlier (at value 8 % the drift occurred only in June 2005). An earlier drift was advantageous only in connection with the longest drift allowing to approach immediately stock exchanges in decrease, and thus the forecasting became more accurate without further initial condition drift (Figure 7).

Within the forecasting term *June 2005 – November 2005*, when a steep price increase after a price decline occurred, the initial condition drift was caused by a prognosis in the fifth month (October 2005, percentage prognosis error -7,12 %). The drift made the forecasting more accurate only if it approached increasing values (longer drifts), (Figure 8). On the contrary, at one-month drift the initial condition value moved away from forecast steeply increasing stock exchange (it acquired the value of the aluminium stock exchange in June 2005, which was the lowest in observed forecasting term). Thus at this length of the initial condition drift the forecasting by means of the limiting value error 8 % was more successful when the initial condition drift did not occur.

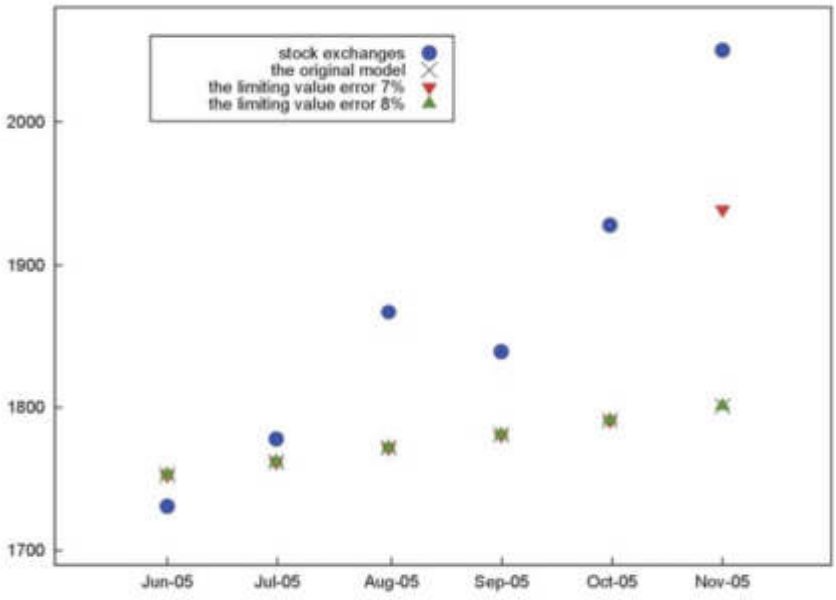

Figure 8 The forecasting by drift to the limiting month within June 2005 – November 2005 (variant E)

3.3 *The forecasting success of higher limiting value error 8 % at the commodity price forecasting*

The forecasting by means of higher limiting value error 8 % was more accurate than forecasting at the limiting value error 7 % only in some cases using disadvantageous lengths of the initial condition drift. If within the forecasting term we considered the most accurate length of the initial condition drift, we stated that more accurate prognoses were always obtained by means of the limiting value error 7 %. A partial success rate of a higher limiting value error was observed within significant price fluctuation and at the changes in price evolution [5].

- **significant price fluctuation**

Within significant price fluctuation higher limiting value error was advantageous only in connection with the longest initial condition drift. Within this price course the most accurate were the drifts that allowed placing the initial condition value the nearest to the real stock exchanges evolution. Using the longest drift the initial condition value was often replaced by the local maximal or minimal value that had caused the initial condition drift, which was not advantageous for forecasting following unstable price course.

Within the forecasting term *January 2006 - June 2006* higher limiting value error caused higher inaccuracy of prognoses in the third and the fourth months of the term, because the initial condition drift had occurred only at the limiting value error 7 %. But later initial condition drift in the fourth month, made it possible to capture the steep increase of the stock exchange in the fifth month (May

2006, percentage prognosis error -7,90 %). Since the next initial condition drift at the limiting value error 8 % did not occur, a suitable prognosis was acquired in the last month of the term, when the price steeply decreased, too (Figure 9).

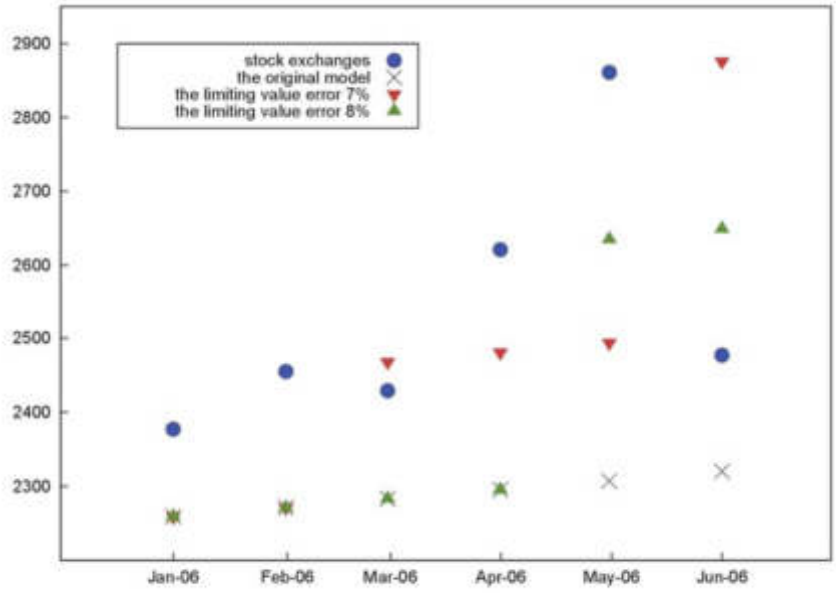

Figure 9 The forecasting by drift to the limiting month within January 2006 – June 2006 (variant E)

- **changes in price evolution**

Within a significant change in the price evolution, the advantage of the forecasting at the limiting value error 8 % was obvious only at the shorter initial condition drifts, which were least accurate during the observed price movement (Figure 10).

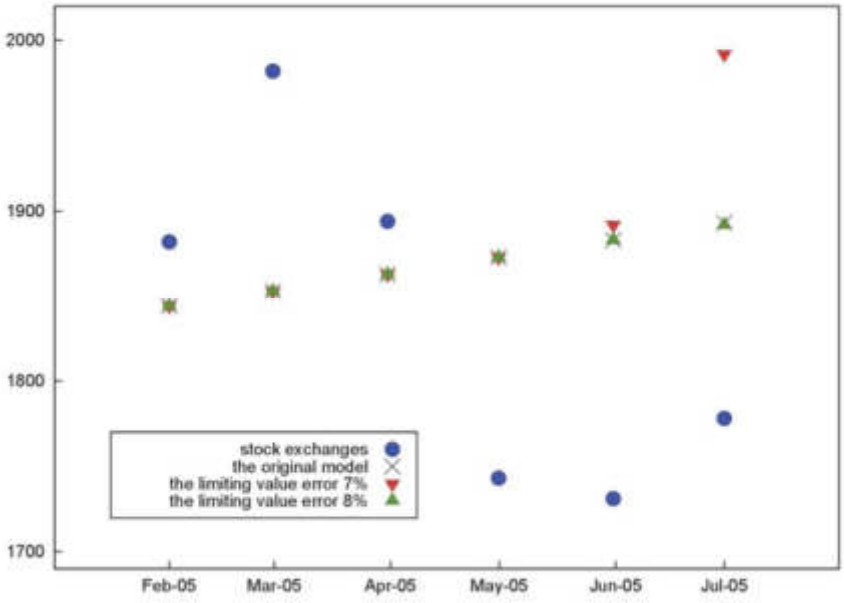

Figure 10 The forecasting by one-month drift within February 2005 – July 2005 (variant E)

By multiplying shorter drifts, the initial condition values used to remain the same as at the beginning of the forecasting term before the change. That was disadvantageous for forecasting the stock exchanges after evolution change [5]. Thereby the next prognoses often gained errors causing the initial condition drift. This situation was improved due to a lower number of drifts, provided by higher limiting value error 8 %.

Conclusions

By having analyzed obtained results, it was found out that if the forecasting results differed at the determined limiting value errors, more accurate prognoses by means of the limiting value error 7 % were more often gained. The lower limiting value error was more sensitive to prognosis error especially at a stable increase and during changes in the price course. An earlier initial condition drift usually allowed more accurate forecasting.

The limiting value error 8 % was more succesfull only in singular cases associated with certain lengths of the initial condition drift within the changes in the price course and significant price fluctuation. In all these cases within the forecasting term the most accurate prognoses were obtained while using another length of the initial condition drift in combination with the limiting value error 7 %. Based on these results, we recommend the limiting value error 7 % as more suitable for commodity price forecasting.

Acknowledgement
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POSSIBILITIES OF BUILDING OF WIDE-GAUGE RAILWAY IN THE SLOVAK REPUBLIC

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Keywords: transportation, railway, wide-gauge railway, analysis
Abstract: The contribution deals with an ambitious project, which is the extension of the current wide-gauge railway from Haniska near Košice to Vienna, thus eliminating the transshipment of wagons and overall it should rapidly increase in volume of goods transported by railway from Asian countries without transshipment to Central Europe. The problem itself lies in the disunited view to building a wide-gauge railway led from the territory of Ukraine across the Slovak Republic for needs of the raw materials transportation to Western Europe. The aim is to establish a theoretical base, to evaluate current infrastructure, to analyze the current status and the overall profitability of the project of wide-gauge railway for Slovakia. The aim is to evaluate the advantage or disadvantage of the possibility of extending the already existing wide-gauge railway across the whole territory of the Slovak Republic, which should in practice, meant the construction of approximately 390 to 430 kilometers of new railway track and at least one terminal of combined transport in the Slovak Republic and the European Union. Although the project has been known for a relatively long time, the discussion about this project is conducted in professional circles for nearly 10 years.

1 Introduction

Railway transport has belonged for several centuries to the most important forms of passenger transport but especially material transport worldwide. 165 years have passed since the operation of the first steam powered train on the territory of Slovakia. From this historic milestone, the railway infrastructure in our country have been formed and improved to the present form.

Nowadays, there are 3,657 kilometers of railway tracks in Slovakia. They are not used in such a form what is their potential, because their carrying capacity for freight transport is used only on around 31%. In relation to this data, the opponents of the project of the wide-gauge railway (WGR) in the length of about 430 kilometers in our area point to the fact that it would be a waste of finances in enormous volume for the construction of another, although specific track, in case when the capacities of existing ones are not used even to half. On the other hand, it is more than realistic that in the case of the construction of this track, the volume of goods flow on the railways in Slovakia _ would considerably increase several times, while the product would flow from the east of the country via the built track Maťovce – Haniska near Košice. The fact is that nowadays through this track, along with other wide-gauge track on Slovak territory (Čop - Čierna nad Tisou) annually flow approximately 15 million tons of cargo, which represents a third of all cargo moving in Slovakian railway network. It can be also considered that the added value of a newly built track would also increase the amount of cargo transported by the tracks of the current split, as the future terminals of combined transport would be connection for wide-gauge railways with road transport and in appropriate locations with the water transport, as well as connection of the wide-gauge railway with normal-gauge railway. This fact could cause an increase in the use of the existing railway network and also it could be a new stimulus for potential investors to visit Slovakia [1].

The very idea of extension respectively the construction of wide-gauge track through Slovakia comes from Russia. The Russian side is interested in the better usage of existing Trans-Siberian Railway, which leads from the Pacific Ocean coast to Moscow in the length of 9,288 kilometers and many tracks to Central Asia, China as well as the Baikal-Amur Railway is connected to it. According to the idea, the goods could be transported without reloading respectively without changing of wagons from Asia or Russia to Central Europe [1].

2 Railways dividing according to the gauge

Most of the railways in the world are so called normal-gauge. *„The track gauge is perpendicular distance between browsing inner edges of the railheads of rail, measured on the axis of the rail at the prescribed depth of 14 mm below top of rail [2]”.*

Normal gauge is based on the dimensions of the English road vehicles; it was defined by G. Stephenson. The first modern railway vehicles was created by the remake of road vehicles, after the introduction of the inner edges to the wheels, adjusting of powered vehicles thus, locomotives, and specialization of the vehicles only for running on railway tracks it came to the gauge of 1,435 millimeters. By the usage of English locomotives during the construction and industrial revolution in the European countries, therefore, this gauge took charge in most of

Europe. However, from the needs of practice, technical or technological solutions but also for safety reasons respectively other political decisions, more than 130 kinds of gauges are currently being used around the world, 30 of them is of crucial importance (Figure 1).

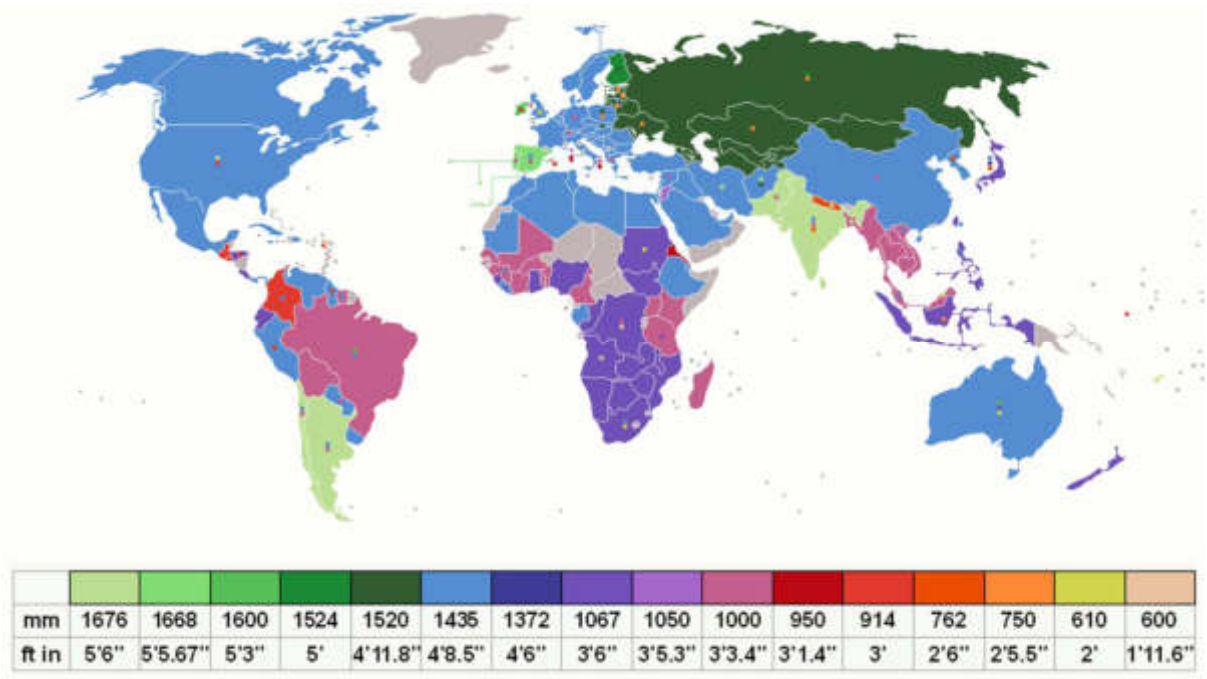

Figure 1 Map of railway gauges in the world [3]

Normal gauge, i.e. 1,435 millimeters is used for almost 62% of railway tracks in the world. It is almost everywhere in Europe except for example Switzerland, Finland and others. However, in almost every country there can be also found local tracks or tracks of a different character with a different gauge than the standard, which have for example recreational purposes or other business purposes. In Slovakia, in addition to standard gauge railways there are also tracks with gauge 600, 760, 900 and 1,000 millimeters [1].

Narrow gauge of tracks is mainly used in countries outside of Europe, which consequences of the historical development of the railways and the industrial revolution in England. Atypical, 610 millimeter gauge is in India, Pakistan and some countries of Africa. Argentina and Uruguay are using 750 millimeter gauge on the railway tracks, Switzerland uses over 800 and 1,000 millimeters. So called Cape gauge is used in the south of Africa, on the Pacific islands, in Australia, Japan and also in Brazil [1].

In Slovakia, in addition to the normal-gauge railways, there are also narrow-gauge railways. Among the tracks with atypical gauge belong Tatra's electric railway network, with a length of 35 kilometers and 1,000 millimeters track gauge. This track from the station Poprad - Tatry leads to Štrbské Pleso with turning in Starý Smokovec and Tatranská Lomnica and it is used for recreational purposes, respectively for tourist purposes in the Tatra region. Other narrow-gauge tracks are Trenčín – Trenčianska Teplá (gauge of 760 millimeters and length of 6 kilometers) and Košice – Alpinka, which was built in 1965 for recreational purposes (5 kilometers length and 750 millimeters gauge).

By the term of wide-gauge railway is meant track whose gauge is more than the standard 1,435 millimeters. These tracks are throughout Russia and Finland - 1,524 millimeters, in Ireland, Australia and Brazil - 1,600 millimeters and gauge of 1,670 millimeters is used in Spain and Portugal. Some tracks in India, Argentina and Chile are 1,676 millimeters gauge, which is the widest existing gauge of railway tracks in the world [1].

3 Advantages of railway transport

One of the most important factors preferring railway transport is its **transport capacity**. For a transport capacity of a normal commodity is determined by standard of 3,000 tons per train set, while on average a road trailer has capacity of about 25 tons, maximum up to 40 tons per trailer. Railway transport thus allows performing, by a single train set, such a transportation power that would be reached by, roughly estimated, 75 road trailers (Figure 2). Thus are saved not only invested financial resources but also labor forces and, last but not least, the environment.

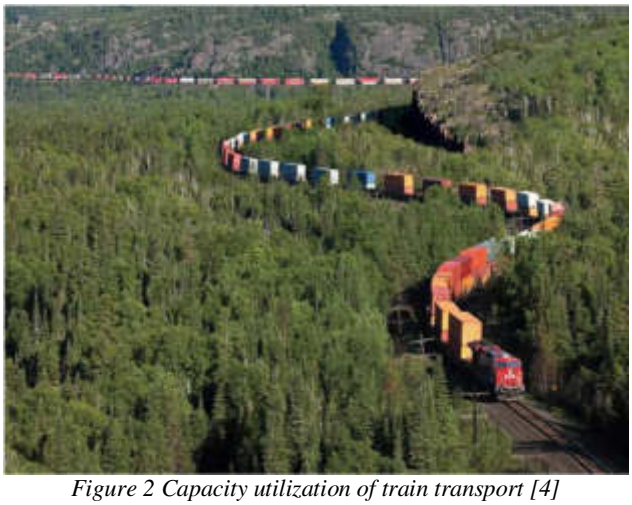

Figure 2 Capacity utilization of train transport [4]

In **terms of safety**, it is necessary to distinguish at least two directions - and it is security of transport itself and on the other hand the security of transported goods. Railway transport belongs, according to statistics, to the safest form of transport in terms of road accidents; it is also secured one of the highest possible standards of security of transported substrate (e.g. nowadays, in road transportation it is not unusual kidnapping of trailer or the whole combination of vehicles, theft of trailer's content and other damage events).

The financial side of runway traffic is the main reason, which greatly exceeds for example road transport. This also includes claims for fuel, respectively for electrified tracks energy claims. As a traction vehicle at train sets is sufficient one, maximum two locomotives so also the costs of operation are, compared with road transport, at a minimum level.

From **the perspective of ecology** when transporting cargo on medium and long distances railway transport has no competition (do not considering river transport respectively marine transport, since it is not possible in certain areas). Whether it has a direct effect of exhalants, in comparison with the road or air transport, it is on a negligible level, but also during its construction there is degraded much smaller part of the country than in the road network.

Lower transport restrictions also belong to the further advantages of railway transport. Nowadays, it is ensured during railway transport almost fluent transportation, including border crossing points in the Schengen area and again it is not necessary to keep a variety of restrictions, such as restrictions on the use of highways and first class roads, restrictions relating to weekends respectively public holidays or safety breaks Last but not least, it is often higher permissible speed of train sets in comparison with goods vehicles.

Except for the advantages offered by railway transport over other forms of transport, there is also **the fact of added value** that is directly related to the tracing of railroad. Wide-gauge but also other railway track directly creates new jobs, it also supports the infrastructure of the region and passenger railway transport may help to develop tourism of the region. As an example, it should be mentioned Levoča district, through which during the building of the main railway artery of Slovakia, thus the north traction Košice – Žilina – Bratislava, the road line was dismissed. It is already only at the level polemics, how much this fact contributed to the development respectively economic stagnation of the whole region, the fact is that nowadays Levoča has no train connection and so the entire suburban but also long-distance transport of persons is ensured only by the bus operators. This fact has significantly contributed to the development of the city. With regard to freight transport, this region, as a whole, is cut off and it all has caused almost zero inflow of investment capital into the region. It is logical that the investor will not enter the area where the infrastructure is significantly weakened, although the potential in the form of workforce is definitely at this place.

In contrast to Levoča district, Spišská Nová Ves can be shown as an example; its economic development was partially supported by the good train infrastructure and thus directs railway connection whether personal as well as freight transport with the main economic centers of Slovak republic.

4 Legislative restrictions

During the construction of railway tracks but also during their operation it is necessary to follow the legislation of the given country, but also in the case of Slovakia, to follow also legislation and the recommendations of the European Union.

Operation on railway tracks in Slovakia modifies the legislation, specifically these laws [1]:

- Law NR SR no. 258 Collection of Laws from 30. September 1993 on Railways of the Slovak Republic as amended by law NR SR no. 152/1997 Collection of Laws and law NR SR no. 259/2001 Collection of Laws;
- Law NR SR no. 513 Collection of Laws from 28. October 2009 on the railroads and about the amending and supplementing of some laws;
- Law NR SR no. 433 Collection of Laws from 21. October 2010, which amends and supplements the law no. 513/2009 Collection of Laws on the railroads and about the amending and supplementing of some laws and which amends and supplements some of the laws;
- Law NR SR no. 393 Collection of Laws from 19. October 2011, which amends and supplements law no. 513/2009 Collection of Laws on the railroads and on the amend and supplement of some laws as amended and which amends and supplements law no. 514/2009

Collection of Laws about the traffic on the railroad as amended;
- Decree no. 245 MTCRD SR from 24. May 2010 on professional competence, medical fitness and psychical fitness of people at operation at railroads and traffic on railroads;
- Decree no. 205 MTCRD SR from 29. April 2010 on designated technical equipment and determined activities and activities on defined technical equipment;
- Law NR SR no. 514 Collection of Laws from 28. October 2009 on the traffic on the railroads
- Decree no. 350/2010 MTCRD SR from 19. August 2010 on construction and technical regulation of tracks;
- Decree no. 351/2010 MTCRD SR from 19. August 2010 on transportation regulation of tracks"
- 235/1920 The law on the construction of new tracks and determination of construction and investment program;
- 085/1964 Agreement between Slovak republic and Austrian republic on modification of railway border crossing;
- 009/1984 Decree on container transport regulation;
- 008/1985 Decree on Convention on international carriage by railway (COTIF).

EU directives must be followed in all sectors, not excluding the railway transport. Effect on this type of transport have [1]:
- 2005/047 Council Directive 2005/47/ES from 18. July 2005 on Agreement between Community of European Railways (CER) and European Workers' Federation (ETF) on certain aspects of the working conditions of mobile workers engaged in interoperable cross-border transport in the railway sector;
- 2004/881 Regulation (EC) 881/2004 of European parliament and Council from 29. April 2004 on establishing of European Railway Agency;
- 2004/050 Directive of the European parliament and Council on compensation in case of non-compliance with agreed quality requirements for railway freight transport;
- 2004/049 Directive of European parliament and Council on the rights and obligations of passengers in international railway transport;
- 2004/049 Directive of European parliament and Council from 3.3.2004 on certification of train crews operating locomotives and trains on railway network of the Fellowship;
- 2001/014 Directive of European parliament and Council 2001/14/ES on the allocation of capacity of railway infrastructure, the levying of charges for the use of railway infrastructure and safety certification;
- 2001/013 Directive 2001/13EC of European parliament and Council from 26. February 2001 amending Council Directive 95/18/CE on licensing of the railway use [Ú. v. L 75 z 15 .03.2001];
- 1995/019 Council Directive 95/19/EC from 19. Jun 1995 on determination of capacity of railway infrastructure and charges for infrastructure use;
- 1995/018 Council Directive 95/18/EC from 19. Jun 1995 on authorizing the use of railways.

Other laws are available in the relevant literature or in the Collection of Laws of the Slovak Republic.

5 Analysis of the facts in connection with the construction of wide-gauge railway

Among the strengths shown by the subjective view of the author belongs:
- strategic position of Slovakia in transnational logistic chain of goods flows,
- incomes for manager of infrastructure, thus for the state budget,
- creation of many job opportunities during the construction but also during the track operation,
- improvement of domestic infrastructure.

Weaknesses of the project could handicap the construction resp. mainly these factors have negative effect:
- huge financial investments into the construction and operation of railways,
- long time horizon of return of investment,
- possible complications with the gaining of private properties for the need of construction,
- possible geological complications in relation to the relief of Slovak republic.

Among the options respectively opportunities that could, from the project for the construction of this track, result for the Slovak Republic are:
- greater use of combined transport and terminals,
- visibility of Slovakia and possible inflow of foreign capital,
- shortening the transit time from Asian countries to Europe,
- possible use of track for passenger transport.

While mentioning the threats, it is necessary to point out that it is only a potential risk. About their realizations often determines the factors that are beyond the given issue, sometimes it can be a random factor, for example:
- lack of interest in freight transport,
- extremely weak usage of track capacity,
- increase of the work price due to unpredictable weather conditions,
- outflow of the capital and investors towards the east, due to lower labor costs,
- significant reduction of the transport volume via a transshipment Čierna nad Tisou.

Conclusions

The intention of contribution is to to clarify the eventual benefits as well as drawbacks caused by the construction of wide-gauge railway across the whole territory of the Slovak Republic, i.e. from its current terminus in Haniska near Košice to Bratislava and then to the state border (with the continuation outside SR).

This topic is quite specific and therefore it is very difficult to find a parallel to the said project. However, since this is a significant step into the future not only for the transport aspect of the position of the Slovak Republic in Europe, or even in the world, it is necessary to pronounce the final verdict.

It is therefore only to competent in what direction the project (which was first time presented in some way already more than ten years ago) will involve. Of course, there are many questions unanswered and even more the risks associated with this project - whether an inaccurate forecast of investments in construction, underestimating of other factors in the construction or in pessimistic estimation, low interest and the associated inefficiencies in usage of wide-gauge railway.

An overall analysis of the mentioned problems is the conclusion to continue and still support the idea of building resp. extension of the wide-gauge railway through the territory of the Slovak Republic, however in line with current economic and political situation.

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HOW TO MEASURE THE SOCIAL CAPITAL IN A SUPPLY CHAIN?

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Keywords: social capital, supply chain, the measurement of social capital in a supply chain
Abstract: The purpose of this article is to characterize the concept of a social capital of supply chain and identify ways to measure this capital for the needs of supply chain management. In addition to traditional methods author brings new proposals to assess the social capital of the supply chain. The author also presents the results of scientific research obtained in two research projects which examined the relationships of social capital and supply chain management.

1 Introduction

In the majority of publications referring to supply chain management the growing importance of the nature of mutual relations between their participants is emphasized which, to a great extent, plays the decisive role in their lasting, effective and efficient functioning. It is most frequently suggested as best for the cooperation between supply network actors to be based on partnership relations as opposed to transaction or confrontation type of interdependencies [1]. Partnership cooperation should be long lasting, result in close mutual bonds and ties of the parties involved, based on trust, openness, common sharing of both risks and profits.

Trust in supply network relationships represents the key for an extensive reduction of transaction costs or at least the guarantee for economic profitability in a network. It mainly results from the fact that in these relations in which trust is present the need for securing the division of future outcomes and activating due mechanisms for the prevention or reduction of opportunistic behaviour is limited.

While discussing the issue of trust between parties involved in network transactions, its internal sources are mainly indicated, i.e. partner's trustworthiness and the tradition of cooperation. However, as many researchers specializing in the study of network organizations confirm, trust, as the fundamental component of network establishment (Among others: Putnam, Coleman, Jarillo, Matysiak), does have its external dimension represented by social capital [2].

2 The perspectives of social capital

Social capital is a concept that has long been discussed in scientific discourse for economic, sociological and management perspective. Although the subject of discussion in this article is the social capital of the supply chain it is worth to introduce the most popular perspectives of social capital, i.e.: macroeconomic and microeconomic.

The macroeconomic theory of social capital says that preserving regular contacts with other people and undertaking activities in order to obtain common objectives results in lasting and positive effects for the functioning units and communities, since this is how their needs are met as well as mutual relations and trust between people become strengthened [3].

The leading objective of social capital is to limit uncertainty occurring in social life and economic life. At the absence of social capital uncertainty would become a major obstacle in undertaking economic activity and cooperation between people and organizations. Social capital substitutes individual outlays indispensable for decreasing uncertainty present in economic performance and cooperation, e.g.: expenditure on protecting one's own resources and goods, costs of collecting information about economic environment (including information about partners), outlays spent on signalling individual attributes enhancing trust of the environment. Therefore social capital cuts individual the costs of property laws, transactional expenses and signalling outlays (market directed information). Social capital increases economic activity, frequently limited by the absence of financial capital, it also modifies directions and improves investments' efficiency [4].

As compared to social capital macroeconomic perspective, which refers to it as an external category in corporate activities, the microeconomic perspective, i.e. its dedication to individual economic entities still persists in the phase of scientific development.

I. Grzanka, who has been analyzing the influence of social capital on client relations defines the term of corporate social capital as: "the category resulting from participation in relations networks which, based on shared standards, principles, values and later trust, enable parties to access resources, especially knowledge and competencies. All the above is focused on obtaining adequate advantages for an enterprise, such as: improved functioning efficiency, development, obtaining competitive advantage". The definition which the author

accepts is that social capital in an enterprise facilitates accomplishing substantial targets and strategic plans [5].

Microeconomic perspective, poorer in research results and scientific discussions, still does not have its own set of indicators dedicated to measuring social capital in enterprises. Therefore, professional literature most often suggests to transfer macroeconomic solutions into this particular area. "According to The Word Bank there are six sources of social capital" which represent the popular set of indicators listed below [6]:

- organizational participation and its diversification,
- trust and solidarity level,
- cooperation scale and the level of readiness for it,
- information and communication (e.g. number of information sources used),
- social integration and inclusion (stratification scale, integration range of minority groups),
- the sense of an entity – exerting influence on environment and especially its key institutions.

The quoted sources are supposed to constitute the background for performing both measurement and evaluation of social capital in an enterprise. Unfortunately, among the listed indicators, it is only trust which received the research tool possible for the implementation at corporate level exactly [7].

3 Social capital in supply chains

Despite the outstandingly rich scientific output in supply chain management (SCM) and many schools, definitions, classifications and approaches resulting from it, supply chain in this concept is almost always defined as "extended enterprise". According to The Global Supply Chain Forum members a supply chain is understood at the network of transfers from the initial suppliers to final recipients. This network covers transfers in the sphere of deliveries, production, distribution, related. to customer service, research and development activities, marketing, etc. The objects of such transfers are goods (raw materials, stuffs, ready-made goods, etc.), information and money. Managing supply chain understood in this way means the integration of all key processes from the final user to suppliers in order to add value to products, services and information.. Such approach authorizes both theorists and practitioners to apply numerous, traditional and modern, solutions typical for an enterprise management to supply chains or delivery networks improvement. It also refers to output accomplished by enterprises in the sphere of social capital which, so far, did not attract enough attention on the part of supply chain researchers. It is even more surprising that in spite of all sorts of differences in SCM concept interpretation, usually there is an agreement in opinions that changing relations between supply chain participants, from confrontation oriented relations and competition power application into long-term partnership oriented relations, based on trust and mutual advantages, does constitute the essence of this concept. Socially justified division of risks and advantages between chain links becomes particularly emphasized within the framework of synchronized context for SCM concept definition. With regard to this particular concept, the supply chain essence comes down to strategic partnership which should be understood as significant and lasting cooperation of its participants based on trust, risk sharing and advantages resulting from undertaking common investment and organization oriented projects aimed at accomplishing different individual goals subject to common targets focused on winning competitive advantage and creating value [4].

As opposed to social capital, constituting a part of supply chain environment, the capital of supply chain itself represents its internal resource and therefore does influence its competitiveness and ultimately also its development. Additionally, as it has already been mentioned, supply chain capital may be managed and planned, organized and controlled by the supply chain participants[4].

Contrary to other types of capital, e.g. financial, real or even human, the supply chain social capital is not the sum of individual social capitals represented by entities which altogether create it. Capital components, such as: certain values, trust, cohesion, involvement or loyalty level, have to be planned and organized specifically for the needs of an overall supply chain [4].

Therefore an internal **social capital in supply chain** may be defined as the set of relations characterized by a certain quality specified by principles and values common for all its participants, such as trust, involvement or cohesion, which aim at accomplishing common goals and common advantages resulting from them [4].

Differently from social capital microeconomic classification, however, in line with the quoted above Putnam's classification of social capital, the authors suggest for the set of supply chain relations (and their properties) to reflect an internal type of social capital, together with participants of its environment which includes e.g. competitive supply chains, independent organizations, society or regional governments. This means that internal social capital may be of bridging or bonding nature [4].

Such internal social capital interpretation allows for its quicker identification and measurement. Supply chains internal social capital may be defined on the basis of analisys the scale, direction and quality of relations with the environment (e.g. by means of supply chain integration models implementation (The review of supply chain integration models according to Poirier, AT Karney, Manugistics is presented, e.g. in [13]) and measured by applying indicators dedicated to corporate social capital.

At macro-social level social capital represents an element of supply chain environment. It is the category which cannot be influenced by an individual supply chain, however, the one which strongly determines this chain functional efficiency.

Social capital performs universal functions, both in a society, an enterprise and also in a supply chain. Therefore at this stage there is no need to indicate any analogies of an influence exerted by social capital on a supply chain. However, the fact which has to be emphasized, since it is of great importance for a group of enterprises involved in a supply chain construction, is an opportunity to take advantage of internal supply chain capital in order to overcome negative effects of environmental social capital influence in which this particular chain functions, as well as negative social capitals of individual enterprises responsible for such a chain construction. Internal social capital of an enterprise does not have this power since it is limited by an external dimension of relations (with business partners) [4].

It has to be emphasized that cooperation for the benefit of meeting a common objective and advantages, constituting the leading characteristics of supply chain management concept, all by itself strengthens relations between enterprises, which is already the initial stage in creating the need for establishing adequate quality relations. Partnership nature, i.e., among others, voluntary common activities, keeping them up and increasing efficiency are influenced by the planned supply chain internal capital development, i.e. its management [4].

According to A. Baraniecka social capital management as part of supply chain will consist in [4]:

1. Identifying both, the level and properties, characteristic for social capital of the supply chain environment and applying this information in planning supply chain development (internationalization in particular).

The identification of social capital level in supply chains environment may determine the choice of such chain configuration, the expected expenditure and effects of its functioning. Social capital, at this stage of aggregation, represents an important background for supply chain management.

2. Supply chain internal capital planning, based on this chain objectives and in relation to data about social capital in the environment;

If capital in the environment does not facilitate the implementation of supply chain strategy, proper strategic decisions should be undertaken and tasks for internal capital, the properties of which may overcome negative effects of environmental influence, should be explicitly specified.

3. Internal social capital organization by means of the set of activities associated with change management in a given area.

The awareness of needs within internal capital allows for the construction, following patterns of organizational culture, its ideal profile and for preparing the process of its creation and implementation in a supply chain. An identified dissonance between the desired and actual condition of this capital (real profile) should become the background for the selection of speed, procedure and tools necessary in social capital construction process.

4. The control of internal social capital level and properties in the context of its influence on supply chain development.

At this stage an ongoing measurement of social capital is performed based on initially prepared profile and indicators dedicated to it [4].

4 The measurement of social capital of supply chain

The social capital measurement represents the key component at all listed above stages. In the situation of benchmarking deficiencies this element may turn out the most difficult and the weakest functioning one within the framework of social capital management in a supply chain. The output of supply chain management concept itself may provide a solution and within its spectrum also supply chain excellence models [9]. They cover groups of phenomena, also including social capital components, deciding about the level of supply chain advancement which, in turn, determines its competitiveness. Following selected supply chains excellence models and considering the research output in the domain of social capital, A. Baraniecka includes the following in the group of indicators of social capital in supply chains: [4] and [8].

- the cohesion of companies operating in the supply chain understood as an implementation of the shared strategy,
- the number of actual vs. declared relationships,
- the average of trust levels for individual relationships,
- the amount of information available vs. the amount of shared information,
- the number of participants carrying out projects dedicated to the development of the supply chain vs. the total number of participants,
- the number of complaints recorded by the customers vs. the number of complaints recorded by suppliers in the supply chain,
- the number of contracts vs. the number of network participants over a specific time (t),
- the growth rate of the number of contracts between network participants,
- the number of pro-development visits against the total number of visits, etc.

These indicators require description that is more detailed, along with a validation and practical application;

however, even as they are, they prove that the social capital in a supply chain may be easily measured [8].

During her studies of social capital, the author was looking for alternative ways of measuring, more reliable and at the same time more simple. Below the author briefly describe some of them. They are as follows:

- surveys and qualitative and quantitative evaluation models ,
- methods based on the idea of rating.

In research of social capital in supply chain there are two types of results: the level of declared social capital and the level of real social capital.

The declared capital is the result of the declaration of the supply chain's participants, which often differs from the real social capital, which we estimate on the basis of actual data. If the declared social capital differs significantly from the actual social capital that means that there is a basis for active efforts to take action in this regard. The declared social capital is the basis for future engagement and real capital is a prerequisite for selection of a concept of cooperation.

Declared level of social capital we determine through surveys, or through models based on declarations. One of the model is original (A. Baraniecka) **AVIT** (acronym) model, which in its design resembles DICE model. The DICE framework is a tool originally developed by Perry Keenan, Kathleen Conlon, and Alan Jackson (all current or former Partners at The Boston Consulting Group. A DICE score is a leading indicator of the likely success of a project based on objective measures. [10].

The components of the AVIT model evaluation declared level of social capital are:

- Awareness of the presence of participants (A)
- Common vision (V)
- Joint initatives (I)
- Trust (T)

To determine the level of social capital in the supply chain, we ask each participant in the supply chain of the individual elements. A respondent may receive for each answer in one of the categories from 1 to 4 points. The category and questions are listed below:

Awareness of the presence of participants – A (1-4 points)

Do you know the links forming the supply chain which you are involved in?

1. I know very well all participants in my supply chain (1 point)
2. I know very well chosen companies (2 points)
3. I know quite well only directly cooperating companies (3 points)
4. I don't know well the other companies in my supply chain (4 points)

Common vision – V (1-4 points)

Do you have a common vision with other companies in supply chain?

1. We have jointly developed a vision with all participants in the supply chain, and together we implement it (1 point)
2. We have jointly worked out a vision with the selected companies and together we implement it (2 points)
3. We have jointly developed a vision with the first tier partner only and we realize it together (3 points)
4. Each company carries out its own vision of development (4 points)

Joint initiatives – I (1-4 points)

Do you undertake joint initiatives with companies in the supply chain?

1. Most of our initiatives base on cooperation with all other actors in the supply chain (1 point)
2. Most of our initiatives base on cooperation with selected actors in the supply chain (2 points)
3. Most of our initiatives base on cooperation with the closest cooperators in the supply chain (3 points)
4. Most of the initiatives we realize alone without the active participation of others (4 points)

Trust – T (1-4 points)

Do you trust the partners in the supply chain and whether they trust you?

1. We trust absolutely for all actors in the supply chain, and we know that we are trustworthy (1 point)
2. 2. We trust absolutely selected companies in the supply chain, and we know that we are trustworthy (2 points)
3. 3. We trust only the closest co-operators and we are confident that they trust us. (3 points)
4. 4. We have limited trust for companies in the supply chain, and we think that they not trust us. (4 points)

The answers to these questions allow to determine the level of social capital (1). Along the lines of the model DICE we summarize the individual parameters, and to these, which we consider important, we assign a higher value (eg. double value have: trust and joint initiatives). Finally, we obtain the following formula:

$$LSC = A+V+ (2xI) + (2xT) \quad (1)$$

LSC - the level of social capital

The level of social capital reaches a level of from 6 to 24, and it allows to set ranges for the values of social capital. A small number of points indicates a higher level of social capital supply chain in the area. Of course, these levels can be different in different areas of supply chain (Figure 1).

Calculations:
Min. 1+1+(2x1)+(2x1) = 6
Max. 4+4+(2x4)+(2x4) = 24
The range of results [6-24]

The assessment of the level of social capital:

6-11	a high	LSC
12-17	a medium	LSC
18-24	a low	LSC

Figure 1 The interpretation of the results of the assessment by the AVIT model

Measuring the real social capital is much more difficult than the measurement of the capital declared.The level of real social capital can be calculated on the basis of the identification of selected indicators, eg. the level of trust or/and commitment. The data is obtained from the companies in a supply chain.

The method of calculating the level of real social capital (2) refers to the idea of level of customer service. It is determined by identifying the share of well executed supply for all deliveries. In the case of social capital it is a fixed share of relationships covered by the trust to the amount of all relationships in the supply chain. A value close to 1 indicates that the level of social capital is high. An example of pattern is shown below:

LRSC = the number of relationships covered by the trust / total relations (2)

LRSC - the level of real social capital

Another method of determining the level of social capital (real and declared) refers to the idea of rating.

The rating assignment consists of three parameters: the social capital of the region where the company comes from, the social capital of the company, the type of social capital of supply chain. Due to the diversity of enterprises in the supply chain rating shall be made for the areas of the supply chain, not for the entire supply chain. This allows you to determine the scope and scale of the differences in the level and quality of social capital throughout the supply chain.

Such an assessment can determine the nature of a social capital in the area of the supply chain, which type dominates and where there the greatest disparities are.

With reference to the evaluation areas there are three criteria:

1. The level of social capital of the region where the company originates:

I – high level
II – medium level
III – low level

2. The level of social capital of the company:

A – high level
B – medium level
C – low level

3. The type of social capital of supply chain

Br – bridging (open to others)
Bd – bonding (focused on the inside of supply chain)

Distinguishing two forms of this capital: bonding capital (uniting, excluding) and bridging capital (including) becomes Putnam's significant input in the theory of social capital. Bonding capital is present in groups directed inwards and strengthens their cohesion, identity and also homogeneity. This capital means relations between entities (individuals) similar to one another. Strong bonds between community participants, characteristic for this type of capital, are accompanied by: inclination towards establishing barriers protecting a group from its environment and excluding "individuals who disturb homogeneity". Bridging capital is, on the other hand, directed outwards – it bonds people originating from different environments, constructs relations between heterogeneous groups. Even though relations established by this type of capital are weaker, still they are of inclusive (joining) nature and, in this way, cut the distance between different social categories.

For example, social capital of supply chain can have 3 assessment:

1) Suppliers: IIICBr – a low level of social capital of region, a low level of social capital of company, bridging social capital in relationship with others (outside the supply chain)

2) Leader: IABd – a high level of social capital of region, a high level of social capital of company, bonding social capital in relationship with others

3) Customer: IABr – a high level of social capital of region, a high level of social capital of company, bridging social capital in relationship with others.

Figure 2 shows an example of the supply chain including the rating of social capital.

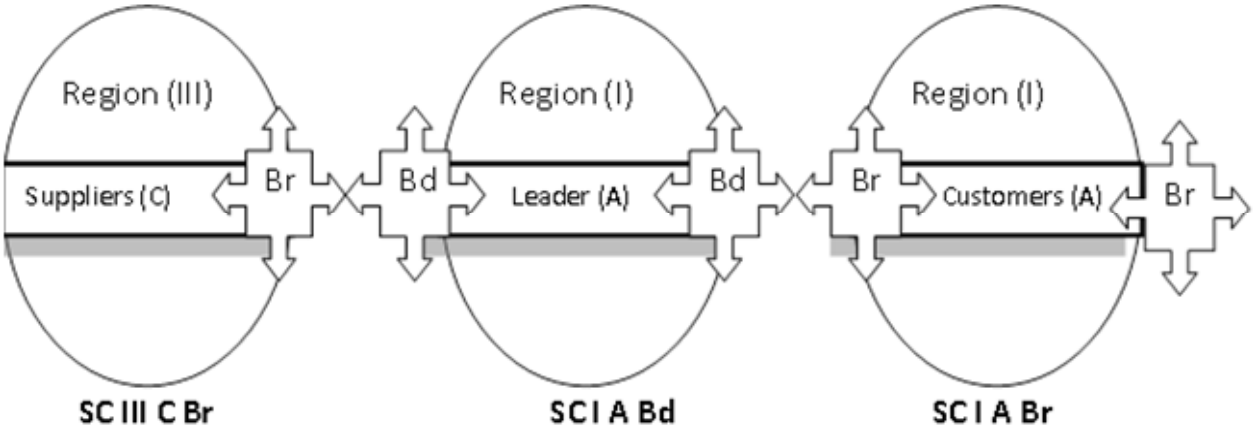

Figure 2 The example of rating of social capital in supply chain

Such an assessment can determine the nature of a social capital in the area of the supply chain, which type dominates and where there the greatest disparities are. This descriptive assessment allows to estimate transaction costs and choose the ways of cooperation in the supply chain (including strategies, concepts and methods) too.

Regardless of the method of evaluation of social capital, there are a few rules for the measurement of social capital:
- To describe the social capital of the supply chain all ties must be considered and conclude on the basis of the principle of domination.
- If there is a clear leader in the supply chain, the tests may be carried out on its level. If the partnership is implemented the way supply chain management survey applies to all companies.
- Social capital can not be added together in the supply chain.

The author wishes to emphasize, that the presented methods are new but very general propositions of measuring social capital in supply chain. The author will verify its in the course of further studies on the subject.

5 Results of research of a supply chain's social capital [8], [12]

The author has conducted over the past 5 years, the three studies related to social capital in the supply chain. The two of them were related to the grants, the third is own research. In the first project (*project no. 4232/B/H03/2011/40 financed by the National Science Center, Poland*), the author examined the perception of social capital at the level of supply chains in Poland (426 companies), in the second (*project no. DEC-2013/09 /B/ HS4/01260, financed by the National Science Center, Poland*) examined the significance of differences in the level of social capital in the Japanese supply chains (6 companies).

The experience of the author as well as the opinions of other researchers [11], suggest that researching a supply chain's social capital is not an easy task. The major obstacles in the research included [8]:
- a lack of knowledge or understanding of social capital among respondents;
- too little awareness of benefits resulting from the understanding of the social capital category;
- too complicated research tools, which discourage collaboration;
- a general unwillingness on the part of modern organisations to participate in scientific research (at least in Poland).

"Despite the said limitations, the authors managed to establish short and modest dialogue with Polish companies regarding the social capital of their supply chains (Hence, 1,820 companies were contacted and 426 were researched at the preliminary stage of study). The screening tests during indirect reasoning showed the considerable importance of social capital in undertaking initiatives in supply chain management. The companies researched indicated that the lack of trust and commitment of collaborators in the supply chain and ensuing restrictions in access to data, as well as the growing uncertainty of business operations were a major barrier to implementing actions towards improvement [8].

What seems reassuring, in particular given the fears presented herein that the practitioners ignore the issue of social capital, is that the majority of researched companies (74%) see the considerable influence of the supply chain's social capital (trust, commitment, loyalty of collaborators in supply chains) on their market success. Almost 10% of respondents recognised social capital as the most important factor influencing the effectiveness of market actions [8].

The companies see many benefits from high social capital in the supply chain, the most important benefit (indicated by 32% of respondents) being the increase in the competitiveness of the supply chain (and individual

companies). Other areas influenced by the supply chain's social capital are: product quality (25%), collaborations costs (16%), comfort and satisfaction with work (15%)and product price (12%) [8].

In the context of the demonstrated awareness of the significance of the supply chain's social capital, it seems paradoxical that a considerable percentage of researched companies (49%) do not analyse the level of this capital. Only 27% declare they analyse the social capital of their own supply chain, and 22% plan to undertake such research.[8]

As the deliberations presented herein show, a supply chain's social capital is not much discussed in theory or applied in business practice. It seems that tradition and the effective promotion of the macro-economic approach to social capital have dominated the application of any relevant theories in practice in the public sector. This is probably why social capital is regarded by business environments as an unknown and uncontrollable external factor of company and supply chain operation. A similar situation is found with respect to the social capital of companies. It was concluded, too quickly and easily, that this "invisible" resource of individual organisations could not be accurately measured, and that one could therefore not interfere with its structure or level in order to adjust it to the needs of supply chain management "[8].

Other studies conducted by the author indicate different perceptions of the social capital of the region from which the partner in the supply chain comes from. According to research results that low social capital Polish is not considered by the Japanese as a barrier to implementation of solutions typical for Japanese companies in Poland. The reason for this is probably a systemic change in the investment strategy group keiretsu, manifested in this case, balancing the negative effects of low levels of social capital, a high level of human capital with its relatively low price (low labor costs). It seems that the Japanese agree with Polish workers introduced by the amendments, if these do not impair the economic efficiency of enterprises. [12]

Conclusions from the previous considerations regarding the potential differences in the functioning of the Japanese supply chains in terms of Polish culture and social capital, supplement the preliminary results of research conducted by the staff of the *Department* of Strategic Management and Logistics at the University of Economics in Wroclaw, a research project funded by the National Science Center granted based on a decision the number of DEC-2013/09 / B / HS4 / 01260, *Management methods in the Japanese supply chains in Poland and the UK* [12].

Conclusion

According to the study of literature, as well as research results, social capital supply chain is not a category generally known. As mentioned in the article as the main source of trust, social capital influences the effects of co-operation of enterprises in the supply chain. It is therefore important to promote this category on the basis of the theory and practice of business, as well as ways to improve the measurement and management skills. The observations of the author shows that if now the social capital is not widely recognized as a source of competitive advantage, it soon so it will be (unification of other bases of competition) and then will succeed those companies that now consciously manage the social capital of their supply chain.

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SELECTED IT SOLUTIONS IN LOGISTICS STRATEGIES OF SUPPLY CHAINS

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Keywords: logistics, supply chain management, IT solutions
Abstract: The aim of the chapter is to present some IT solutions which could be recognised as innovative solutions in both areas: technology and organisation. The above mentioned solution could be implemented by logistics. Currently, logistics is the field of knowledge which on the basis of IT systems is aim-ing at the integration of organizational divisions of enterprises. It is supposed to ensure the optimum shaping of the supply chains from the moment of acquiring materials, through processing and distribution in various fields of commerce, until the final purchaser. Companies are forced to constantly introduce more and more new solutions, resulting in innovation driving the progress of the market. This article is a part of research, which is considered to the problem of implementation of IT solutions logistics.

1 Introduction

Logistics is the science of organization of production processes, warehousing, raw materials, materials and commodities aiming at the optimisation of chains of supplies (from mining the raw-materials to the consumer). Logistic management consists of formulating strategies, planning, steering and control (conducted in an effective way in order to minimize global costs) of the process of transfer and storage of materials, supplies of products in progress, finished goods and relevant information, from the point of acquiring the places of consumption, in order to adjust to and fulfill the customer's needs. On the other hand, the logistic systems are the deliberately organized and integrated - within a particular economic layout - flows of materials and products and the corresponding information that allows for the opti-mization of the supply chain management. Therefore, logistic systems must not be equated with IT systems (the latter serve as basis for logistics and without them logis-tics could not have been realized in its modern form). [1] The implementation of a logistic system results in changes within the enterprise organ-izational structure. The aim of these actions is to modernize technology, supplies and organization as well as the systems of storage, transport and sales. Due to the fact that logistics is closely bound with computer science, the above mentioned changes should proceed faster.

The supply chain is the network (series of links and shared) of processes that exists between suppliers and customers. These links and processes involve all activities from the acquisition of raw materials to the delivery of finished goods to the end consumer. Raw materials enter into a manufacturing organization via a supply system and are transformed into finished goods. The finished goods are then supplied to consumers through a distribution system. Generally, several companies are linked together in this process, each adding value to the product as it moves through the supply chain [2], [5].

The supply chain includes all activities and processes to supply a product or service to the final customer. Often, the supply chain includes more than one company in a series of supplier–customer relationships. Supply chains usually include five functional components [13]:

1) Demand planning:

A planning process to predict the demand of products and services based on forecasts. Accurately forecasting customer demand improves customer service while decreasing costs by reducing demand uncertainty.

2) Requirements planning:

A Process of this planning answers onto demands of customers. Planning of demand defines need of renew supplement of supplies in knots of net of distribution.

3) Transportation planning.

A planning process to optimally schedule, load, and deliver shipments to customers while considering constraints, such as delivery date, mode of transportation, carrier, etc.

4) Manufacturing planning and scheduling,

A planning process that optimally schedules manufacturing orders with production capacity. This is performed by combining Material Requirements Planning

(MRP) and Capacity Requirements Planning (CRP) to create optimized and constrained production plans.

5) Supply planning,

A planning process that meets customer demand based on available inventory and transportation resources. This includes Distribution Requirements Planning (DRP), which determines the need to replenish inventory at branch warehouses.

Integration of logistic activities depends on create of integrated organizational systems and informative, and time and space co-ordination of flow of products and information concerns not only relationships between suppliers and purchasers, but it treats also to procedures of management. Co-ordination of procedures of planning, organization, motivating and control of logistic connected action with flow of products and information be holds with regard of connections and consequence of this flow for different function of enterprise especially finances, production and marketing. [12]

2 The IT Technology in logistics systems

When speaking of an integrated IT system of an enterprise, one should bear in mind the modular IT system operating all areas of its activity, beginning from marketing, planning and supplies, through technical preparation of production and production steering, distribution, sales, managing renovation, until financial and accounting operations and human resources management [11]. The most popular integrated IT systems are the ERP systems (Enterprise Resource Planning). ERP allows the automating, integrating and analyzing of processes within an enterprise.

On the basis of experiences of West European countries it appears appropriate to pay attention to gradual development of logistic management, from improving the available IT systems to the more common use of instruments with algorithms of logistic solving of management problems [10]. The control of these processes requires relevant information and its processing. The tools applied for this purpose are e.g. automatic product identification, computer simulation, electronic data interchange, complex cost accounting and instruments of controlling. Owing to the integration of logistics and controlling it is possible to create solutions which might be of help in the decision-making process.[14]

The complexities of getting material ordered, manufactured and delivered overload most Supply Chain Management (SCM) systems. The fact is, most systems are just not up to handling all variables up and down the supply chain [7].

For years, it was thought that it was enough for manufacturers to have an MRP or ERP system that could help answer fundamental questions such as:

- What are we going to make?
- What do we need to make the products?
- What do we have now?
- What material do we need and when?
- What resources/capacity do we need and when?

Manufacturers need to know a lot more today to have a truly effective supply chain. There are a number of fundamental weaknesses in the old system logic. Many planning and scheduling systems in use today assume that lead times are fixed, queues do not change, queues must exist, capacity is infinite and backward scheduling logic will produce valid load profiles and good shop floor schedules. These assumptions are totally illogical, and following them causes many schedule compliance problems. An effective fix is first to streamline operations and then to apply predictive, preventive forms of advanced planning and scheduling.

Manufacturers need to develop flexible supply chain processes that can adapt to the needs of various customer segments. They must also develop supply chain strategy, processes and supporting systems that conform to current and future requirements.[6]

Supply Chain Management (SCM) software solutions coexist with, but are not the same as, Enterprise Resource Planning (ERP) software solutions. ERP software generally encompasses all aspects of the business–-order entry, distribution, procurement, production, logistics, inventory, and finance. The primary purpose of an ERP system is to control the flow and execution of transactional information across the supply chain. [11]

SCM involves two flows. Information flow signals the need to start the flow of material. In a supply chain, the fast flow of high-quality information and material is inextricably linked and of paramount importance to SCM success. Untimely or low-quality information virtually guarantees poor performance.

While Supply Chain Management software is related to Enterprise Resource Planning software, SCM is focused on planning and ERP is focused on execution. Two of the most beneficial supply chain practices are:

- matching the correct supply chain strategy to the product and
- communication between supplier–customer partners in the supply chain.

Supply Chain Management systems provide decision support for those decisions that must be made prior to execution. It essence, it performs the planning required to allow ERP systems to execute the plan.

For superior competitive advantage, companies must implement a “closed-loop” supply chain management system that interacts with its ERP system. In a closedloop, the ERP system includes operational data (inventory movement, customer orders), tactical planing tools, and strategic planning tools brought together into a fully-integrated environment. This environment must also be able to adapt toadjust to the ever-changing needs of the company.

Information technology, and in particular, the Internet, play a key role in furthering the goals of supply chain integration. While the most visible manifestation of the

Internet has been in the emergence of electronic commerce as a new retail channel, it is likely that the Internet will have an even more profound impact on business-to-business interaction, especially in the area of supply chain integration. The Internet can redefine how back-end operations – product design and development, procurement, production, inventory, distribution, after-sales service support, and even marketing – are conducted, and in the process alter the roles and relationships of various parties, fostering new supply networks, services and business models.

The term "e-business" – as distinct from "e-commerce" – can be used to describe this exciting adoption of the Internet to accelerate the goal of supply chain integration. In this context, e-business specifically refers to "the planning and execution of the frontend and back-end operations in a supply chain using the Internet."

How and where do we see the impact of e-business on supply chain integration? There are four key dimensions in which the impacts can be found [4]:

- Information integration
- Planning synchronization
- Workflow coordination, and
- New business models

Information integration refers to the sharing of information among members of the supply chain. This includes any type of data that could influence the actions and performance of other members of the supply chain. Some examples include: demand data, inventory status, capacity plans, production schedules, promotion plans, and shipment schedules. Ideally, such information can be accessible by the appropriate parties on a real-time, on-line basis without significant effort.

Planning synchronization refers to the joint design and execution of plans for product introduction, forecasting and replenishment. In essence, planning synchronization defines what is to be done with the information that is shared; it is the mutual agreement among members as to specific actions based on that information. Hence, members in a supply chain may have their order fulfilment plans coordinated so that all replenishments are made to meet the same objective – the ultimate customer demands.

Workflow coordination refers to streamlined and automated workflow activities between supply chain partners. Here, we take integration one step further by defining not just "what" we would do with shared information, but "how." For example, procurement activities from a manufacturer to a supplier can be tightly coupled so that efficiencies in terms of accuracy, time, and cost, can be achieved. Product development activities involving multiple companies can also be integrated to achieve similar efficiencies. In the best-case situation, supply chain partners would rely on technology solutions to actually automate many or all of the internal and cross-company workflow steps.

Adopting e-business approaches to supply chain integration promises more than just incremental improvements in efficiency. Many companies are discovering whole new approaches to conducting business, and even new business opportunities not previously possible. E-business allows partners redefine logistics flows so that the roles and responsibilities of members may change to improve overall supply chain efficiency. A supply chain network may jointly create new products, pursue mass customization, and penetrate new markets and customer segments. New rules of the supply chain game can emerge as a result of integration fueled by the Internet.

Integration cannot be complete without a tight linkage of the organizational relationships between companies. This linkage must take place on many plans. The success of any supply chain integration effort is predicated on close cooperation inspired by a perception of mutual benefit. As we will see, e-business approaches can go a long way toward fostering the necessary level of trust and commitment.[4]

3 The integration of logistic activities

The supply chain management refers to the strategy of integration in order to simplify the flow of materials and goods through the company. It takes place by way of strate-gic alliances, various forms of partnership, concepts of selecting the key suppliers and recipients, etc. Irrespective of the form of cooperation, it results in integration of logis-tic systems of enterprises and their logistic processes, in the search for ways of in-creasing trust and commitment in relations 'supplier - recipient', in linking the IT systems, etc. The cooperation and integration processes sometimes lead to the change of the centre managing the flow. The use of the supply chain management strategy leads to the improvement of market service and logistic costs reduction. The partners may participate in profits and the entire scheme of 'supplier - recipient' becomes more com-petitive. This tendency is naturally linked with the limitation of the number of suppli-ers. It constitutes a revolution with respect to the traditional principles of maintaining a large number of suppliers and raising competition between them. The supply chain integration should begin with internal integration. In order to achieve external integration and for an effective supply chain management, in the first place one needs a correct i.e. a well conducted internal integration, a well organized internal flow through particular phases of the enterprise. The concept of supply chain management cannot be realized on a large scale if a well organized, planned internal logistic chain is unavailable. The specificity of the integrated management should be examined from two points of view:

- integration of management functions,
- integration of management areas.

The integration of logistic activities includes the creation of integrated organization and information

systems and a space-time coordination of product and information flow does not only concern relations between suppliers and recipients, but it also refers to the procedures of management. The coordination of procedures of planning, orga-nizing, motivating and controlling the logistic activities connected with the product and information flow is performed with the consideration of relations and conse-quences of this flow to other functions of an enterprise, especially the finance, produc-tion and marketing. [12] An analysis of the strategic potential of logistics conducted early enough may prevent an unjustified commitment to improve this scope of the enterprise activity, when it turns out that the existing level of reserves of effectiveness and competitiveness growth is scarce. As J. Weber aptly remarks, not every enterprise identifies the possi-bility to improve its strategic position here. In order to determine the legitimacy of the controlling 'entering into' logistics, an examination of logistics attraction for an enterprise is used with the application of a portfolio analysis. It is appropriate to examine the potential effectiveness of the complete logistic system and its fundamental processes. If it appears justified to support logistics by controlling, then its main strategic tasks will be as follows [8]:

- organizing the planning process, including the introduction of logistics into the strategic planning and control, linking and synchronizing the strategic and operational logistic planning and control,
- introducing and developing modern concepts, methods and tools of logistic manage-ment (e.g. just in time),
- coordinating the strategic fragmentary plans and - documenting the planning process.

In the operational logistic controlling the goals established in strategic planning must be specified. The assumption that appropriate products in relevant quantities must be delivered to the right stand in the right time is insufficient. It is required to develop a system of goals for every functional area of an enterprise which is 'supervised' by logistics. A current support of planning and budgeting within logistics as a develop-ment and rationalization of the adopted goals is also desired. It includes the assurance of planning and control of logistic processes as well as their synchronization and opti-mization within the entire enterprise by a systematic support of the decision-making process of managers responsible for logistics by means of preparing and providing appropriate information in time. According to H. CH. Pohl, within the logistic control-ling system one can distinguish the internally oriented tasks [9]:

- planning and control of goals,
- planning and control of systems,
- coordination of logistic subsystems,
- control of planning and realization,
- planning and control of deliveries,
- providing information helpful in decision-making,
- planning and control of logistic costs,
- deviation analysis within logistics,
- analysis of weaknesses,
- optimization of supplies,
- reporting,
- transport planning,
- material flow planning,
- preparation of orders,
- programming and consulting,

and the externally oriented tasks:

- production control,
- planning and control of run times,
- deadline control,
- purchasing planning,
- production planning,
- sales planning.

4 The logistics strategies

Activities within logistics are assigned to the logistic strategy which is one of the functional strategies within an enterprise. Logistics may constitute the element or even basis of a competitive strategy of a company. The relations between logistics and the enterprise strategies play a significant part in strategic management and have a large influence on the development and implementation of new communication strategies. The logistic strategy may either be a manner of competition, a crucial element of com-petition or an operational extension of the adopted mode of obtaining competitive advantage. The logistic strategies may be analysed in the context of a business line model by M.E. Porter. In that case, within the low cost strategy logistics may be used in the following ways [3]:

- The logistic cost reduction is a fundamental way of maintaining the position of the cheapest manufacturer;
- The low cost position is obtained by combining logistic strategy with another func-tional strategy of an enterprise;
- Logistics is the heart of the low cost strategy in the long term.

The observation of logistic strategies used in practice allows the decoding of their general idea. It is about a simultaneous realization - at least fragmentarily by the use of the same means - of the two goals:

- Increasing competitiveness;
- Improving supplis' utilization.

The following logistic strategies are used for this purpose:

- Supply chain management;
- - Cooperation;
- - Shortening the cycles;
- Reduction or elimination of supplies;
- Logistics of diversifying the mode of competition.

Supply chain management assumes that the benefits formerly assigned to vertical integration within logistics

may be obtained by way of coordinating independent operations of companies. The problem of the vertical integration recedes into the back-ground - it becomes a tactical issue. The crucial point - of a strategic dimension - is the creation of cooperation links working to the advantage of both parties. The cycle shortening strategy appears to have resulted from a belief that the race against time is the most important kind of competition. It assumes shortening three cycle types:

- Cycle of accepting and realizing the order;
- Cycle from receiving materials to finished goods delivery;
- Cycle of introducing the finished goods to the market.

The cycle shortening strategy imposes numerous solutions within the scope of re-source utilization. Their layout should make their flow possible without storing. More-over - although it is not obvious - it is connected with the mode of competition. The carrier of the cycle shortening concept results from the growing role of solutions in which the adopted mode of competition requires from a logistic system a constant broad offer of goods of high availability to customers with a simultaneous elimination of all forms of resources.

The idea of differentiating the strategies of competition (acc. products or markets) with the use of logistic strategies is relatively new and bound with recognition of many unused chances in logistic service of the market and the related negligence. It is ex-pressed by organizing the companies' activity by means of the logistic strategy of market competition. It is underlined that a product is not only a thing of specific fea-tures, but also a set of services connected with it.

5 The realisation of logistics strategies

J. Witkowski indicates that one should control the realization of the logistic strategy for the purpose of the enterprise management.[12] The follow-ing table presents the indexes of monitoring the logistic strategy realization.

Table 1. The indexes of monitoring the logistics strategy realization.[12]

Origins of monitoring variables	Quantitative or qualitative indexes and measures	Sources of information
1. GOALS OF LOGISTIC STRATEGY		
Improvement of customer service	average time of delivery standard deviation from average time of delivery number or value of deliveries realized in a given period of time number or value of deliveries realized in a given period of time to the number or value of all orders in general number or value of returned goods to the number or value of all orders in general	register of orders and deliveries
Cost reduction	average worth of total logistic costs worth of total logistic costs within the worth of turnover or costs in general worth of total logistic costs within the worth of supplies and distribution worth of logistic costs according to cost centres worth of costs of transport, storage, supplies' maintenance and other logistic costs in the worth of logistic costs in general	register of costs
Optimization of the level of supplies	average worth of supplies in general average worth of volume of raw materials and materials, non-finished and finished goods, spare parts in the worth of supplies in general average worth of current seasonal, reserve and incorrect supplies in general index of supplies' rotation	warehouse statistics, cost registering

	index of speed of supplies' rotation	
Minimization of product flow times	average time of transferring, storing and process-ing the groups of supplies during the time of their flow through the enterprise logistic system	as above: process exami-nation
II. SITUATIONAL ARRANGEMENTS		
1. Internal:		
Human resources	number of employees on managerial and executive positions outlays on raising qualifications of employ-ees indexes of work output	HR statistics and cost register
Organization	level of adjusting organizational structure and the organization of flow of products and information to the requirements of the ap-plied logistics strategy	evaluation by experts
Technology	outlays on the development of the material database of logistic system technological and exploitation indexes of transport, warehouse infrastructure and its equipment	cost register
Product	worth, quantity, tonnage or volume of the materials delivered to particular production places and warehouses in a specific period of time worth of logistic costs in unit sales product price	register of deliveries and sales cost register
2. External:		
Suppliers	average waiting time for deliveries worth of a minimum batch index of complaints	Register of deliv-eries
Customers	worth of purchases of particular customers in particular periods of time profitability of particular groups of customers expectations within logistic service standards the offered quality standards of logistic service	Register of sales and benchmarking costs
Competitors	level of logistic costs level of modernity and effectiveness of the organizational and technological logistic solutions	Interview, surveys etc.
Logistic service providers	unit prices for particular logistic services level of transportation and storage capacities the offered quality standards of logistic ser-vice (examples of indexes as above)	cost register, register of deliv-eries, export evalua-tions, customers' opinion

The above mentioned idea of monitoring the realization of logistic strategy based on the observation of the control variables, determination of concordance of the actual level of the assigned indexes included in the strategic plan, and finally specification of methods of processing and channels of information flow, complies with the concepts of the object (functional) early warning systems. It should be noticed that the objective control of the logistic strategy should also use indexes concerning the organization, technology, product, suppliers,

competition and logistic service providers. Logistics has always played and it still does play a significant part in competitive strategies based on leadership within costs, differentiation (also within logistic service), shortening time cycles and the use of the company's capacities. The management-oriented integration of all logistic functions and processes becomes more important, because it is conditioning not only effective organization and enterprise modernization, but it is also opening new possibilities of solving problems and using potential effects in the operating and strategic activity. The introduction of controlling within the scope of logistics cannot be a simple coinci-dence, because it would have resulted in the waste of resources and unjustified cost increase. A complex procedure, supervised by the enterprise strategic goals, specifying goals, tasks and controlling tools sequentially in the intentionally selected areas and functions of logistics, is necessary. Only in such circumstances, the goals set towards logistics can be reached effectively.

Conclusions

In order to achieve significant reserves, the enterprise management should make com-parisons of actual costs with the assumed costs or with the budget realization. There is a possibility to achieve better results in the decision-making process. The management board must make a choice between such alternatives as: renting additional transporta-tion or increasing the company transport base, increasing deliveries or goods, develop-ing or consolidating warehouses, automating the system of order and information processing. Broadening or narrowing the range of territory, sellers, products or recipi-ents requires the knowledge of the current productivity of the existing segments and a potential change of profits and advantages of the above mentioned alternatives. For this purpose, one needs a database able to aggregate data so as to obtain information on such segments as: recipients, sellers, products, territory and channels of distribu-tion. The system should store the data according to the fixed and flexible components in order to extend the rising profits and losses that refer to the alternative strategies.

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