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System Approach for Logistics Distribution Network's Organization and Planning

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Abstract

Operation and servicing of logistics systems based on many factors. The factors relative to a system can be external and internal and have different effects on various performance indicators. Differing vectors of these systems leads to the complexity of the performance evaluate of them. *The* article describes a multidisciplinary approach to the studying of logistics distribution networks organization and planning that is based on whole society benefits. Suggested approach includes logistics, cities transportation planning, marketing, product, state and human parameters. Simulation parameters of different systems and their relationship are represented on an example of calculating the number of vehicles for the transportation service. Solving the logistics distribution networks organization and planning problems should take into account numerous different connective systems and evaluate by one criterion – society benefits.

Keywords

Logistics, Organization, Planning, System, Approach, Benefits, Human, Factor

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1. Introduction

Logistics solves a complex of interrelated management tasks of material and concomitant flows. References' review show problems that can be solved by logistics science: retailer selection (Anikin, 2014), choice of transport mode (Ballou and Srivastava, 2007), carrier selection (Ballou and Srivastava, 2007), choosing a supplier (Mirotin and Tashbayev, 2002), the service level choice (Mirotin and Tashbayev, 2002), the material flows distribution (Krykavsky, 1999), the optimal order quantity (Wilson, 1943), the own or hired transport and storage choice (Rushton et al., 2000), inventory placement in stock (Buliński et al., 2013), the choice of stores number (Belovodskya, 2011), enterprise resource planning (Monk and Wagner, 2006), (Alesynskaya et al., 2006). The researchers' explore processes of material flow's promotion inside the supply chain and logistics system. But at the same time, it is important to take into account functioning of other systems. Works (Krauth, 2005; Krauth, 2005a) describes approaches for planning and organization process in logistics and analysis more the 130 different effectiveness indicators from different points of view: Management, Employee, Customer and Society. Multidirectional of effectiveness indicators still leave space for further research in this area. Also, the mechanisms of interaction and influence of these parameters on each other and on the functioning of the system to which they belong to is not enough investigate. Combine approaches to assess the functionality of logistic systems determine their further development. Interdisciplinary and interconnection systems between logistics, cities transport planning, marketing, product, state and human, are also important because they are all interrelated. Article aim is underline the several systems interaction at the logistics distribution networks and propose an approach to solving this problem.

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2. Findings from the Content Analysis

It's also important that Conjunction with logistics approach includes and examines different approaches that characterize other systems work, such as: cities transportation planning, marketing, product, state and human. Marketing approaches are studying the demand and market opportunities. The tasks of marketing include:

1. Analysis and evaluation of actual and potential consumer's needs for company's products (Grigoriev, 2012).

2. Marketing support development of new products and services firms (Sandage and Fryberger, 1975);

3. The conditions analysis, evaluation and forecasting markets development on which operates or will operate the firm, including the research of competitors activities (Malhotra, 2002);

4. The company assortment policy formation (Berezin, 2008);

5. The firm pricing policy development (Adcock, Halborg and Ross, 2001);

6. Participation in the strategy and market behavior tactics of company, including the development of pricing policy (Kotler and Keller, 2012);

7. Products and services company sales (Huff, 1964; 2003; Kotler and Keller, 2012);

8. The Marketing communications (Kotler and Keller, 2009);

9. The sales service (Grigoriev, 2012)

Tasks analyses demonstrate marketing specifies of the logistics services direction. Logistics makes marketing competitive. In this case it is necessary to consider product (material flow) impact. Thus inherent parameters of material flow impact on technology of its logistics services. The material flow parameters refer to (Dibskaya et al. 2008, Laktyonova, 2002): nomenclature and products number, overall characteristics (volume, area, linear dimensions), weight characteristics (total weight, gross weight, net weight), physic-chemical goods characteristics, the packaging (packing) characteristics, the sale contract conditions, transportation and assurance terms, financial (cost) characteristics, subject to the other physical distribution operations involving the goods movement.

The state, as the business partner, offers the conditions for conducting commercial activity. On one side it adopts laws, sets the level of taxes, privileges, the natural resources and licenses cost. From the other side establishes living wage, monitors the average income, inflation and other macroeconomic indicators. It effects on customers purchasing influence and the business "rules". It is important to emphasize that the state policy changes under the human and business influence. New ways of activities are forced to adopt new laws and cancel the old ones. Human and society participates in elections that impact on their living standard later.

Growing competition in markets, indicate that businesses should be given great attention to research of their clients and creating the most favorable conditions for making purchases (Food Marketing Institute, 2012). Studying consumption expenditure at the present stage and developing recommendations for the activity improving of logistics and marketing systems are very important today (Chekitan and Schultz, 2005). Moreover, this issue is not enough understood in modern science due to permanent and temporary needs (Study Shows Shopper Behavior, 2012).

Consideration human parameters (gender, age, height, weight, education, salaries) are an important element of the material flow planning and promotion. The human, in the process of buying, has various spends: money, psychological activity, physical energy, thieving of time (Gyulyev and Dolya, 2012; Dolya et al., 2011). The process of buying has several stages: The first one is decision about products need to buy. Than choose the store to buy this products. Stores can be on different distances (Huff, 2003), has different sizes (Huff, 2003), prize and serves levels (Kotler and Keller, 2009), that lead to choice of the store or product influence, time and number of purchases, purchase frequency, etc (Food Marketing Institute research, 2012). During road trip and moving inside the store human is fatigued and burns calories which have value estimation too (Gyulyev and Dolya, 2012; Dolya et al., 2011).

Different territories may have different combinations of factors presented above by description systems (Dolya et al., 2008; Dolya, Lobashov and Kancedal, 2011). Thus, the population number that living in a certain area, determines the potential market share. Area localities effect on the vehicle range in compiling routes. Its own level of income and expenditure in each locality and prices on goods are also different (Lee and Nakanishi, 1988). At the same time, in some localities goods may be "fit" to their citizens, in others – they don't. Consideration of the cities parameters (the transport network density, the automobilization level and population density, area size, urbanization level, climates characteristics) allow to generate the logistics services technology of the country, region or city.

Each system is independent and can operate and adapt to the work of others. Thus, these systems have the following properties (Dmytrychenko, 2006): integrity, complexity and connectivity, degree of structure, orderliness and emergence. Thus, the urban system can exist independently of the marketing and logistics systems. But, at this stage of the society integration it is difficult to imagine it.

The estimation of functioning foregoing systems there is its own measures. The effectiveness of urban transport systems can be estimated by average time posts on the transport network, the transportation volumes of cargo and passengers, road capacity, and average travel distance on the transport network (Dolya, 2011; Grigorov et al., 2006). Efficiency for the state determined by the amount collected taxes of the number registered organizations, the subsistence level and the permissible emission standards for environmental pollution. Marketing: changing of indicators sales, market reach indicators, quality indicators and advertising investment, the cost to attract customers. Logistics: the system profit, the total costs, delivery times, inventory levels in the system, the investment efficiency and project decisions. The product (material flow) can be estimate by sales number, expiration date, the product value. Human can be estimated by cost of spend time and physical energy (calories for example). Human functional state can be described using the PARS, EEG, ECG and other medical indicators (Dolya, et al., 2011; Davidich et al., 2011, Afanasieva et al., 2010). Obtained data combined into Fig. 1.

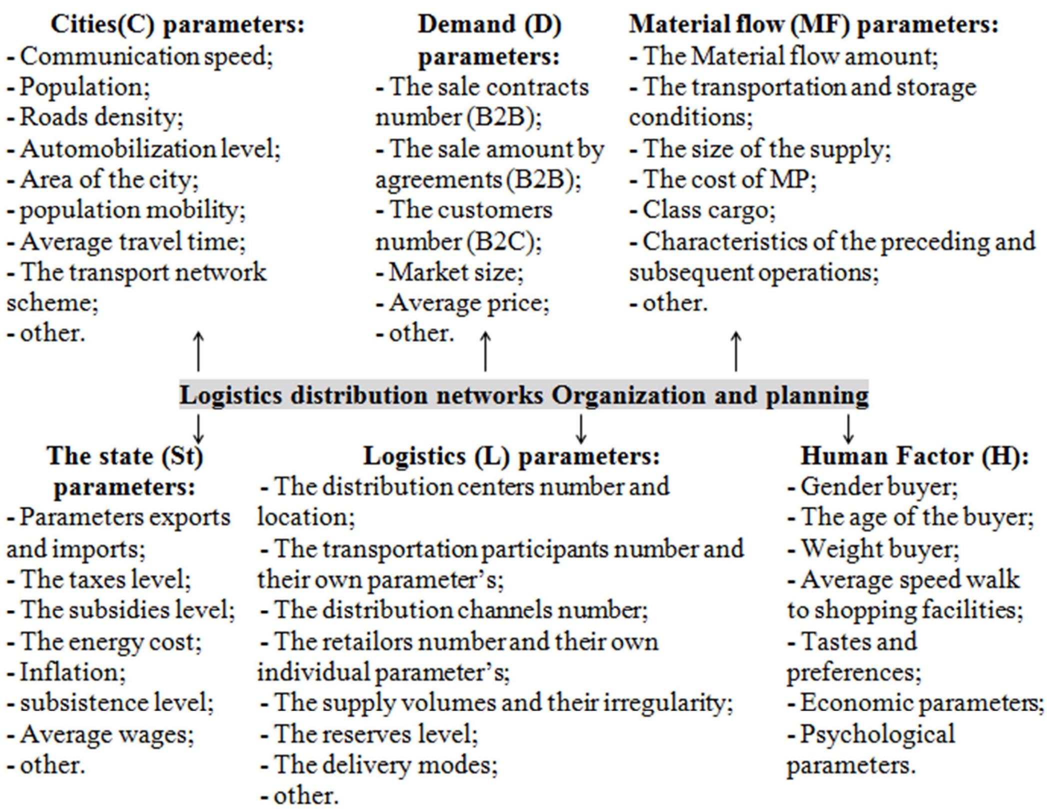

Figure 1. Logistics distribution networks organization and planning parameters including.

As we can see from the measures of effectiveness, there are many versatile indicators. Each of them characterizes its own system, but does not assess the others.

3. Simulation Models

Consider models of different parameters influence on other systems on cities example:

Average time vehicle turnover ($\overline{T}_c^h$) is determined by:

$$\overline{T}_c^h = \frac{\overline{l}_м}{V_m^h} + t_{ni} + t_{pi}, \quad (1)$$

where $\overline{l}_м$ – average route length, km;

V_m^h – communication vehicle speed. km / h;

t_{ni} – idle under load, h; (depends of material flow)

t_{pi} – the idle time during unloading to service retail network, h.

The average route length can be found like:

$$\overline{l}_м = 0,76\sqrt{\lambda_o^{-1}}, \quad (2)$$

where λ_o – dislocation density of consumers, defined as:

$$\lambda_{\partial} = \frac{N^{p}_{м}}{S_{м}}, \tag{3}$$

where $S_{м}$ – district service area (city area), km^2;

$N^{p}_{м}$ - The retailer's number, units (logistics systems parameter);

The communication vehicle speed for the largest cities, can be defined as (Lobashov and Kancedal, 2011):

$$V^{mc}_{m} = 17{,}4 \cdot \text{Gn-}1{,}62 \cdot \text{Gn}^2\text{-}10{,}56, \tag{4}$$

where Gn – The road network density, km^2/ km^2.

or (Lobashov and Kancedal, 2011):

$$V^{mc}_{m} = \text{-}1{,}29 \cdot 10^{-3} \cdot \text{PA}^2 + 0{,}326 \cdot \text{PA-}1{,}68, \tag{5}$$

where PA – Automobilization level, auto/1000 citizens.

$$A = \frac{Q_{MF} \cdot T_{\lim}}{\overline{T}^{h}_{c} \cdot n_{o} \cdot q_{н} \cdot \gamma} \tag{6}$$

where, Q_{MF} - material flow volumes in the retail network per time period (depends of market share and retailers sales), ton;

$T_{\lim}$ - Time period limitations for logistic services, days;

n_o - The vehicle circles number, units;

$q_н$ - The vehicle capacity, ton;

γ - Vehicle capacity utilization coefficient (depends of material flow class)

As we can see there is correlation between the parameters of different systems. Any changes in systems parameters will impact on the functioning state of other ones.

To investigate the factor's influence on vehicles' quantity and logistics distribution network's organization and planning were selected factors and that range of variation (see tab. 1) and characteristic diagram was built characteristic, Fig. 2.

Table 1. The range of variation of the research data (State Statistic Service of Ukraine).

Parameters	Characteristic	Average meaning	Number of intervals	Units of measurement	Measure range	
					Min	Max
P	Average good Price	15	5	EURO per kg	5	25
S_{pr}	Salary per day	200	5	EURO per month	120	280
Ts	Tastes and preferences	0,06	5	%	0,02	0,1
Tx	Taxes level	30	5	%	20	40
Asz	Area size	800	5	km^2	300	1500
Al	Automobili-zation level	170	5	Vehicles per 1000 Citizens	130	210
RN	Retailer's Number	15	5	Units	5	25
γ	Capacity utilization coefficient	0,8	5	-	0,6	1,0
q_n	Vehicle's capacity	15	5	Tons	5	25
N_{cit}	Number of citizens	2000000	5	Citizens	1000000	3000000

Fig. 2 analysis show that increase of all parameters (tastes, Automobilization level, retailer's number, capacity utilization coefficient, area size, number of citizens, salary per day) except average good price (P) vehicle's capacity and Tastes and preferences, lead to growth of the number of vehicle for distribution planning. The greatest influence on value change depending pendent variable has tastes and salary per month. Tastes was identify like percentage, from non-taxes salary, that use to buy defined good.

For compatible evaluation of all systems we may use the indicator that would take into account the components of each of them. We can propose the approach, which is based on the general society benefits. In general way it can be represented as:

$$B_S = f(B_C; B_D; B_{MF}; B_{St}; B_L; B_H), \tag{7}$$

where B_C – benefits for localities, cities;

B_D – Benefits for marketing;

B_{MF} – Benefits for product manufacturers;

B_{St} – Benefits for The state;

B_L – Benefits for Logistics systems;

B_H – Benefits for Humanity.

In simplest form it can be found as:

$$B_S = B_C + B_D + B_{MF} + B_{St} + B_L + B_H. \tag{8}$$

This indicator will help to evaluate the logistics distribution networks organization and planning effectiveness while several interrelates systems parameters changes. Planning and organization decision making in logistics distribution networks should base on the society overall benefits indicator. The indicator is aimed to get the benefits of society as a whole, instead of some separate systems.

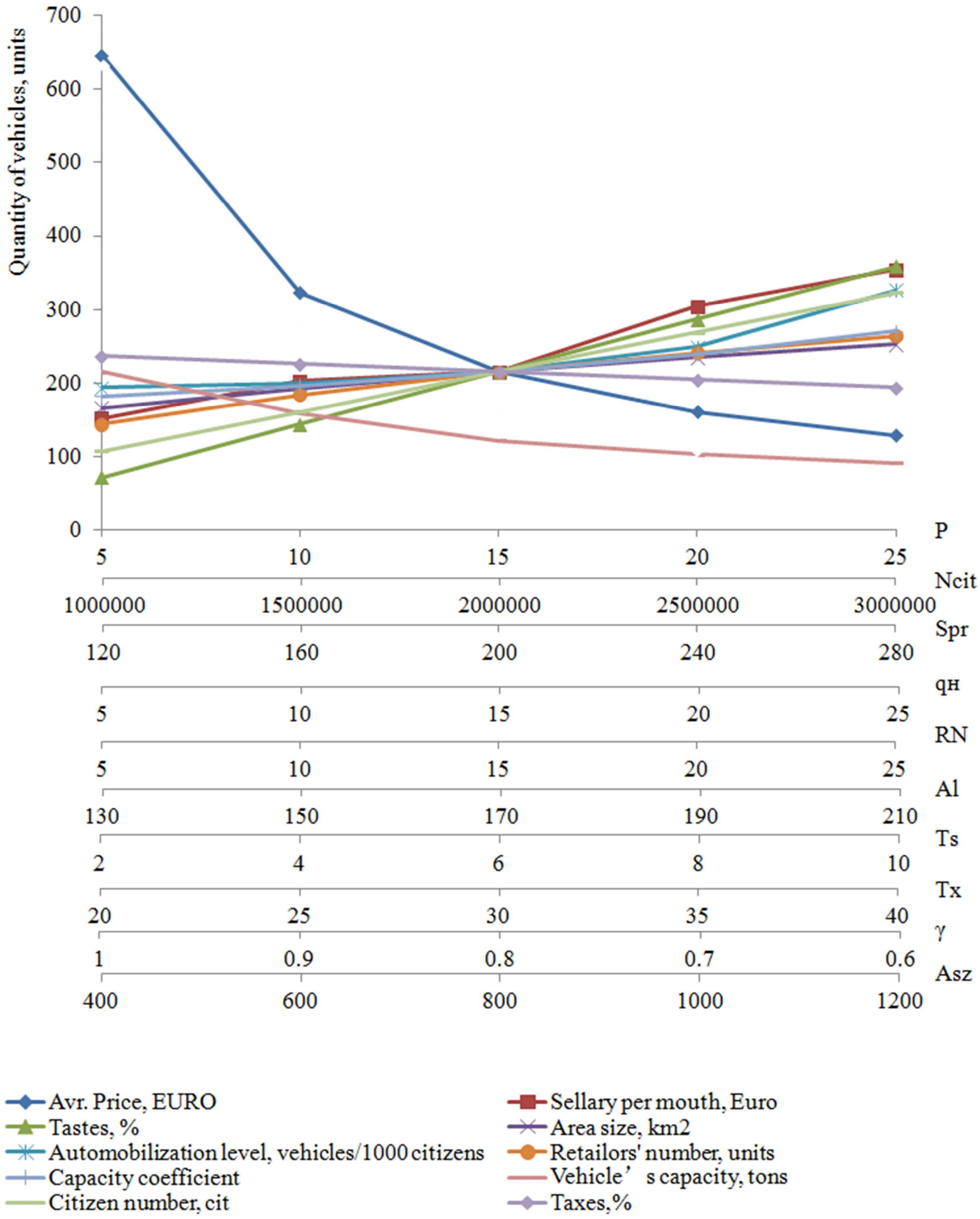

Figure 2. The characteristic graph of parameters influence on the vehicles number for various distribution systems.

4. Conclusions

The studying of logistics distribution networks organization and planning as an integrated approach identifies new and sophisticated branches of its development. Orientation on the effectiveness of multiple systems functioning leads to rethinking of benefits. Logistics distribution networks organization and planning should be focused on human factor, which is very important in this approach. The limitations of other systems in their compatible operations have to be included. Only system and integrated approaches to solving this problem, can improve the quality of life and benefits of society. Logistics as a tool for optimization is designed to improve these systems functioning. In future, it is necessary to explore and reveal regularities of systems cooperation above described. Implementation and approbation on real objects is also one of the important future tasks.

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