Transport and logistics innovations in supply chain management: Evidence from Kazakhstan

Lazzat Gabdullina[a*], Kasiya Kirdasinova[a], Assemgul Amanbayeva[b], Aigul Zeinullina[c], Elvira Tlessova[a] and Saule A. Azylkanova[a]

[a]*Eurasian National University named after L.N. Gumilyov, Nur-Sultan, Kazakhstan*
[b]*Kazakh Humanitarian-Law Innovation University, Semey, Kazakhstan*
[c]*Semey State University named after Shakarim, Semey Kazakhstan*

C H R O N I C L E	A B S T R A C T
	Logistics system is one of the basic concepts of effective supply chain management. In the Republic of Kazakhstan, all types of public transport constitute a single transport system (ETS), which includes railway, river, sea, road, air and pipeline transport. An important element of the ETS of the country is the transport network, which determines the possible directions of transportation and the points between which a particular type of communication is established. It consists of communications of different types of public and non-public transport. The formation of effective supply chain management and transport network is due to a number of socio-economic factors: the development and location of the economy; urban settlements; the direction and power of the main transport and economic relations; location of large resort and tourist sites, the need to optimize costs. Additionally, this research analyzes the trends in innovation for logistic services of supply chain management in the targeted region through multiple aspects, intellectual capital, and organizational resources. Research findings show that both multiple aspects and intellectual capital are positively and significantly associated with innovation in logistic services for the supply chain management. However, the study finds no evidence for the relationship between organizational resources and innovation for logistic services in supply chain management. As a result of the research, practical aspects and significance of the management of the transport and logistics system of the republic are determined, on the basis of which the relevant conclusions were made.

1. Introduction

The globalization of industry and trade has brought both many advantages and challenges. Companies that previously existed in one place now reach their customers even in another part of the world (Levitt, 1993). Thus, there is a need to search for sources of raw materials, to create optimal production and transport mechanisms (Peter, 2011). The role of transport in ensuring economic growth both an individual company and the entire state is undeniable. For instance, Kazakhstan borders of Europe and Asia has a high transit potential. Considering the growth in freight traffic between a major producer

* Corresponding author
E-mail address: lazzat.gabdullina@bk.ru (L. Gabdullina)

China and a significant consumer in Europe during the period of overcoming the effects of the global crisis, the main objective of the transport policy of Kazakhstan is for the creation of a Eurasian transcontinental bridge.

Increasing production of goods requires effective supply chain management, which will be based on optimizing raw materials, market shares and transport work (Awudu & Zhang, 2012; Chandra & Kumar, 2000; Rasool, Iftikhar, Nazir, & Kamran, 2016). Supply chain management includes the functions of logistics, operations and materials management, marketing, procurement and information technology (Foo, Lee, Tan, & Ooi, 2018). In turn, an efficiently built supply chain strategy leads to improved productivity, quality indicators and competitiveness. Therefore, transport and supply chain management act as a sensitive barometer of the national world economy (Tate, Ellram, & Kirchoff, 2010). At the same time, being a major consumer of energy vehicles, construction and other materials, they largely determine the utilization of production capacity, significantly influencing the formation of gross domestic product (GDP). For instance, the share of transport in GDP of most developed countries ranges from 4-9%, and in employment of the population is 3-8% (Bojković, Anić, & Pejčić-Tarle, 2010).

Transport is also of great importance in solving social and economic problems. Provision of the territory with a well-developed transport system creates an integration effect, being one of the factors attracting the population and production. Although transport does not produce material goods, but only participates in its delivery to the points of consumption, transport costs are considered in the price of goods (Dablanc, 2007). In some industries, transportation costs are significant, for example, in forestry, petroleum industries, where they can exceed 50%. Based on this, there is a need for cost-effective supply chain management in the transport sector. Modern innovative technologies in the fields of transport and logistics will only contribute to reducing costs and increasing earnings. The transport factor is of particular importance in the Republic of Kazakhstan with its vast territory and uneven distribution of resources, population and fixed production assets. Thus, transport is an important component in the economy of any state and this emphasizes the relevance of this work. In the modern scientific literature of foreign authors, great attention is paid to the issues of managing the national economy from different positions of socio-economic development, including the supply chain management. For example, in a study, Dirko and Poleschuk (2018) analyzed the competitive advantages of logistics clusters in the Baltic region and discussed possible directions for the development of logistics industry of the region under the current conditions.

Bardal (2018) analyzed the role of transport in the economy of the Far East and studied the factors affecting the importance of transport in the regional economy at the present stage. Buurman (2002) focused on the principles of optimizing the technical and technological parameters of the points of the joint between transport and production, oriented to the system-wide interests, with intensive technologies for the delivery of prepared materials. Various authors have discussed the issues of supply chain management. Now most companies pay attention to their sustainability and stability that can be achieved by building sustainable supply chain management (Kusi-Sarpong, Gupta, & Sarkis, 2019). The sustainability of a company or production is determined by the environmental, economic and social aspects. To control these indicators, large companies use the concept of integrity in the construction and management of supply chains (Castillo, Mollenkopf, Bell, & Bozdogan, 2018). Currently, big data analytics is more and more used in supply chain management. This gives companies access not only to the data that is continuously generated by traditional devices, but also to a huge amount of data generated from unstructured data sources such as digital clickstreams, surveillance camera frames, social media images, media publications, blog posts, discussions on the forum. Thereby, it is possible to build a more efficient supply chain management. Pluzhnikov, Kukharenko, and Shikina (2017) investigated the formation of transport logistics at various stages of the economic development of the industry.

The development of the economy of Kazakhstan at the present stage can be traced in the publications of Kazakhstani economists (e.g. Buurman, 2002; Copacino, 2019). They investigated the theoretical and methodological, methodical and practical issues of organization and development of the unified integrated transport and logistics system in Kazakhstan, studied the issues of the development of effective supply chain management and transport logistics in the Republic of Kazakhstan and the creation of a joint transport and logistics company.

2. Methods and Materials

This paper considers the relationship between multiple aspects (setting the stage activities; customer clue, gathering activities; negotiating, clarifying, and reflecting, activities; and inter-organizational learning), intellectual capital (Relational capital, structural capital, information capital), organizational resources (knowledge resources, technological resources, financial resources, and human resources) and innovation for logistic services in supply chain management under section I. A questionnaire survey was conducted based on the selected items and logistic executives were observed as targeted respondents. An overall sample of 280 respondents was collected during the time span of 13 weeks starting from 21st of August to 2nd of December 2019 from different areas of Kazakhstan. Results are observed through descriptive scores, correlation matrix, variance inflation factor, confirmatory factor analysis, and structural equation modelling. In section II, the study utilises the following methods and materials for the better understanding of the readers. This includes analysis of government documents (Master Plan for the development of the transport and logistics system (CLW)) and indicators of World Bank's LPI Logistics Systems Performance Index with the help of descriptive method and method of statistical analysis of indicators of logistics companies in Kazakhstan.

3. Results and Discussion

Descriptive results are provided in Table 1 with the N-statistics, mean statistics, skewness statistics, and Kurtosis statistics. Overall 280 respondents are found to be valid whereas mean score of every item in the model presents how the set of the responses are found over a central point. The lowest mean score is 2.93 as represented by HR, and followed by SC; 2.94. Contrary to this, the remaining items provide the mean score of above 3 which indicate sensible responses from the respondents. For presenting the trends in the normal distribution of the dataset, the last two columns under similar table show the layout for skewness and kurtosis which provide both positive and negative distribution.

Table 1
Descriptive Results

Variables/Items	N Statistic	Mean Statistic	Skewness Statistic	Kurtosis Statistic
F1 or Multiple aspects				
SSA: setting stage activities	280	3.9357	.035	-1.201
CC: customer clue	280	3.9964	.081	-1.326
GA: gathering of ideas	280	3.9929	-.003	-1.303
NEG: negotiating	280	3.0179	-.016	-1.298
CAR: clarifying and reflecting activities	280	3.0750	-.059	-1.342
IOL: inter-org. learning	280	3.1179	-.075	-1.259
F2 or Intellectual Capital				
SC: structural capital	280	2.9464	.080	-1.266
RC: relational capital	280	3.0500	-.082	-1.210
INFC: informational capital	280	3.0714	-.030	-1.332
F3 or Organizational Resources				
KR: knowledge resources	280	3.9893	-.013	-1.270
FR: financial resources	280	3.0750	-.082	-1.355
TR: technological resources	280	3.0250	-.067	-1.323
HR: human resources	280	2.9321	.059	-1.259

Fig. 1 indicates the sructural input model for the confirmatory factor analysis or CFA where three exogeneous varaibles under the title of F1, F2 and F3 are provided. For F1, six factors, for F2 three factors, and for F3 four factors are added to reflect their relative latent constructs. Additionally, error terms ranging from e1 to e13 are covering the observed factors of the latent varaibles which are covariated with double headed arrow and separate regression weight equal to 1 is also presented for each of the error term, accordingly. The results for CFA are provided in Table 2 where all items are significnatly crossing the minimum acceptence threshold level of .50 and above.
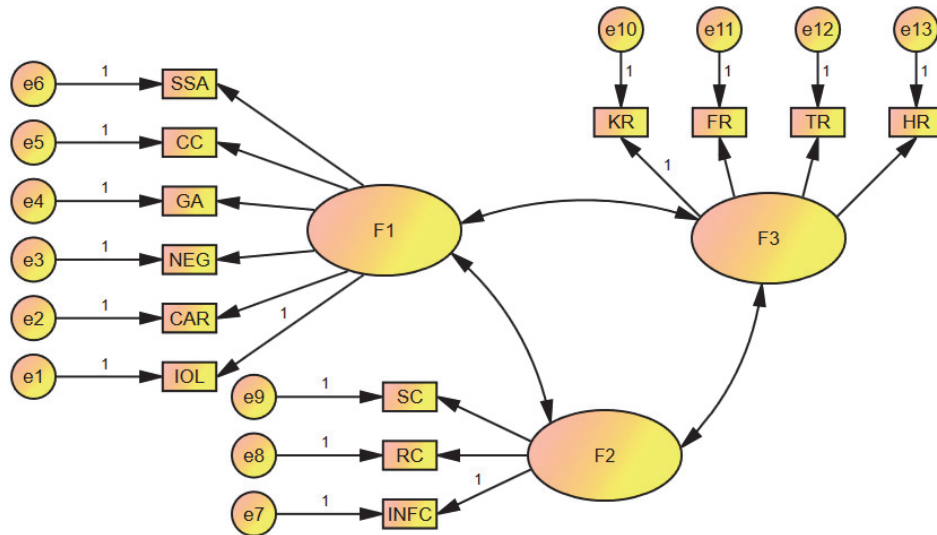
Fig. 1. Structural Input Model of the Study

Table 2
Factor Loadings of the Model

Item Names	Factor Loadings	Minimum Acceptance Threshold level
		F1 or Multiple aspects
SSA	0.82	≥.50
CC	0.75	≥.50
GA	0.88	≥.50
NEG	0.88	≥.50
CAR	0.65	≥.50
IOL	0.89	≥.50
		F2 or Intellectual Capital
SC	0.82	≥.50
RC	0.76	≥.50
INFC	0.79	≥.50
		F3 or Organizational Resources
KR	0.87	≥.50
FR	0.91	≥.50
TR	0.77	≥.50
HR	0.75	≥.50

Minimum factor loading is 0.65 as presented by CAR, followed by HR and CC while highest is 0.91 are shown by financial resources under F3 title. These values demonstrate the individual significance of every item which are added in the latent construct to represent the latent variables entitled as F1, F2, and F3. However, only the factor loadings of these items is not enough to accept their significance but the literature support is also needed for the model fit-indices which are CMIN/DF as used by (Kohls, Sauer, & Walach, 2009; Koufaris & Hampton-Sosa, 2002; Loo, 2000), GFI as supported by (Hooper, Coughlan, & Mullen, 2008; MacCallum & Hong, 1997; Shevlin & Miles, 1998), AGFI by (Ainur, Sayang, Jannoo, & Yap, 2017; Effendi & Matore, 2019; Wu, 2016), CFI by (Lai & Green, 2016; Marcoulides & Yuan, 2017; Taasoobshirazi & Wang, 2016), and finally RMSEA (Lai & Green, 2016; Maydeu-Olivares, Shi, & Rosseel, 2018). Our results as presented under Table 3 are supporting with

the above stated literature where CMIN/DF is 15.228, GFI; 90.62, AGFI;89.32, CFI;87.93, RMSEA;0.049. Therefore, it is inferred that the CFA model is fit and there is a wide acceptance for all the factor loadings of each item under Fig. 2 and Table 2, accordingly.

Table 3
Model Fit Findings for CFA

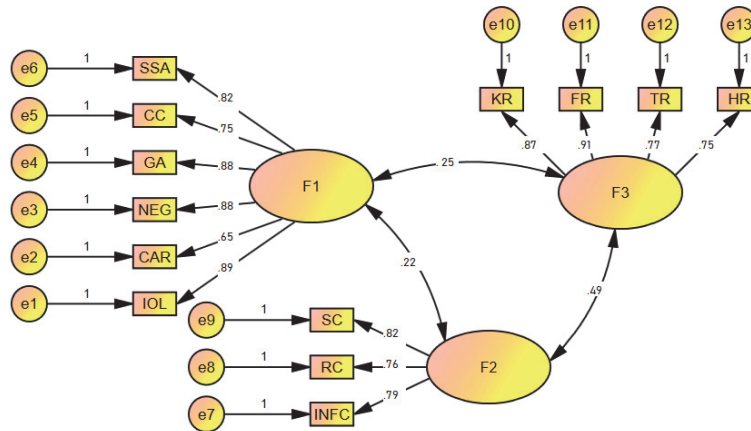| Title of Model Fit	Score achieved	Criteria For Acceptance
CMIN/DF	15.02	>5
GFI	90.62	Near or above .90
AGFI	89.32	Near or above .90
CFI	87.93	Near or above .90
RMSEA	0.049	< 0.060

Fig. 2. Output for CFA, F1 means Multiple aspects, F3 means Intellectual Capital, F3 means Organizational Resource

Table 4 shows the correlation matrix between the various items of F1, F2 and F3 with their relative significance level. As per the findings, significant correlations are highlighted with *, where VIF and Mean VIF with the tolerance level are provided under Table 5.

Table 4
Correlation Matrix between the Items

Variables	SSA	CC	GA	NEG	CAR	IOL	SC	RC	INFC	KR	FR	TR	HR
(1) SSA	1.000												
(2) CC	0.067	1.000											
	0.267												
(3) GA	-0.060	0.041	1.000										
	0.314	0.496											
(4) NEG	0.059	0.055	0.034	1.000									
	0.324	0.356	0.567										
(5) CAR	-0.050	-0.099	0.030	-0.020	1.000								
	0.409	0.097	0.613	0.736									
(6) IOL	0.050	-0.029	-0.014	-0.036	-0.082	1.000							
	0.402	0.633	0.813	0.549	0.173								
(7) SC	-0.083	-0.050	0.061	0.029	-0.079	-0.010	1.000						
	0.164	0.408	0.312	0.626	0.188	0.874							
(8) RC	0.049	0.046	0.087	0.039	-0.031	-0.005	-0.026	1.000					
	0.416	0.443	0.144	0.519	0.604	0.934	0.661						
(9) INFC	-0.010	-0.033	0.077	0.069	0.043	0.100	0.094	0.000	1.000				
	0.864	0.580	0.201	0.250	0.476	0.094	0.118	1.000					
(10) KR	-0.077	-0.024	-0.006	-0.094	-0.059	0.021	-0.031	0.046	0.084	1.000			
	0.201	0.694	0.926	0.116	0.324	0.724	0.601	0.445	0.162				
(11) FR	-0.024	0.041	0.033	-0.058	0.013	0.017	0.038	0.011	-0.009	-0.040	1.000		
	0.689	0.491	0.580	0.332	0.833	0.780	0.525	0.859	0.875	0.501			
(12) TR	-0.037	0.028	-0.032	0.143*	-0.038	-0.007	0.020	0.029	-0.041	0.009	0.020	1.000	
	0.536	0.638	0.594	0.017	0.530	0.908	0.737	0.631	0.491	0.878	0.743		
(13) HR	-0.050	0.041	0.018	0.019	0.015	0.045	-0.011	0.174*	0.049	0.051	0.043	-0.024	1.000
	0.404	0.494	0.766	0.754	0.803	0.457	0.857	0.003	0.415	0.391	0.477	0.686	

* shows significance at the .05 level

Table 5

Variance inflation factor

Items for F1, F2 and F3	VIF	1/VIF
NEG	1.051	.952
INFC	1.048	.954
RC	1.046	.956
HR	1.043	.959
CAR	1.038	.964
KR	1.031	.969
TR	1.03	.971
SC	1.029	.972
CC	1.027	.974
IOL	1.024	.976
GA	1.024	.977
FR	1.014	.986
Mean VIF	1.034	.

As per the findings for VIF, all items show their VIF less than 5 and the same is found when the mean VIF is calculated. Similarly, tolerance values are above .10 meaning that there is an issue of high interdependency between selected items of F1, F2, and F3. Fig. 3 has shown the structural model for exploring the relationship between innovation in logistic services for supply chain management and its determinants like F1, F2 and F3 with their relative items as explored earlier. F4 is entitled for the innovation in logistic services for supply chain management which is represented through three sub items like Log1, Log2 and Log3. The results for this structural model are provided in Table 6, where we have tested following hypotheses:

H₁: Multiple Aspects are positively and significantly associated with innovation in logistic services for supply chain management.

H₂: Intellectual Capital are positively and significantly associated with innovation in logistic services for supply chain management.

H₃: organizational resources are positively and significantly associated with innovation in logistic services for supply chain management.
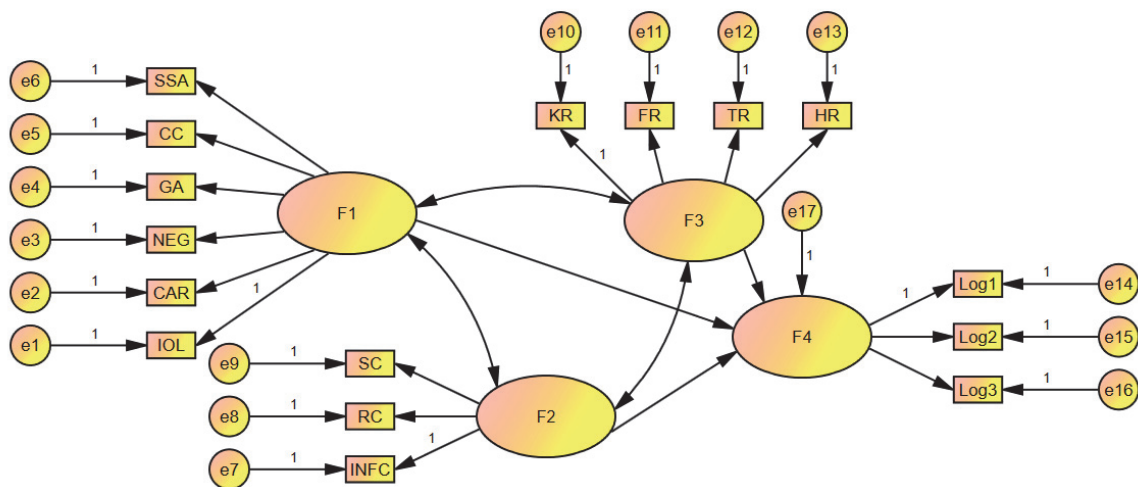

Fig. 3. Structural Model for Relationship Between Multiple Aspects (F1), Intellectual Capital (F2), and Organizational Resources (F3) and Innovative in Logistic Services for Supply Chain Management (F4)

The regression coefficient for F1 to F4 is 0.254 explain a positive and direct impact, which means that multiple aspects create a good influence on innovation in logistic services in supply chain management. It means that selected multiple aspects are good to understand the trends in innovation for the logistic services in supply chain. This effect is significant at T-score is 6.325 and p-value also provides the evidence to accept H1 that Multiple Aspects are positively and significantly associated with innovation in logistic services for supply chain management. Similarly, the effect of intellectual capital through its selected components on F4 is 0.627 with the T-score of 8.982. It means that with the increase in the organizational factors like relational capital, information capital, structure capital, higher innovation in logistic services for the supply chain management is found. This effect is further supported with the p-value which is significant at 1 percent chance of error, meaning that we are 99 percent confident to accept H2; Intellectual Capital are positively and significantly associated with innovation in logistic services for supply chain management. Higher such capital in the business is leading towards more innovation and vice versa. However, for the organizational resources like knowledge, financial, technological, and human are found to be irrelevant in determining the innovation in logistic for the supply chain management, hence failed to accept H3 as stated above. The overall explained variation through F1 and F2 in F4 is .105 which specifies low variation, specifying the addition of more exogenous variables in future studies.

Table 6
Output for Structural Model of the Study

Dependent Variable	Direction	Independent Variables	Coefficient	T-score	P-value
F4	←	F1 or Multiple aspects	0.254	6.325	0.000
F4	←	F2 or Intellectual Capital	0.627	8.982	0.000
F4	←	F3 or Organizational Resources	0.187	0.625	0.521

R=0.268
R^2=0.105
Chi-square = 125.12
Sig=0.000
Note: F4 Indicates Logistic innovation, standard error omitted deliberately.

The main place in transport logistics is occupied by the tasks of drawing up routes that allow us to reduce the vehicle mileage to a minimum or which minimize the cost of transporting goods. In practice, the concept of supply chain management is more extensive and includes logistics as an aggregate of technical means and management methods that ensure the delivery of the required goods to the destination at a given time in the right quantity and with minimal costs (Fig. 4).
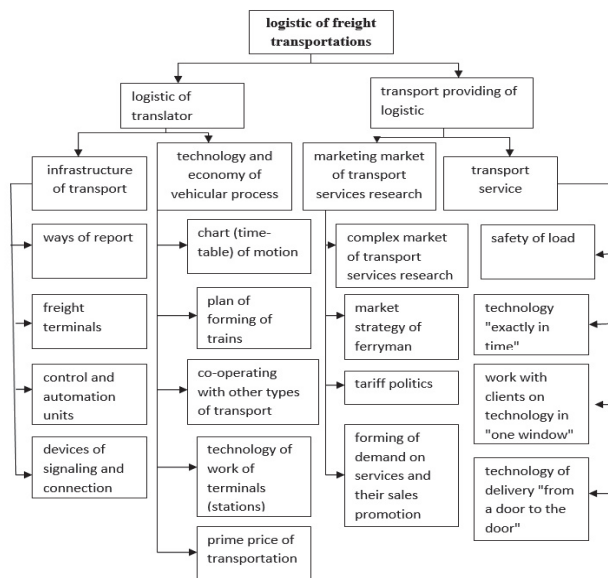

Fig. 4. The Functional Structure of Transport Logistics

Thus, in the current state of the economy, supply chain management and logistics is considered as a tool to develop and implement an entrepreneur's strategy that meets the requirements of a complex of industrial management, transport and market processes. After analyzing the work of companies engaged in transportation in Kazakhstan and abroad, the most common methods used in transport logistics are found:

Methods of carrier selection. When analyzing the costs and results of cargo delivery, the profit can be estimated as a stochastic random variable. This estimate is used for probabilistic statements about expected profits and allows us to identify the causes of lower profits and identify ways to increase them.

Matrix method. In this method, the solution of the carrier selection problem is associated with the analysis of market conditions (degree of scarcity and cost of services, availability of alternative acquisition channels, frequency of supply, etc.). To formalize the procedures for selecting carriers according to the minimum cost criterion, when assessing the cost of acquiring carriers' services, a matrix is used, the lines of which indicate the quantities of the order and delivery conditions (volume, frequency, guaranteed periods, vehicles and packaging, services rendered, etc.). The columns are the producers of the services of the same name (carriers), and at the intersection of the lines and columns there is the cost of services and tariffs. By determining the lowest costs per column, the buyer can choose a potential carrier. The final choice is made by considering the characteristics of the level of quality of service, which can be assessed by a point system. The disadvantage of this method is the complexity of formalization.

Valuation method. The essence of the method lies in the fact that the choice of carrier is assumed due to the desire of the company to optimize the value of the goods and is determined by the variable profit. For developing more efficient supply and logistic chain management, it is necessary to consider the effect of structuring the chain, which is associated with optimizing the structure of the production cycle (supply cycle or the movement of flow components) implemented by the logistics chain. It is achieved by eliminating the intermediate stages of the movement of the components of the flow, as well as the desire for the direct conjugation of logistical units specializing in basic operations. The magnitude of this effect is equal to the total savings on quasi-operational costs. This effect formed the basis of the "lean production" logistics concept (Fig. 5) (2005).
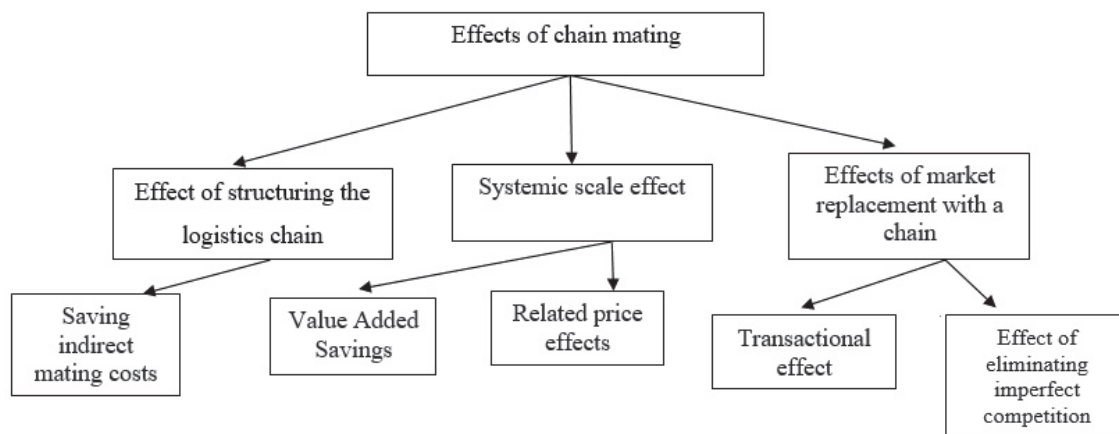
Fig. 5. The Effects of Chain Conjugation of Logistics Facilities

In order to develop the logistics system and supply chain management of the Republic of Kazakhstan with the involvement of international consultants, Master Plan for the development of the transport and logistics system (CLW) was developed. This document is a program for the development of the transport logistics industry within the framework of the current programs of the Government, in particular, the State Program for Forced and Industrial-Innovative Development. After analyzing the statistical indicators of logistics companies, the authors determine that the volume of freight traffic in Kazakhstan has significantly increased, which amounted to 88.1% of the total share of the logistics market in the economy. Kazakhstan's logistics and supply market is attractive in terms of investment in the industry. It is expected that a large foreign operator will enter the Kazakhstan market with its

logistics companies, with an improved quality of services, and a new mechanism of supply chain management, which has not previously been carried out in Kazakhstan. With all the positive and negative aspects of the entry of a large operator, one thing is certain and that is the arrival of innovative technologies and world-class standards, which would further accelerate the development of not only the logistics services and supply market, but also business and economy as a whole.

In Kazakhstan, the professional logistics market and supply chain management are only in their infancy and their rapid development is expected. This is due to a number of reasons:

- there is an increase in demand for the class A outsourcing logistics market, which consumers are both small companies without their own warehouses and large companies;
- the transfer and construction of new warehouses outside the city limits and the concentration of industrial-innovative enterprises around them;
- the increasing demand for logistics services, primarily for class A and B warehouses in the regions, and their construction by private companies without state participation;
- the annual growth in freight turnover in the country is accompanied by an increase in demand for logistics services and the lack of domestic companies, the expectation of the arrival of a foreign logistics company with its technology;
- the absence of a full-fledged market of logistics services; there are certain elements of logistics, such as freight, freight forwarding services, undeveloped warehousing;
- there is a demand for logistics in the regions, which leads to the expansion of the company's logistics in regions where there are no modern warehouses and terminal complexes.
- application of new mechanisms and strategies of supply chain management.

Currently, the state of the transport and logistics industry of the country is at the stage of development. In 2014, the World Bank's LPI Logistics Systems Performance Index in Kazakhstan takes the 88th place. The forecast for 2020 is the 40th place. The first set of problems is the underdevelopment of infrastructure, which is reflected in the almost complete absence of modern warehouse-oriented business, both in large cities and regions, and even more important - in the lack of an appropriate transport fleet, both rail and road (Fig. 7).
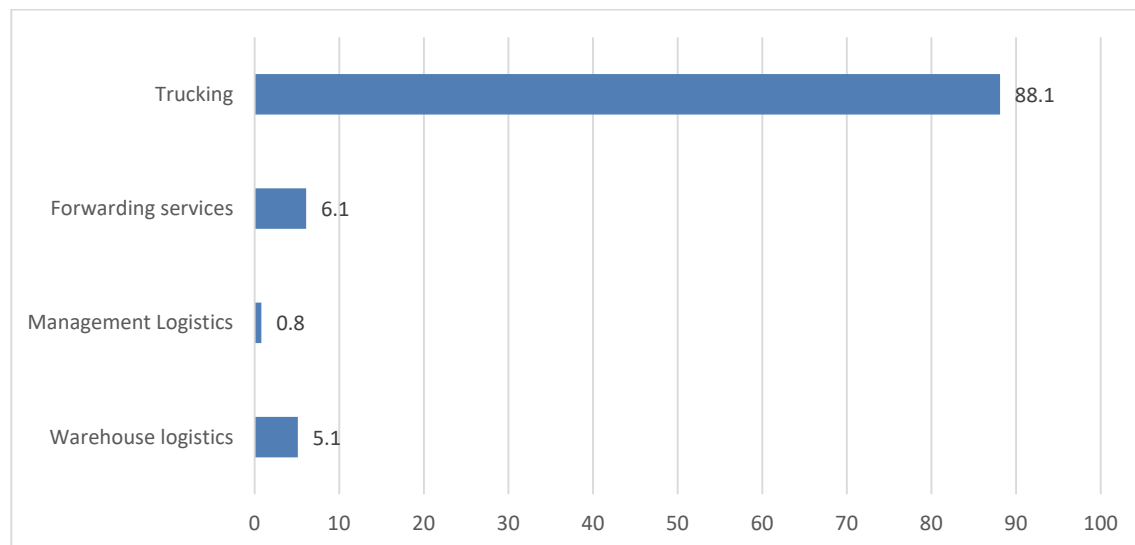

Fig. 7. The Status of Logistics Activities in the Republic Of Kazakhstan, %

4. Conclusion

The transport activity is a part of economic activity, which aims at increasing the degree of satisfaction of the needs of society by changing the geographic location of goods and people. The economic importance of transport for Kazakhstan is great due to the following features: the vast territory of the republic, which extends from west to east for 3,000 km, and from north to south for almost 1,700 km - the long range of freight traffic. The interests of the largest industrialized countries of the Asia-Pacific Region (APR), including China, European countries and Russia with their enormous scale and resources, turn Kazakhstan into an object of active foreign economic policy. The combination of these factors, in turn, largely determines Kazakhstan in the system of world economic processes. Integration of Kazakhstan into the world economic space creates a zone of continental and transcontinental economic preferences within Kazakhstan. Four international transport corridors formed on the basis of the transport infrastructure existing in the republic pass through the territory of Kazakhstan. Corridors can significantly reduce the distance in the East-West traffic and the time of cargo delivery. All these transport routes are relatively new, they began to actively develop in the 90s. They can significantly reduce the distance and time of delivery of goods in transport East West communication. The formation of effective supply chain management and transport network is due to a number of socio-economic factors: the development and location of the economy; urban settlements; the direction and power of the main transport and economic relations; location of large resort and tourist sites, the need to optimize costs. Our study has provided a significant contribution in the literature while integrating the multiple aspects, intellectual capital components, and organizational resources in determining the innovation in logistic services for the supply chain management. Results are in favor for the hypotheses that there is a significant and positive impact of multiple aspects and intellectual capital on innovation for logistic services in supply chain, where no influence from organizational resources are found for innovation on logistic services for supply chain. These findings are observed as significant contribution in both theoretical and empirical literature where industry exports and logistic managers can observe the relationship among the stated variables for upcoming strategic decisions and their implications.

Acknowledgement

References

Ainur, A., Sayang, M., Jannoo, Z., & Yap, B. (2017). Sample size and non-normality effects on goodness of fit measures in structural equation models. *Pertanika Journal of Science & Technology, 25*(2).

Awudu, I., & Zhang, J. (2012). Uncertainties and sustainability concepts in biofuel supply chain management: A review. *Renewable and Sustainable Energy Reviews, 16*(2), 1359-1368.

Bardal, A. B. (2018). The transport complex of the Far East: development trends and economic role. *Ekonomicheskie i Sotsialnye Peremeny,* 56, 24-36A.

Bojković, N., Anić, I., & Pejčić-Tarle, S. (2010). One solution for cross-country transport-sustainability evaluation using a modified ELECTRE method. *Ecological Economics, 69*(5), 1176-1186.

Buurman, J. (2002). *Supply chain logistics management*. McGraw-Hill.

Castillo, V. E., Mollenkopf, D. A., Bell, J. E., & Bozdogan, H. (2018). Supply chain integrity: A key to sustainable supply chain management. *Journal of Business Logistics, 39*(1), 38-56.

Chandra, C., & Kumar, S. (2000). Supply chain management in theory and practice: a passing fad or a fundamental change? *Industrial Management & Data Systems, 100*(3), 100-114.

Copacino, W. C. (2019). *Supply chain management: The basics and beyond*: Routledge.

Dablanc, L. (2007). Goods transport in large European cities: Difficult to organize, difficult to modernize. *Transportation Research Part A: Policy and Practice, 41*(3), 280-285.

Dirko, S. V., & Poleschuk, E.N. (2018). Logistics of the Baltic region: state and development prospects. *Transport and Service, 6*, 16-23.

Effendi, M., & Matore, E. (2019). Structural Equation Model (SEM) in assimilating EQ, SQ and AQ for mechanical students context. *Proceedings of Mechanical Engineering Research Day*, 230-231.

Foo, P.-Y., Lee, V.-H., Tan, G. W.-H., & Ooi, K.-B. (2018). A gateway to realising sustainability performance via green supply chain management practices: a PLS–ANN approach. *Expert Systems with Applications, 107*, 1-14.

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.

Kohls, N., Sauer, S., & Walach, H. (2009). Facets of mindfulness–Results of an online study investigating the Freiburg mindfulness inventory. *Personality and Individual Differences, 46*(2), 224-230.

Koufaris, M., & Hampton-Sosa, W. (2002). Customer trust online: examining the role of the experience with the Web-site. *Department of Statistics and Computer Information Systems Working Paper Series, Zicklin School of Business, Baruch College, New York.*

Kusi-Sarpong, S., Gupta, H., & Sarkis, J. (2019). A supply chain sustainability innovation framework and evaluation methodology. *International Journal of Production Research, 57*(7), 1990-2008.

Lai, K., & Green, S. B. (2016). The problem with having two watches: Assessment of fit when RMSEA and CFI disagree. *Multivariate Behavioral Research, 51*(2-3), 220-239.

Levitt, T. (1993). The globalization of markets. *Readings in international business: a decision approach, 249*.

Loo, R. (2000). A psychometric evaluation of the general decision-making style inventory. *Personality and Individual Differences, 29*(5), 895-905.

MacCallum, R. C., & Hong, S. (1997). Power analysis in covariance structure modeling using GFI and AGFI. *Multivariate Behavioral Research, 32*(2), 193-210.

Marcoulides, K. M., & Yuan, K.-H. (2017). New ways to evaluate goodness of fit: A note on using equivalence testing to assess structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal, 24*(1), 148-153.

Maydeu-Olivares, A., Shi, D., & Rosseel, Y. (2018). Assessing fit in structural equation models: A Monte-Carlo evaluation of RMSEA versus SRMR confidence intervals and tests of close fit. *Structural Equation Modeling: A Multidisciplinary Journal, 25*(3), 389-402.

Peter, L. M. (2011). Towards sustainable photovoltaics: the search for new materials. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 369*(1942), 1840-1856.

Pluzhnikov, V., Kukharenko, S., & Shikina, S. (2017). *Identification of business processes of the enterprise by intrinsic states method.* Paper presented at the SHS Web of Conferences.

Rasool, Y., Iftikhar, B., Nazir, M. N., & Kamran, H. W. (2016). Supply chain evolution and green supply chain perspective. *International Journal of Economics, Commerce and Management, 4*(10), 716-724.

Shevlin, M., & Miles, J. N. (1998). Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. *Personality and Individual Differences, 25*(1), 85-90.

Taasoobshirazi, G., & Wang, S. (2016). The performance of the SRMR, RMSEA, CFI, and TLI: An examination of sample size, path size, and degrees of freedom. *Journal of Applied Quantitative Methods, 11*(3), 31-39.

Tate, W. L., Ellram, L. M., & Kirchoff, J. F. (2010). Corporate social responsibility reports: a thematic analysis related to supply chain management. *Journal of Supply Chain Management, 46*(1), 19-44.

Wu, J.-F. (2016). Reproducing an alternative model of intercultural sensitivity for undergraduates from Taiwan and Hainan. *International Journal of Modern Education and Computer Science, 8*(1), 1.