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Enhanced Transport Economy Modelling Along the 'New Silk Road'

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A B S T R A C T

This paper presents an innovative method to enhance transportation of cargo applied on the 'New Silk Road'. Allocation of shadow costs gives economic incentives to improve the Eurasian communications by employing the equality principle and the model for Efficient Use of Resources for Optimal Production Economy (EUROPE). The profitability increase, the technology is advanced, the environment and the living conditions improve. A single monetary key factor expresses aspects of interest and enables simultaneous monitoring, managing and evaluation. The method constitutes decision support tools for long-distance transportation at higher policy analysis organizational levels. The results of the case study point at usefulness for the launched methodology to reduce the spillages and losses when transporting cargo by truck along major transport routes. Peace and prosperity are promoted. The major benefits would be higher profits and less residuals.

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INTRODUCTION

The main hypothesis in this paper is that cargo transportation can be enhanced by application of the EUROPE model. The main goal is to facilitate the cargo transports by truck along the 'New Silk Road'. Trucks are chosen as the study object due to good access of data for truck transportation.The sub-goals are to improve the economy, the environment and the technology plus the living conditions connected to the 'New Silk Road'. The case study concerns the flow of agricultural produce transported by trucks along the 'New Silk Road'.The research questions to be answered are how to use the EUROPE model to improve long distance transports and how such a versatile tool, an economic instrument, can be designed and modified for this purpose? For whom is this tool important? Who are the potential end users?How can the EUROPE model be modified to improve thetransportation efficiencyalong the 'New Silk Road' using the results from the case study for transportation of agricultural products by trucks? Who does this endeavour benefit?

The research contribution is a better understanding of how transportations can be facilitated by application of economic instruments. Also, a method to improve national finances is presented.

This paper launches a novel method for how to reduce transport spillages and wastes. The readers are given a single key factor to simultaneously monitor, manage and evaluate their projects.

The methodology in this paper facilitates the ambition to better connect China to Russia and Europe in a logistic sense. The model provides a key factor (12) that can be used as an indicator for how well this ambition is fulfilled in terms of the efficiency of the transports along the 'New Silk Road'. The methodology is based on the equality principle reported in literature [1- 8] to enable allocation of fictive costs to unwanted residuals to reduce the existence of wastes.

Earlier attempts to optimize logistics in Eurasia were, for example, Forrest [9] who describes the building of the Baku-Tbilisi-Kars (BTK) railway, a so-called 'Iron Silk Road' that will connect the oil-rich Caspian Sea region to Turkey, and then to Europe beyond. Lin [10] outlined how the territory Xinjiang 'the Center of Eurasia'played a very significant role to link China to the western world. Scientific efforts like the use of the equality principle for improvement of logistics that is proposed in this paper are hard to find in the scientific literature.

Few scholars have studied shadow costs in relation to systems for cargo transportation. Many works describe technical, economic and environmental aspects of trade routes. No studies have been made of how to,by one key factor and on a monetary basis, monitor, measure and evaluate the performance of cargo flows. This paper develops a new cost structure to provide economic

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incentives to make cargo flow more efficiently along the major trade routes. The introduced methodology represents a brand-new concept about improvement of international cargo transportation.The objective of this study is to provide useful economic instruments that managers can use to obtain guidelines for how to increase the cost efficiency of activities and schemes related to cargo transportation by employment of the EUROPE model.

The Silk Road was the first intercontinental route and started in China near Canton and crossed the Gobi Desert, went through the north of India, thenit passed Alexandria before ending in Rome [11]. The Land Bridge railroad through China, Kazakhstan, Mongolia, Iran and Russia Eurasian is sometimes called the 'New Silk Road'.The Silk Road Economic Belt consists of infrastructure projects such as roads, railways, and pipelines which strengthen the links between China, Central Asia, Iran, Russia, and Europe [12]. The Silk Road was important for Iran whichwill be reinforced financially and politically by the 'New Silk Road'.

The EUROPE model

Basic framework

The equality principle [1- 8] forms the scientific basis of this paper. All residuals are regarded as a regular product outputin Equation (1) that is the EUROPE model, the model for Efficient Use of Resources for Optimal Production Economy, aimed at allocating a logical portion of costs to residuals through multiplication by the total costs in question by splitting them up in logical proportions. A suitable organizational unit, for example, a production line or a whole factory must be defined depending on the circumstances. System limits are hence set in flexible ways.

$$PF = \frac{A}{B + C} \quad (1)$$

SC = Corporate-internal shadow cost additionally allocated to

$$A = PF * TC \quad (2)$$

TC = Total Costs = Fixed Costs + Variable Costs = FC + VC

$$SC = \frac{(A * (FC + VC))}{B + C} \quad (3)$$

Where PF is the Proportionality Factor (without sort, it is a mathematical fraction), A is the quantity of the residuals from a certain resource produced that are to be optimized, B is the quantity of the regular resource output, Cis the sum of the quantities of all the different residual fractions stemming from "the black box" of the studied system, i = 1, 2 ... n in order of estimated and descending economic and/or environmental relevance. Units are: kg, litres, Joule, CNY, €, RUB etcetera.

Theoretical foundations

In the transportation context, this corresponds to the desired functionality of the important flow of goods in Eurasia. Thus, the equality principle is an economic instrument since it features economic incentives to generally improve source reduction.The constructed shadow costs or shadow prices [13] in the suggested approach are a versatile tool.

Application of the proposed cost structure on transportation

General Theory for Optimisation of Transportation Flows

The flow of goods in the transport corridors and the unwanted losses and spillages from these flows are inputs to Equation (1). The total cost for all the goods stopping to flow or changing the route directions (TC transport) is required. The energy content losses in the halted or deviated goods flows are encompassed in the studied goods volumes. Equation (1) gives:

$$PF_i = \frac{A_i}{B_i + C_i} \quad (4)$$

Where

A_i = the" bad" to be optimised or at least reduced

B_i = value of the annual total goods transportation flow in branch i.

C_i = sum of the total 'bads'

PF_i is multiplied with TC i to obtain the transportation flow cost (TRANSLOST)to allocate to a certain estimation and/or budget.

TRANSLOST i = Shadow cost allocated to $A_i = PF_i * TC_i$ * Weight factors

TRANSLOST i = Shadow Cost i = $SC_i = PF_i * TC_i$ * W air impact i * W land impact i * W water impact i

TC_i = the total cost of war *i* due to blocked trade route *i* and/or the natural disaster *i*or similar force majeure causing big, regional economic losses along trade route *i*, W air impact i, W land impact i, W water impact i= the weight factors allowing management to consider environmental protection in region i

Sort: Renminbi (RMB) (popular name: Yuan (CNY)) on a monthly, quarterly or annual basis

TRANSLOST i is inserted in the budget or the profit and loss accounts of the trade bloc in question such as the Association of Southeast Asian Nations (ASEAN) or the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). TRANSLOST will force the entities of interest to promote a more efficient transport system due to the emerging shadow costs which, if taken seriously, put pressure on the actors to improve the transportation conditions.

Summarized theory

The theoretical findings of this study can be collocated in the general TRANSLOST Equation (5) in the case of *n* transport routes regarded.

$$\text{TRANSLOST tot} = \Sigma = \left(\frac{A_i}{B_i + C_i}\right) * TC_i * W_{air\ impact\ i} * W_{land\ impact\ i} * W_{water\ impact\ i} * W_i \quad (5)$$

i= 1, 2, …, j, where A i is quantity of the transport waste in transport route i, B i is quantity of the regular transport flow in question that produces, for example, A i, C i is quantity of all the unwanted transport flow spillages or losses of the regular cargo main flow B i that have a negative impact on A i, TC i is total societal cost of transport route i stopping or changing direction employing (3), W i is the weight conferred to impact on air, land and water by residual i(without sort, it is a mathematical fraction), W i ≥ 0, j = 1, 2, …, n within a defined production or administrative unit during a certain time period. Sort: CNY, RUB, €, $, £ or ¥ etc. and tonnes.

Equation (12) is useful for at higher administrative and larger geographical levels, such as ESCAP, economising on the resource efficiency, advancing the technology and improving the environmental conditions for the 'New Silk Road'.

Case study: the 'new silk road' basic data

This case study relates to the flow of agricultural produce transported by trucks along the 'New Silk Road' particularly about its importance for the ESCAP nations. The Central Asia Regional Economic Cooperation Trade Facilitation (CAREC) [14, 15]publishes annual reports on the transport Corridor Performance Measurement and Monitoring (CPMM) [16]. Based on Q3, 2015 report [16], 11 CPMM partner associations submitted a total of 698 data samples; road samples comprised 75 percent and rail movements the rest. Thus, road transports are considered here to implement the more available data of statistical relevance.Commodities transported along the CAREC corridors are: agricultural produce (19 percent), machinery (18percent), base metals (13percent), industrial materials (9percent), and textiles (7percent). Perishables account 24percent of all movements mainly transported by truck. 97percent of all samples crossed at least one international border. Corridor 1 connects Kazakhstan, Kyrgyz Republic, and PRC [17].It has 13,600 km of roads and 12,000 km of railways. Corridor 1a allows trucks to travel fast. Per Swedish professionals in the freight business, the losses of agricultural products when transported by road are approximately 0.1percent.

The 'Western Europe – Western China' corridor stretches 8,445 km, of which 2,787 km (33percent) lays in Kazakhstan. The importance of Corridor 1b is evident.

Corridor 1c supports transit of cargoes between Kazakhstan-Kyrgyz Republic and PRC – Kyrgyz Republic. It is a critical gateway for exports from PRC such as textile, food, and machinery to customers in Bishkek. According to Santos (e-mail contact 2016)per CPMM data, there is 26.75% traffic along Corridor 1 for 2015 (road and rail), 16.66percent for road, and 65percent for rail (only samples from Corridors 1 and 4).The value of the trade between Europe and East Asia is G$1509 [18].

Application of the considered methods

The numerical values used are approximated to exemplify the consequences in practice of the presented general approach. For the agricultural produce transported along Corridor 1 that connects Europe to East Asia, Equation (10) gives:

TRANSLOST Agricultural = [(0.1percent losses of agricultural products when transported along Corridor 1 * 19percentagricultural produce transported along the CAREC corridors * 17percent road transport along Corridor 1 * G$1509 for the value of the trade flows between Europe and East Asia) / (G$1509 + ((0.1percent / 19percent) losses of all products* G$1509))] * TC Europe-East Asia trade break down = 0.000,032 (without sort, it is a mathematical fraction) * G$1509 = M$48.4 = approximately M$48 as a constructed shadow cost to additionally be inserted into the budget of ESCAP to obtain an economic incentive to improve the efficiency of the cargo transportation of the agricultural produce by trucks along Corridor 1 between EU and East Asia. The general terms are presented in Table 1 [19].

In 2013, the GDP of European Union was G$17,351 [20]. TRANSLOSTAgricultural hence constitutes 0.000,27 percent of the GDP of EU. This portion of the GDP can be adjusted by the weight factors W air impact i, W land impact i, W water impact i and W i, see Equation (12). This shadow cost approach provides a tool for simultaneously managing, monitoring and evaluating activities that affect transportation. TRANSLOSTAgricultural is inserted into the budget and the profit and loss accounts of ESCAP per the general principle shown in Table 1 [19].

METHODS

In this paper, a cost structure is proposed for economising on transportation efficiency losses in the 'New Silk Road' that may jeopardise its normal functionality and cause regional access changes. A cost efficiency and equity point of view is employed with emphasis on the economy of cargo transportation due to mismanagement of the cargo-flow between Asia and Europe.

In introduction, we touch upon the Asian and Eurasian context. Particularities of the logistics, politics and the transportation economy for cargo flows about the 'New Silk Road' were reviewed. Certain alternative models are explored and commented upon.

TABLE 1. The schematic public finances for ESCAP [19]

Expenditure	Total receipt
TRANSLOST	M$48
Public Sector Borrowing Requirement	M$48

The quality principle and EUROPE model [1-8] are described and applied in this transportation context. Guidelines are given to use the methodology for improving the transportation efficiency on larger geographical scales. General theory of business administration and economics are used.

Transportation by road is featured due to better access to statistical data for trucks than railways. The case study that follows concerns how to improve the flow of agricultural products along the 'New Silk Road'. The outcomes of the present study are summarised in a conclusions' section. Suggestions for further research are listed.

The scientific methodology combines: a) what transport policy should be changed and how bythe case study, and; b) the development of theories and models based on the accumulation of relevant knowledge presented in this paper. The study ranges within economics of transportation about industrial organization and public policy for mathematical methods and models [21], for example, the EUROPE model. According to Gaedicke [22] this model belongs to the Environmental School featuring a reactive process with the message to react.

Both qualitative and quantitative research methodology is applied. Primarily, data are obtained by interviews and via 'neutral' numerical data from the Internet and used primarily in the introduction and the case study. The research approach in this work is mainly analytical. The validity of the developed methods to improve the transportation efficiency is considered by the application of widely accepted theory of economics and business administration such as cost benefit-analysis and accounting, respectively. The reliability is ensured by consulting relevant standard works and applying the economic theories of importance for our approach. The case study shows the practical value of the truck transport research conducted here and exemplifies the model-usage in general. That reinforces the reliability of the results.

RESULTS AND DISCUSSION

The present study introduces aninnovativemethodology for reducing the losses and spillages when transporting cargo using the 'New Silk Road' as an example for how to apply the method in practice with emphasis on trucks.The methodology enables an efficient use of natural resources by creating economic incentives that promote the source-reduction of spillages [23] that affect the eco-systems in a negative way. The results are viable for the management of transports aboutefficient use of transport routes when focusing on the economic and pollution impact. The constructed shadow cost TRANSLOST that is inserted into the budget of ESCAP (Table 1) constitutes a very reasonable 32 millionth of the hole TC Europe East Asia trade break down of G$1509 for the trade between Europe and Southeast Asia breaking down. Thereby, weights are not employed but can be applied.

A major result is the summarizing Equation (5) which mathematically collocates the findings of this study. In simple mathematics, Equation (5) encapsulates the general idea about using the EUROPE model for transportation issues. However, in the case study, Equation (3) is applied to estimate the shadow cost.

Corridor 1 has 13,600 km of roads. The case study exhibits a negative shadow cost impact of M$48 on the ESCASP budget corresponding to $3529 per km (M$48/13,600 km) transported cargo between EU and East Asia in the 'New Silk Road'. This constructedbut useful shadow cost of approximately $4 per transportation distance meter allocated to the agricultural produce might be substantial but weighting is not applied. This illustrates how the equality principle should be applied on a continental level to accomplish a reduction of transport spillages.Thus, the main hypothesis that truck transportation can be enhanced by application of the EUROPE model is verified. The logics of the theory supports the verification of the hypothesis, because the introduced theorems are mathematically adequate.

The model's major advantage is the induction of improving changes in the transport systems. The weakness is the less good precision of the impact on the affected actors which may be improved by novel algorithms based on the EUROPE model to increase the accuracy.The model requires professional judgments to apply. However, if the relevant data are available, the model can easily be implemented.

The validity of the introduced methods is satisfactory due tothe commonly used theory of business administration used for our research. The comprehensive practical usage of the economic theory supports the validity.The reliability of the study is acceptable as thecase studysupportsit.

CONCLUSION

The main hypothesis in this paper that transportation can be improved by application of the EUROPE model is verified because the logics of the designed theory supports this conclusion. Also, the introduced theorems are mathematically correct.The main goal of this study to improve the transports by truck along the 'New Silk Road' is achieved because the results from the case study support this conclusion. The sub-goals to improve the economy, the environment, the technology and the living conditions are also achieved due to the findingsof the performed analysis.The research questionshow to use the EUROPE model to improve transports, how such a

versatile tool can be designed and modified for this purpose,and for whom this tool is important are answered by the study's results and discussion.The research contribution mainly isa versatile tool that can be modified to better understand how long-distance transportation by trucks can be designed to be more efficient. This tool is of importance mainly for larger, institutional actors.

Suggestions for future works

The methodology can be applied to goods transportation globally. An area to study would be how to apply the methodology to the Maritime Silk Road, the transportation of goods along the Asian coasts to central Europe. The methodology can also be applied on railway transports in Eurasia.

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Persian Abstract

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چکیده

این مقاله یک روش ابتکاری برای افزایش حمل و نقل محموله های مورد استفاده در جاده های جدید ابریشم ارائه می دهد. تخصیص هزینه های سایه، باعث ایجاد انگیزه های اقتصادی برای بهبود ارتباطات اوراسیا با استفاده از اصل برابری و الگو برای استفاده کارآمد از منابع برای اقتصاد تولید مطلوب (اروپا) می شود. افزایش سودآوری، تکنولوژی پیشرفته، محیط زیست و شرایط زندگی بهبود می بخشد. یک عامل کلید کلیدی پولی جنبه های مورد علاقه را بیان می کند و مانیتورینگ، مدیریت و ارزیابی همزمان را امکان پذیر می سازد. این روش ابزارهای پشتیبانی تصمیم برای حمل و نقل از راه دور را در سطوح سازمانی تجزیه و تحلیل سطح بالاتری ارائه می دهد. نتایج مطالعه مورد اشاره در مورد استفاده از روش پیشنهادی برای کاهش تلفات در هنگام حمل بار توسط کامیون در مسیرهای اصلی حمل و نقل است. صلح و رفاه ارتقا یافته است. مزایای عمده سود سود بیشتر و کمبود آن کمتر خواهد بود.