Structuring of goods flow database in transport supply chain

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Abstract — Transportation is an important factor to the development of economy and competitiveness of business. It influences customer’s satisfaction with a particular company. Aside from its importance as an indispensable service of supply chain, transportation represents a substantial cost for the business and makes essential influence to environmental performances. To make transport more efficient and to reduce its costs it is necessary to obtain data about different activities and factors of importance for transport. Having this in mind creation and use of goods flow data base must be a platform to analyze transport activities, give conclusions and recommend and implement changes. There is a need to define limited data set which will reflect significant transport indicators of the current state and realized changes during time. Such data will enable correction measures corresponding to the requests of strategic goals defined on national and international level. Database should be available to the certain beneficiary groups with defined level of authorization rights. It is difficult, even in developed countries to establish a positive intention of economic entities to engage in one of these information systems. Provincial institutions, local governments, and the state of Serbia are of great importance in a comprehensive collection of data on commodity and transport flows, which should serve to define a modern and rational transportation system that will enable sustainable development of the economy in the territory of AP Vojvodina, and thus within the whole country, too. The paper proposes limited data which are significant to follow goods flow and which should be elements of information system and organizational structure within Republic of Serbia which will enable collecting of data, their analysis and dissemination.

Keywords: transport, supply chain, database, information system, goods flow

I. INTRODUCTION

Transportation is becoming important fact of comparative advantage of companies and prices of their products and services. It functions as an activity that physically connects the business to its supply chain partners which are suppliers and customers of goods. It influences the customer’s satisfaction with a particular company. It is a service which can’t be avoided within supply chain and which is not small part of services’ or goods’ prices, and as such is an important factor of business. The transportation cost sometimes determines customers' transaction results in a profit or a loss for the business. Very important issue is ecological influence of transport which should be dramatically changed due to the mode of transport and its efficiency. To make transport more efficient and to reduce its costs it is necessary to have data about different factors related to transport. Data base of goods flow must be a platform to analyze transport activities, give conclusions and recommend and implement changes.

At the moment there is no database with data about transport in the Republic of Serbia, at neither national nor provincial or local level. Consequence of this is that there are no data about transport process and its status within the value chain of services and goods which would enable its analysis. Without such approach there will not be improvement, no systematic approach, neither scientific analysis. Situation in the sector of transport in Serbia must be improved and for such a process is a need to involve information-communication technology in the sector of transport.

To design database, input and output data should be defined. Input collects raw data within the organization or from the environment. Processing is the process of forming data and bringing them into an understandable form. Output transfers processed data to clients who use them or to activities that will have benefit of them. Information system requires a feedback which is output that is returned to a number of members in the organization to help them to assess or to correct input form of a document.

There is a need to define limited data set which will give reflection of important issues of transport and its changes during time. This set should enable correction measures corresponding to the requests of strategic goals in the sector of transport at national and international level. Database should be available to the certain beneficiary groups with defined level of authorization rights.

Subject of research presented in this paper are commodity and transport flows in Vojvodina.

Problem which is tackled is lack of data about commodity and transport flows.

General goal authors wanted to reach is improvement of transport through Vojvodina and creation of sustainable system of commodity and transport flows.

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Specific goal of this paper is to suggest data groups which must be incorporated into the goods flow database.

II. LITERATURE OVERVIEW

There are not many articles tackle the topic of information system for the goods flow analysis. Some authors call goods flow as commodity flows. Authors from Australia [1] explain that data on commodity flows in Australia are poorly covered by official statistics. The analyst demand for many strategic visions a nationwide picture of commodity flows. Authors described FreightInfo database which use combined assembly techniques: development of secondary data from existing national data collections made by experts, the identification of major flow sources and destinations, and a program which enables field data collection from freight carriers, consignors and consignees, for all transport modes.

American authors' [2] research presents a methodology for freight flows estimation along corridors for international trade. They developed a methodology which disaggregates regional flows from the Federal Highway Administration’s Freight Analysis Framework (FAF) to the state level and applied to the State of Texas. They put in focus congestion nodes on roadways and railroads and apply the methodology to estimate current and future freight demand.

Authors from Brazil present a methodology to estimate freight flows using secondary data within urban sector. Low efficiency of transport and traffic congestion together with lack of policies and problems in decision-making process are typical for the Brazilian context. The paper describes new methodological approach for data processing in order to support decision-making in Brazil. The results achieved indicate the need for a systematic data collection in order to improve future results [3, 4].

Researchers [5] collated available datasets and developed a freight flow model to better understanding of freight movements between countries. This can be used for long-term planning efforts. A simple methodology assists to understand links between major district in the country with a similar district in another country. Existing trade data are base for supply volumetric data for each country. The model can then generate commodity-level corridor flows between African countries, and between them and the rest of the world. The model enables differentiation between intra-country rural and metropolitan flows, using a gravity-based modeling approach as a first step towards developing a freight demand model for sub-Saharan Africa. The similar investigations are done by other authors like [6].

Design and management of Large Logistics Networks (LLN) usually involve model-based analyses of the networks. The usefulness of such an analysis highly depends on the quality of the input data, which of course should be best possible to capture the real circumstances. Authors of this paper developed an advanced procedure model for a structured, goal- and task-oriented information and data acquisition for the model-based analyses of LLN is proposed. This procedure model differs from other approaches by focusing on information acquisition rather than solely on data acquisition, and by employing a consequent verification and validation concept. [7, 8,9].

Transport modeling in general and freight transport modeling in particular are important tools which explain the effects of investments and policies [10].

III. METHODOLOGY

As one of the most productive way to collect data and information on commodity transport flows is making information system for monitoring commodity and transport flows. If the whole economy, or a significant part of the economy would be involved in the generation of data in the information system as a partner, then specifying a methodology for collecting data to monitor commodity and transport costs would not be necessary. However, it is difficult, even in developed countries to establish a positive intention of economic entities to engage in one of these information systems. Provincial institutions, local governments, and the state of Serbia are of great importance in a comprehensive collection of data on commodity and transport flows, which should serve to define the modern and rational transportation system that will enable the sustainable development of the economy in the territory of AP Vojvodina, and thus the whole country. The authors propose the structure of database for commodity transport flows which covers mode of transport and specially intermodality issues. They define the way how to collect data and organizational structure which must be implemented by state institutions and which will ensure collecting of right data in the requested time, its analysis, drawing conclusions and dissemination to beneficiaries and stakeholders.

Determination of a database is dependent on the goals of its configuration and who is intended to use the data from the database. The aim of the database for tracking commodity and transport costs in AP Vojvodina is to monitor the data relevant to the movement of goods within and through Vojvodina, according to various parameters.

The parameters are:
• Type of goods,
• The volume of goods,
• Hazardous substances,
• Relationships transport,
• Type of Transportation,
• Intermodal units,
• Special conditions of transport.

To define structure of the database an survey was performed within 40 important entities in the sector of transport in Vojvodina. Stakeholders and all interested parties, and all necessary for giving of so-called input data, in this case, all economic entities in Vojvodina are these who use:

• raw materials for production and supplied them from a source from the country or from abroad and
• placing their products in some markets, at home or abroad.

The data about such subjects should be entered in the
subsystem called: Subsystem for basic data about information systems’ partner.
This includes entrepreneurs, micro, small, and large companies that operate in Vojvodina.
Of particular importance are: freight forwarders, customs, ports. The table for it is presented in Figure 1 which presents a mask to enter company’s basic data.

![Figure 1](image1.png)

**Figure 1. Design of subsystem for basic data about partners-participants in database**

A. Input data

Input collects raw data within the organization or from the environment.

Information system of commodity and transport costs would have the following subsystems:
• Subsystem basic data information system partners,
• Subsystem types of goods,
• Subsystem quantity of goods,
• Subsystem "hazardous substances",
• Subsystem-haul transport,
• The subsystem of the mode of transport,
• Subsystem intermodal units,
• Subsystem special transport conditions.

Figure 2 shows the shape of table designed to enter input data into the different subsystems.

![Figure 2](image2.png)

**Figure 2. Designed table for input data**

Short description about each subsystem is offered to the users to facilitate input of data and to enable better understanding of the whole structure, like shown in Figure 3.

![Figure 3](image3.png)

**Figure 3. Design of short description of subsystem for data input**

B. Output data

Output data transmits processed data to people who use them or to activities that will have benefit of them.

Output data should include the results of the analysis of data obtained from donors of the input data with goal to obtain a complete picture of factors in the field of commodity and transport costs in AP Vojvodina. Output data are intended to be used by:

• Republic administration
• Provincial and local Administration
• National, regional and local Chambers of Commerce
• National, regional and local development agencies
• Universities and colleges
• Institutes
• Republic Institute for Statistics
• Town Planning Institute
• Institute for Nature Protection, Work Protection
• Civil society organizations
• All businesses
• Diplomatic service
• Organizations for mediation, such as consulting organization
• Business incubators
• Science and technology parks
• Clusters.

The beneficiary of the output data are expected to use them to respond to them and to work on improving the situation in the field of transport and cargo flows in AP Vojvodina.

Output information system should contain the following information:

1) Commodity flows in Vojvodina
• Total cargo flows (according to the classification and volume)
• International cargo flows (according to the classification and volume)
The structure of cargo flows by type of goods
The distribution of cargo flows by transport vector
The distribution of the flow of goods along the length of haul transport
• The total volume of cargo flows "hazardous materials" (by volume)

2) Transport flows in Vojvodina
• Total transport flows (according to the classification and volume)
• Total international transport flows (according to the classification and volume)
• Distribution of international transport flows by districts
• Total domestic transport flows (according to the classification and volume)
• Distribution of transport flows by means of transport (by volume, %)
• Allocation of internal transport flows by districts (according to the classification and volume):
The volume of transportation of goods in structure and the biggest beneficiaries
The scope of work on industrial tracks
• The volume of transport work in water transport (according to the classification and volume)
• The volume of transport work by road (according to the classification and volume)
• The total volume of intermodal transport (by volume)

The distribution of the use of intermodal units by type:
- containers
- interchangeable transport vessels
- parts of road vehicles
- complete road vehicles
The largest users of intermodal transports.

Example of one output is shown in Figure 4. It presents share of transport quantities due to transport modes in the territory of Vojvodina.

![Figure 4](image1)

Figure 4. Projected output of transport distribution by modes of transport for APV (quantities)

![Figure 5](image2)

Figure 5. Projected output of distribution by type of goods for the APV in % (export)

Figure 5 is other example which gives visualization of data distributed by type of goods for the export of Vojvodina.

![Figure 6](image3)

Figure 6. Outfit of output for water transport (data for two years)

Figure 6 is example of output data and shows volume of transport work among ports of Vojvodina.

C. Determination of users of the information system

The users of the information system can have an unlimited or limited access to the data. Unrestricted access to information should be provided to:
• Partners of the information system, provided for certain types of goods is not required to limit access,
• The organs of state administration,
• Republic Institute for Statistics,
• Provincial authorities,
• Local governments - can limit access to certain data,
• Scientific and educational institutions - can limit access to certain data.

Other users of the information system should have limited access, and be charged with an appropriate fee.

D. Defining methodology for collecting data for monitoring

Province has an analysis of the flow of goods in their territory carried out by the Faculty of Technical Sciences in Novi Sad, 2012, entitled: Macro analysis of commodity and transport costs in the Autonomous Province of Vojvodina. Provincial Secretariat for Economy, Employment and Gender Equality has previously noted lack of this analysis and financed the production of the said study. The study is of strategic importance because no other exists and is the only existing document of this kind in the territory of Vojvodina. Flows of goods are constantly changing, they make a living process and therefore it is necessary to monitor changes continuously. How in Vojvodina at the moment there is no established system for monitoring the flow of goods, it is necessary to set up such a system as soon as possible. The proposal is that the Secretariat for Economy and Tourism should set up commodity and transport flows center of Vojvodina which could be called: Bureau for transport statistics.
National and regional institutions with local governments have great importance for collection of data. The Secretariat should compose a system for all stakeholders to be obliged to give all necessary data which would be requested as input to the database.

IV. DISCUSSION AND CONCLUSION

The paper describes survey which was performed to help define a pilot set of data which were implemented into the creation of database of commodity flow and to determine input points and output users of data with dissemination system of them. The paper proposes structure within Republic of Serbia which will enable collecting of data, their analysis and dissemination. Such approach will give picture of the state of the art of the transport sector and enable political body to bring political measures which will improve situation and above all, it will give data to all included into the transport value chain to note its role, to understand situation and trends, to see where the goods are coming from, there origin and where they are going to, to understand where the transport costs could be reduced and where are possibilities to spread their business in this sector. The aim of authors is to arise awareness about real need to constitute such an information system to analyze goods flow in Vojvodina and to finally start to collect data and use conclusions of analysis.

REFERENCES


