FORMING OF MULTIMODAL TRANSPORT NETWORK AS A PART OF SPECIFIC PRODUCT SUPPLY CHAIN

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ABSTRACT

The paper analyzes the forming of a multimodal transport network in a product supply chain taking into consideration the service user point of view. The study has been basically aimed at the analysis of the actual needs of the user and search for the optimal frame for designing a specific multimodal network for specific product supply with reference to the actual case of white cement import to Croatia from the designated origin in Spain. Respecting a complete overview of the entire process as well as good knowledge of the key elements of a specific supply chain enables the user to establish an optimal link between the origin and destination upon evaluation of transport choices and consideration of different priorities and criteria. The principal aim of the authors of this paper is to systematically elaborate the fundamental characteristics of the specific multimodal network giving the guidelines for optimization of a specific logistic supply chain.

1 INTRODUCTION

Planning a supply of a new product that is going to be presented to the market either for the first time or respectively in a new manner introduces the need to evaluate and form a right supply chain for the product as a main task of the user. Supply chain is a system that consists of sub-systems which are formed of suppliers, transport operators, third party logistic providers, final consumers etc. Decomposing the entire chain into specific processes and activities enables optimization processes by identification of each specific link. A major goal of this paper is to provide one of possible variants of a structural framework for forming a multimodal transport network in a specific product supply chain. The paper elaborates the multimodal transport link detected in actual supply of a product and gives an overview of processes of making a decision while choosing a multimodal operator.

Therefore, formation of an optimal multimodal network as a part of supply chain for the specific product, when origin and destination are previously defined, can be obtained by evaluation of transportation possibilities of the link and selection of optimal multimodal operators based on previously set criteria.

Results of the research imposed the need to elaborate the specific parts of the process that are explained in the paper. First part, Multimodal network as part of specific supply
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The process of supply chain design, as well as formation of the multimodal transportation network as its part has to recognize and to analyze the actual needs of the user, as one of the first, essential steps. The main, inevitable task at the beginning of the process is to classify the product on the basis of their demand patterns, which means that product can be primarily functional or primarily innovative [1]. Different kind of supply chain needs to be established according to the product demand patterns. Functional products are characterized with predictable demand while innovative products are characterized with unpredictable demand. Both product categories are characterized with other distinctive economical and logistic differences such as product life cycle, average stock rate, time required from ordering the product to manufacturing the product, etc.

Following the initial definition and decision, adequate supply chain has to be structured. It is essential to determine the physical function of the actual supply chain for the particular product which corresponds to the actual physical costs detection, which are in fact the price of material, transportation costs and storage costs.

Establishing the optimal transportation link between origin and destination is the main task of the user when origin of the product is known, and the price of material is defined as well as storage capacities of the user that are not unknown variable. In a specific product supply chain where origin and destination are identified, user has to evaluate the optimal transport link between the two points. Investigation and evaluation of the transport link includes the definition of layering model for specific network which provides a framework for analysis of the transportation system [2]. Multimodal transport networks are in fact multilayer transportation networks were lower levels are characterized with higher accessibility and defined for shorter distances while higher levels are characterized with limited accessibility and defined for longer distances. Evaluation of transfer possibilities between layers or more precisely, transport networks, is essential in the process of forming a specific multimodal network.

Logistic market research needs to give an overview of the transportation potential of the link. The network should explore the modal freight transportation infrastructure of the origin and destination points as well as the number of multimodal operators and third party logistic providers. Different market research and assessment methods can be used to collect the specific data from the operators: costs, modes of transport, service provided etc. depending on the user’s priorities.

Defining the priorities and criteria represents an essential part of the process. Criteria and priorities may vary depending on the type of the product, modes of transport etc. However, it has been established by numerous researches and surveys that cost, quality of the service and time needed to perform the service are the most relevant factors that make the difference between operators [3]. Strictly economical approach is mainly oriented on minimizing costs which is only one factor among economic, qualitative and other factors to be considered. Furthermore, analysis of the transportation cost of the link and evaluation of
criteria gives a basis for the framework for deciding which choice is the best for the particular product supply chain.

Selection of multimodal operators, depending on the specific criteria defined before, can include one multimodal operator for the entire link or several multimodal operators on different parts of the link. Niche multimodal transport operators have several advantages in comparison to mega multimodal transport operators [4]. Niche multimodal transport operators are usually specialized for specific transports and specific types of cargoes and they are used by mega multimodal transport operators on particular transport routes. Mega multimodal transport operators take the responsibility in organizing the transport on the entire transportation link and coordination with other operators, carriers, haulers and logistic services providers.

Establishing a network with one multimodal operator on the entire link gives several advantages such as contracting with only one party and passing the separate negotiation with terminals, ship-owners and haulers to the multimodal operator. Multimodal operator takes complete responsibility for the transport link by following and controlling every process in the link. Introduction of several operators at the specific link gives user control over costs and processes at specific points of the link but at the same time asks for more involvement in the entire process.

Each choice has its benefits under previously set criteria and preferences which enables the user to choose an optimal link for the specific supply chain. Development of specific multimodal network has to include the integration of all separate transportation and logistic models into a unified system which enables the user to form a right supply chain for a specific product.

Contract with the multimodal operator has to define the main relevant issues such as the subject of the contract, defined price of the service and other relevant and less relevant factors [5]. Recognizing the key factors and defining them in the contract is essential for qualitative control of the process. Number of contracts needed to cover the entire services of the specific multimodal network depends on the user’s needs and number of logistic services providers in the specific supply chain.

3 STRUCTURING THE PROCESS OF FORMING A MULTIMODAL NETWORK

Essential factors for the successful final result are the formation and use of a specific methodology in evaluation process leading to final selection of multimodal transport operators and third party logistics provider. Following steps can be used as a guideline for optimization of the process [6]:

- outlining areas of opportunity
- critical assessing user’s strengths and weaknesses
- deciding what is on the table
- identifying a shortlist of the providers that meet user requirements
- considering the human element carefully

Knowing organizational limitations as well as recognizing priorities and criteria represents a starting point of the process. Examining the network infrastructure of multimodal transport operators and logistic services providers, and comparing their capabilities with user requirements is the most demanding and time consuming part of the process. Inevitable key element is the evaluation of human resources in the organization. Existence of capable experts within the organization gives multiple options in choosing multimodal operators and logistic providers by having possibilities in contracting one transport operator or logistic services providers.
provider for the entire transport link or several transport operators and logistic services providers for different parts of the transport link.

Linear supply chain which links the supplier, distributor and the customer is a simplification of the entire process used by many authors but in reality, complex network exists between the origin of the product and the final user. Optimization of the multimodal transport network depends on managing the connections of the network and over viewing and controlling the entire process, thus making the final decision of choosing the transport and logistics services providers one of the main tasks.

Structural evaluation of the inputs from the market optimizes the process of formation of final multimodal network. Introducing guidelines for simplifying the decision into its constituent elements by breaking them down into smaller and more manageable components is essential in forming structural evaluation [7]:

- identification of the overall goal in decision making
- identification of all alternative options
- assessment of option performance against criteria
- valuation of performance
- weighting the objectives or criteria
- evaluation and ranking of options
- sensitivity analysis

Every particular choice has to be elaborated and based on previously set criteria. Consultation of number of sources has to be established as a starting and final point of the process.

Process of forming a multimodal network recognizes different stages in evaluation of the options: available, known, feasible, considered and chosen [8]. Evaluation of the options depends on the previously set priorities and criteria making the process of selection and decision structured. It is advisable to input data collected in the computer aided program which acts as a supporting tool in decision making process.

Impact of every decision influences the entire supply chain, with possible changes in transportation and logistic costs as well as deadlines defined by the user. Integration of activities in the links of multimodal network is particularly necessary when there are multiple transport operators and logistic services providers involved. Successful supply chain demands planning of each step in the process as well as recognition of all specific logistic services connected to every specific point in the chain.

4 MULTIMODAL NETWORK IN CASE OF WHITE CEMENT

Process of multimodal network formation as a part of supply chain for product of white cement has identified following key elements in the transportation link:

- origin inland transportation
- loading port
- maritime transportation
- unloading port
- destination inland transport

Every separate element includes specific transportation and logistics services that form the complete multimodal network along with origin and destination points, transport modes, multimodal operators and logistic services providers.

From the origin in Spain to destination in Croatia, white cement import has identified several key issues which needed to be carefully evaluated in the process of formation of the specific multimodal network. Origin of the product has been defined as cement plant located in the inland of Spain. Destination has been defined as warehouse place located at cement
plant in Croatia. Multimodal transport network included inland transportation network and maritime transportation network respective of locations of origin and destination, which according to the layering model, defined the specific multimodal network as two-layered. The specific two-layered multimodal network has included inland transportation network as lower level and maritime transport network as higher level as shown in Figure no 1.

![Diagram of multimodal transport network using two transport modes (truck and vessel)](image_url)

**Figure 1: Representation of multimodal transport network using two transport modes (truck and vessel); Source: made by authors based on Fiorenzo-Catalano "Choice Set Generation in Multi-Modal transportation Networks"

Initial task of logistic research attended the logistic surroundings of the origin and destination which has been oriented towards identifying the optimal and nearest ports that have existing container waterway routes. Identification of optimal ports depends on the actual proximity of the ports to the origin and destination points as well as inland transportation links to the ports and maritime transportation links between the ports.

Case of white cement import has identified several multimodal transport operators on the designated route. Specific data such as cost, delivery time and other specific services has been collected. Upon evaluation of the data based on criteria defined by the user, following link between origin and destination points has been established: one multimodal operator covered the organization of transport, documentation and information flow from origin of the product to the destination port; transport between the destination port and designated warehouse as destination point has been transferred to another provider of logistic services. Documentation and customs formalities at the destination have been covered by the contracted provider of those services. Final deliveries to the user’s terminals and final customers were organized by the user contracted haulers and customers depending on the final sales terms. The final established multimodal transport network, as shown in Figure 2, included several multimodal transport operators and third party logistic service providers which demanded greater involvement from the user in the entire process, in order to control the information and documentation flow.
5 CONCLUSIONS

Formation of a multimodal transport network as part of specific supply chain is a complex process that requires knowledge of the product and adequate supply chain. Establishing logistic research that follows market research provides the complete overview of the possible supply chain that corresponds to the product. Structuring the process and establishing a framework for deciding gives the decision maker the possibility to make a right choice that serves the market demand. Exploring all possibilities optimizes the process that leads to selection of the best scenario for particular product supply.

Knowledge of key elements of the multimodal transport network enables the user to investigate the logistic infrastructure and evaluate the options. Recognizing the user’s needs and preferences, and setting the criteria and priorities gives directions for structuring the process of forming a transport network. One of the most important key elements is the human element within the user’s organization. Depending on the expertise of the human resources within the organization, user has more options by having the possibility to control and overview processes in the entire transport network.

Introducing the chosen multimodal transport operators and logistic services providers to the actual supply chain forms the final multimodal transport network for the specific product. The final multimodal transport network is established when all of the transportation links and modes are integrated together with transfer points as well as origin and destination points. Control of the information and documentation flow is essential for successful multimodal network as part of product supply chain.

REFERENCES

