Technical note

DYNAMO PLV – DYNAMIC AND SEAMLESS INTEGRATION OF PRODUCTION, LOGISTICS, AND TRANSPORTATION

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Abstract

Production, logistics, as well as traffic and transport, are facing special challenges within their disciplines. Because of the multi-dimension of the problems, only an interdisciplinary consideration of these disciplines will lead to concepts which enable a sustainable value enhancement within the supply chain as well as a sustainable transportation development. The aim of a recently started German research project named Dynamo PLV is to transform existing separating interfaces between the disciplines into seamless connections, and hence to enable a deeper understanding of the decisions being made in the three disciplines and their impacts on the others. The following article will provide more detailed information on Dynamo PLV, and a deeper insight into the subproject 'Freight Transportation', in particular.

INTRODUCTION

In the context of globalisation, manufacturers have more and more links to worldwide active supply chains, which means a strong growth of freight transportation. Thereby, the transportation system is more and more reaching its capacity limit. This constrains our mobility, and changes the role of the transportation system from a facilitating to a limiting factor for production and logistic processes. Transportation-related decisions of the public authorities are also important. They are influenced by the same trends, and should consider the development of production and logistics. The seamless consideration of the segments is necessary to enable decisions aimed at an integrated optimisation of production, logistics, and transportation, and not for an optimisation of the single segments only. The aspired result of Dynamo PLV is a decision support system which transforms separating interfaces into seamless connections, and which should be available for decision makers in companies and politics as well as for transportation authorities.

PROJECT FRAMEWORK

The project Dynamo PLV aims at developing an integrated model to support decision-making towards an integrated optimization of production, logistics, and transportation. It consists of eight subprojects. Each of these subprojects follows the same research agenda to achieve the common aim of the project:

- A model typology is developed, and existing models are examined.
- Partial models are developed which serve for a pre-structuring of the overall model.
- Measures are developed which can be evaluated with the help of the new integrated model.

As supply, production and demand can be seen as core areas, five subprojects have been defined within these topics (see *Figure 1*). They are supplemented by transportation as the connecting factor, by

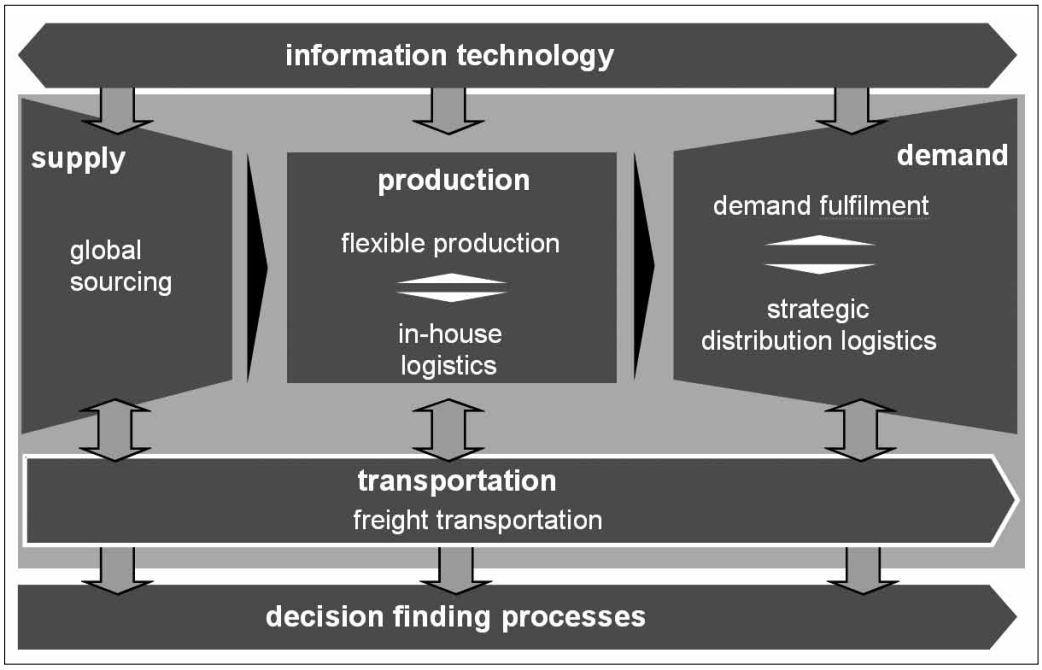

Figure 1
Structure of Dynamo PLV

information technology (see Buchmann et al. 2010) and by decision-finding in an interdisciplinary system.

In the transportation part, a detailed consideration of the effects of transportation measures on production and logistics on the one hand, and the effects of measures in production and logistics on transportation on the other hand will be considered in Dynamo PLV, with a focus on freight transportation.

FREIGHT TRANSPORTATION

Motivation

For a successful development of production and value creation, companies are dependent on the satisfaction of their transportation needs and hence on an economical attractive and reliable transportation supply. The traffic caused by them is termed commercial traffic (freight transportation and passenger commercial transportation).

The individual internal steering of commercial transportation by companies often competes with the collective design of transportation management according to the general goals: satisfaction of mobility needs, improvement of transportation safety, increase of economic efficiency, and protection of natural resources (Binnenbruck 2001; Roth 2009). At the same time, public authorities cannot consider all existing interdependencies between transportation planning and industry adequately, due to insufficient information.

Existing goal conflicts between production/logistic planning and transportation planning necessitate an interdisciplinary view for an adequate solution. For example, the reduction of the negative impacts on the environment caused by freight transportation is in conflict with the transportation requirements of companies. For an overall modelling approach an inclusion of all transport modes is necessary.

State of the art

Commercial transportation has been underrepresented in research for a long time (Flämig & Hertel 2006). Until now, the interdependencies between production, logistics and transportation have only been researched insufficiently and barely systematically. But this is important, in particular as the goal conflicts between economic progress and environmental protection are coming more and more into awareness nowadays (Boltze 2007).

Even if the data basis for commercial transportation and hence for freight transportation have been improved meanwhile, approaches for modelling the freight transportation demand have been only sporadic up to now. Amongst others, models are supporting decisions in transportation management and other areas by a calculation of the traffic volume differentiated by origins, destinations, time, modes, and routes. The spatial and temporal differentiated loads on transportation infrastructure – as a result of the modelling – are the basis for transportation planning (Steierwald, Künne & Vogt 2005).

For modelling the transportation demand, the sub-steps 'trip generation', 'trip distribution',

'mode choice' and 'trip assignment' are familiar in transportation planning. Transportation demand models are currently enhanced, e.g. with regard to a simultaneous integration of the different steps. So far, the focus of these developments is clearly on passengers. Neither consequences of decisions or incidents in production on transportation demand nor consequences of transportation measures on production and logistics are represented in existing models. An overall modelling of the interrelations between the disciplines production, logistics, and transportation does not exist at the moment (Clausen, Iddink & Neumann 2007).

Research approach

It should be possible to include requirements of production and logistics into the planning of freight transportation (Clausen et al. 2007) and, hence, into the management of the overall transportation system. On the other hand, transportation supply shall be included in the planning of production and logistics. This is important to reduce goal conflicts and inefficiencies between the needs for transportation and the basic aims of transportation planning. Therefore, information gaps regarding the interdependencies have to be identified, and they have to be closed with the help of different methodical approaches. Appropriate analyses for all transport modes, as well as from an intermodal point of view, are needed. Furthermore, suitable instruments for modelling these interdependencies have to be developed, and measures have to be adapted or newly developed with consideration of the interdependencies. As data basis, a typification of companies is necessary, to denominate their specific transportation requirements and to serve as a basis for a transportation model as well as for a decision model. This can be a basis for first evaluations of measures.

Therefore, in this project, the relevant features of freight transportation and which kinds of offers exist on the market are elaborated for the different transport modes, supported by a system-theoretical analysis as well as by surveys. Then the interdependencies between the different areas are structurally typified, based on a comparison of the freight volume relevant characteristics of production and logistics with the identified features. Supported by extended surveys, the interdependencies are valued with regard to their relevance for decisions affecting the demand for freight transport, and production and logistics respectively. They are described with the help of qualitative and quantitative parameters, which are identified by literature review, system-theoretical analysis and surveys. In doing this, fundamental aims are the determination of the evaluation of these parameters by decision makers, the identification of influencing variables on this evaluation and the relevance of the scatter of these parameters to the decision makers' behaviour.

The reproduction of parameters and interdependencies behind these parameters in the existing freight transportation demand models are analysed, with regard to all transport modes. Possibilities of simultaneous or sequential modelling are considered. The research needs for the development of models including the different interdependencies, the resulting necessity for a refinement of the models (e.g. temporal distribution), as well as the need for investigation for the calibration and validation of models are specified. On that basis, a master plan for the overall modelling of freight transportation including its interfaces to production and logistics is developed.

Existing infrastructural, regulative, financial, and informational measures, which influence supply and demand throughout all transport modes, are structured by an analytical approach. This catalogue is supplemented by new measures. Freight transportation-relevant measures, which have a positive influence on the parameters mentioned above and their underlying interdependencies, are identified out of this catalogue. By estimating the effects, among others with the help of freight transportation demand models, some transportation-related measures are improved as examples and new ones are developed. One example here could be an enhanced approach of mobility pricing.

The results shall serve as basis for an inclusion of interdependences between production, logistics, and transportation into decisions regarding measures relevant to freight transportation by decision makers in public authorities.

Using the results in Australia or New Zealand would probably need some adjustments due to different circumstances (like company types or geographical conditions), but nevertheless they can also bring benefits to the research here, e.g. by improving forecast models (see Jewell et al. (2007) for examples of recently used models in New Zealand). In addition, current research about intermodal aspects of mobility pricing which is conducted at the University of Canterbury, Christchurch, could benefit from the findings as it also considers the effects on freight traffic.

PROJECT DETAILS

With a project start in January 2011, the project is scheduled for three years. The project is conducted by eleven professors from Technische Universität Darmstadt, Germany, and from European Business School, Wiesbaden, Germany. This includes one new junior professorship in Commercial Transportation.

To ensure a close collaboration between the involved parties, regular meetings of all participants will take place. Furthermore, the partners will try to use international experiences for their research, and also to stay in contact with ongoing research projects connected to this area.

Additionally, the work done at the universities is accompanied by the implementation of an economic advisory board, which consists of representatives of ten companies and public authorities. The advisory board meets at least once a year to discuss the findings of the researchers and to provide input and impulses for the further research.

The project is part of the LOEWE program and therefore funded by the German Federal State of Hessen. LOEWE stands for State Initiative for the Development of Scientific-Economical Excellence and started 2008. Meanwhile 84 projects are supported by this initiative.

For further information:

www.dynamo-plv.de (in German)

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