Standard Software for Supply Chain Design and Optimization

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Abstract

Immense levels of data and the complexity of current logistics networks have made software support indispensable. Recurring calculations in network design and transportation planning can be automated with the help of planning software. Furthermore sophisticated algorithms are available to improve planning performance and reduce planning efforts.

After a brief introduction of requirements in logistics planning, an overview of principal functionalities and applications of the standard software 4flow vista is presented. The paper focuses on manual and automated optimization techniques for network design and transportation planning and finishes with an outlook on future research in transportation planning which will be undertaken in the research project MultiTrans.

1. Introduction to supply chain design

In addition to the planning of sourcing, production and assembly, logistics have become a critical success factor. In order to control nowadays complexity, supply chain design has to be process-oriented as well as structure-oriented in the future. Supply chain design does not only focus on single locations, in fact it takes place globally and on a network-wide basis. Changing markets require continuous, fast and flexible supply chain design. Different scenarios have to be modeled within a very short timeframe in order to facilitate comparisons and enable a profound decision making in every stage of the planning process (figure 1).

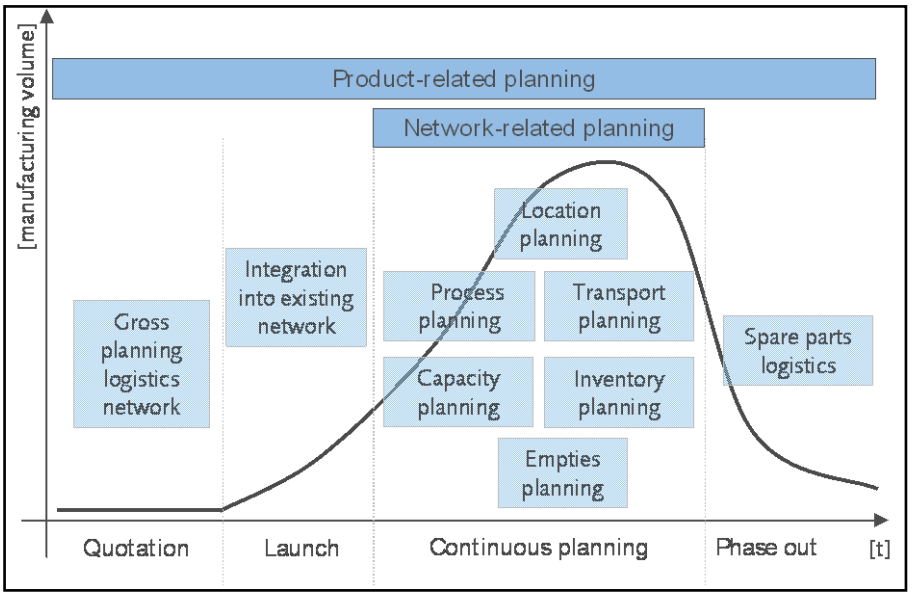

Figure 1: Functions of a continuous supply chain design across the entire product life cycle

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Future supply chain design will be characterized by a standardized planning process on a common, cross-functional data base. This ensures the planning consistency from development to volume production.

2. The idea of 4flow vista

4flow vista is the only standardized software solution for an integrated support of all supply chain design tasks. The logistics manager is enabled to flexibly map various planning scenarios (figure 2). The planning software 4flow vista can be applied intuitionally. For a complex network planning the consistency of the planning is crucial. 4flow vista ensures consistency throughout all levels of the network as well as within the various levels.

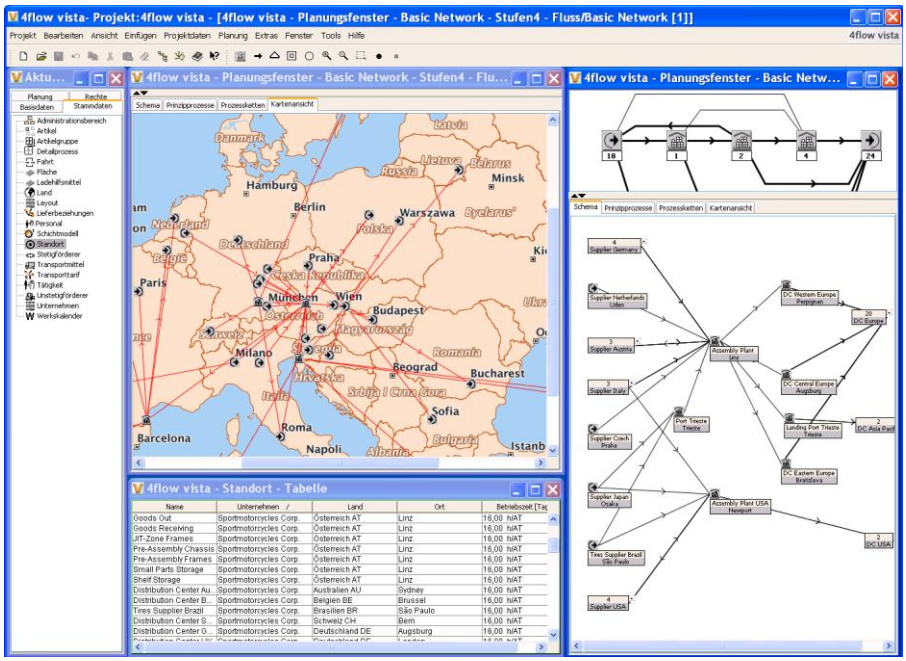

Figure 2: 4flow vista allows the planning in various views

Positioning of the software 4flow vista

The core competence of 4flow vista is the configuration of logistics (figure 3). Therefore, the functions of 4flow vista are to be assigned to the areas Supply Chain Design (design of structures and processes) and Supply Chain Planning (continuous planning of logistics) within the concept of Supply Chain Management. Since up to 80 per cent of the total supply chain costs evolve during the supply chain design phase, this stage is of striking importance. In all later phases costs and service can only be influenced on a limited scale and with disproportionate efforts.

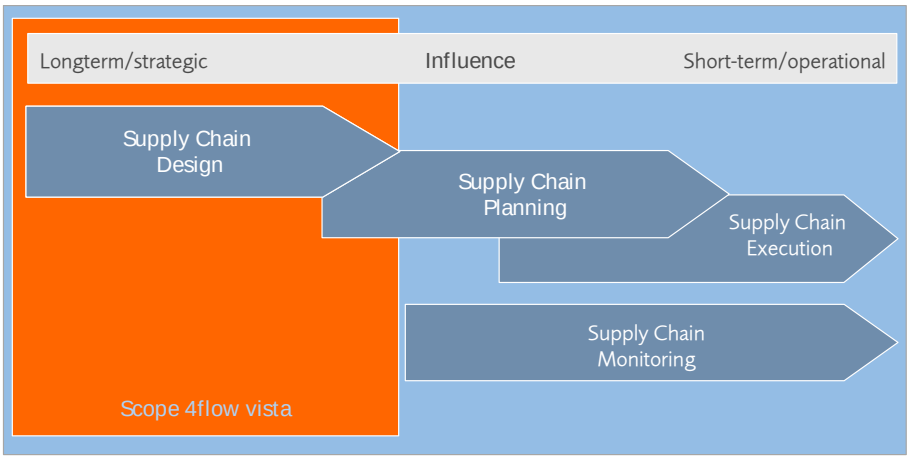

Figure 3: Integration of 4flow vista in the concept of supply chain management

Planning levels of 4flow vista

The entire design of physical processes and structures of logistics networks takes place on several levels (figure 4). Starting from a complete network, the planning of particular locations as well as certain functional areas – such as goods receipt, production/assembly, storage, picking, and shipping – will be required. In 4flow vista all of those planning levels exist and can be mapped. 4flow vista offers flexibility for planning-case specific applications: planning levels can be self-defined and interlinked. Chosen parts of networks - for instance locations or functional areas - can be chosen and viewed in detail.

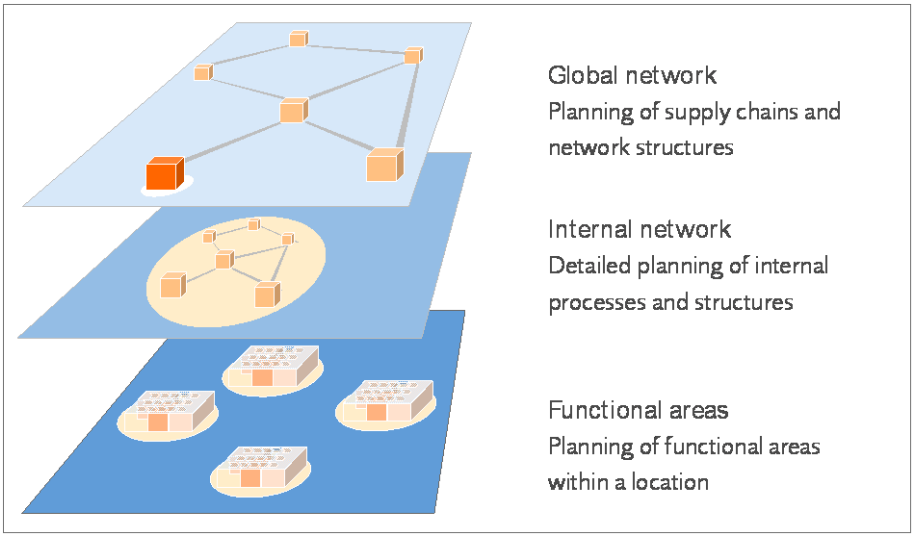

Figure 4: Planning levels in 4flow vista

Planning views

Various views are available for the planner: besides the geographic view, the network planning can take place in the schematic view as well as on the basis of process chains (figure 5). Switching between the views is possible at any time. Particularly in the case of multi-tier networks the schematic view is extremely valuable since different network levels can be visualized effectively.

3. Examples for manual and automated optimization with 4flow vista

Any planning project starts by defining the planning objects and the planning objectives. Subsequently, the user can start designing the networks in various scenarios. Different logistics alternatives are analyzed and processed. They serve as basis for the decision on the network structures and processes that shall be realized. Furthermore, a variety of mathematical optimization algorithms are implemented to assist planners in identifying favorable solutions.

Rough planning of logistics networks in the early product phase

During the early product life-cycle phase, 4flow vista supports the logistics manager in the comparison of various strategies. A typical use case can be found in the evaluation of Total Landed Cost for alternative suppliers, These scenarios can be modeled easily in order to pre-select those alternatives that require a more detailed analysis. Thus logistics, procurement as well as management receive a decision basis for the selection of suppliers, production sites, transport relations and means of transportation.

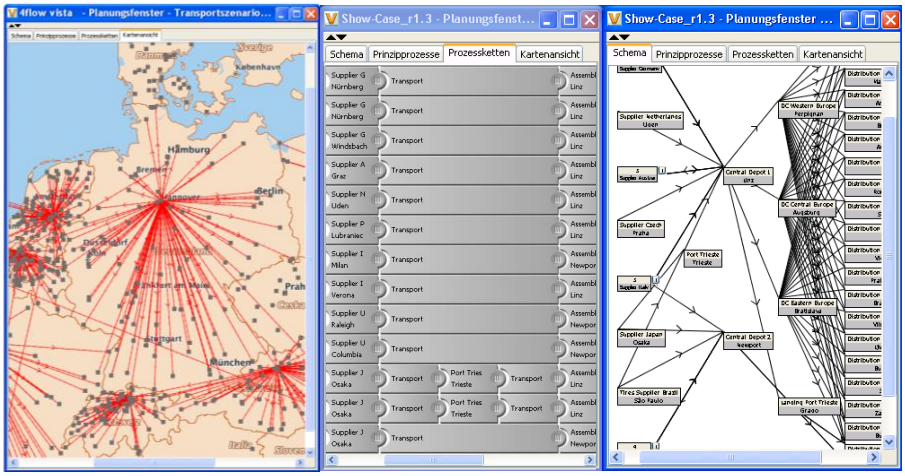

Figure 5: Visualization of locations and transports and processes in the various views

In addition to scenario comparisons, 4flow vista also offers a multitude of mathematical optimization algorithms for logistics networks. Among others, these comprise:

- Definition of the optimal number and position of locations (Greenfield),
- Relocation and/or closure of existing facilities, such that costs are optimized,
- Assignment of customers or suppliers to warehouses,
- Creation of regional groups (Clustering),
- Identification of the most cost-efficient and/or shortest lead time flow through the network (Routing).

Transportation planning

The transportation planning in logistics networks affects all planning tasks as a sub-question. In 4flow vista any carrier can be entered with its loading space dimensions, allowed payload and speed. In modeling the transport relations the planner defines the means of transportation used, their frequency and the underlying tariffs based on shipping price systems. Furthermore, the transit inventory is taken

into account by the resulting transportation costs. Apart from the mere transportation volume the weight, the dimensions and the stackability of the means of transportation are considered for the calculations of loading space utilization.

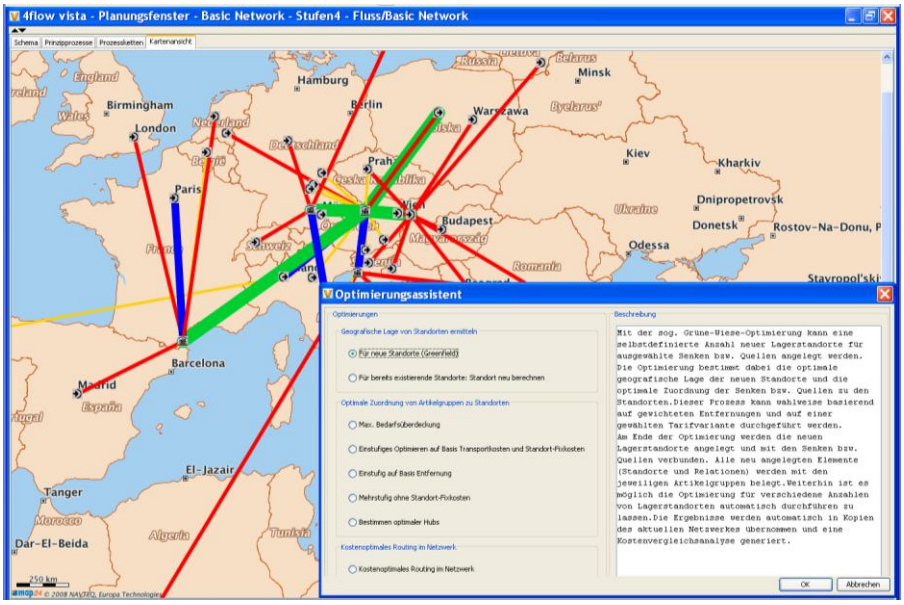

Figure 6: Optimization of selected relations within the transportation planning

4flow vista automatically optimizes transport relations by using mathematical optimization algorithms (figure 6). Thereby optimal means of transportation, transportation tariffs and frequencies are determined. Furthermore the appropriate milk-runs within a defined supplier region are identified. The combination of incoming and outgoing transports creates integrated transportation concepts.

4. Future trends and research

In order to create and sustain efficient logistics networks, software support is indispensible. As logistics managers are confronted with increasing cost pressure, complexity and globalization, new demand for supporting planning software arises.

In the research project MultiTrans (Multi-criteria Optimization for Transport Problems) advanced mathematical optimization algorithms for transport problems are developed. One main requirement here is the practical applicability of the algorithms. Therefore a number of restrictions derived from real world problems have to be taken into account:

- Complex transport tariffs (matrix tariffs, non linear tariffs, step tariffs)
- Special flow conditions (only certain paths are allowed)
- Capacity restrictions (maximum weights, maximum throughput, …)
- Characteristics of transported goods (weight, volume)
- Multiple objectives (minimize costs, minimize emissions, ...)
- Intermodal transports (train, road, …)

As result of the project, a reduction in planning effort and better planning results are expected. The developed algorithms should be applicable to large number of current and future industrial transport problems.