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SUPPLY CHAIN ENGINEERING AND THE USE OF A SUPPORTING KNOWLEDGE MANAGEMENT APPLICATION

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Abstract: The future competition in markets will happen between logistics networks and no longer between enterprises. A new approach for supporting the engineering of logistics networks is developed by this research as a part of the Collaborative Research Centre (SFB) 559: »Modeling of Large Networks in Logistics« at the University of Dortmund together with the Fraunhofer-Institute of Material Flow and Logistics founded by Deutsche Forschungsgemeinschaft (DFG). Based on a reference model for logistics processes, the process chain model, a guideline for logistics engineers is developed to manage the different types of design tasks of logistics networks. The technical background of this solution is a collaborative knowledge management application. This paper will introduce how new Internet-based technologies support supply chain design projects.

Key words: Logistics Networks, Knowledge Management, Supply Chain Engineering, Supply Chain Management, Business Process Reengineering

1. INTRODUCTION

Currently the different disciplines of logistics and several companies are looking for new instruments and applications to manage their distributed knowledge about the design of business processes, the planning of logistics facilities and the determination of other organizational aspects, like network strategies and policies, organizational structures, information flows, performance measurement metrics etc.. Examining the engineering process of physical products and software applications a new engineering methodology for logistics networks is developed to reduce the complexity of the design process of logistics networks. This is done by using an existing process reference model, by developing a project reference model and by collecting construction catalogues for several organizational aspects as described above.

2. CHALLENGES OF THE DESIGN OF LOGISTICS NETWORKS

»Large Logistics Networks« can always be found in domains where different goods or products are transformed and transported over several stages by different cooperating partners. They do not only include material and information flow but also the organizational framework, the required resources, policies for planning and control as well as the people acting in this environment [1]. Here, supply chains (SC) and value added chains are used as synonyms for logistics networks. The organizational framework for example covers strategic alliances, extended enterprises and virtual or multinational companies. Within this framework it is possible to identify supply networks, distribution networks, transportation networks, communication networks, reusable package pools, knowledge networks or other communities. All partners in these networks provide multiple but also complementary services or competencies. The components of these large logistics networks (organizations, resources, goods, information, knowledge etc.) are connected by numerous different relations [2]. The number of connections is growing permanently, because there is an increasing demand for more competitive products or services that can only be satisfied by cooperating with powerful partners within these logistics networks.

3. KNOWLEDGE MANAGEMENT AS A INVEVITABLE COMPONENT OF SUPPLY CHAIN ENGINEERING

The management of logistics processes as parts of large logistics networks needs the integration of all partners starting at the beginning of the design phase. By concentrating on core competencies OEM depends more and more on suppliers and service providers that have the knowledge and experience in providing integrated solutions for their customers. This means that for example logistics service providers are not only operators of transportation networks anymore. It also includes the integration of all partners and the management of the information and communication flow along the supply chain. Therefore, the management of knowledge has become a strategic resource for producers and logistics service providers.

Currently the Western industrial societies undergo a change from the industrial age to the knowledge society. In several industries, especially in high tech and in the service industry, knowledge has become a major part of the total industrial value added and often that share amounts to more than 60 %. At the same time, the business partners face a growing lack of guidance through all available information. The today's challenge is to determine which information is relevant for all acting people and how to provide it in different situations of given projects.

Knowledge Management (KM) is the explicit and systematic management of vital knowledge – and its associated processes of creation, organization, diffusion, use and exploitation. Knowledge is a critical asset of current business activities. It is the development of information products, business processes and business scenarios for the application of concepts and ICT (information and communication technology) for data and information management. KM can be divided into two areas: internal and external. Internal KM targets reflect the own company and internal organisational units. External KM focuses on the operation of knowledge products for external or public groups or organizations.

A leading edge KM in logistics networks integrates the adjustment of KM strategies to the different logistics tasks, the experience of detecting relevant information, the design of knowledge acquisition workflows and the configuration of technical solutions for information management.

KM means the availability of information and knowledge for the design of logistics processes as well as for management and execution tasks.

- **KM for Design Tasks:** Participants are decision makers, strategists and logistics planners designing and implementing systems and processes for material flow and information management. Knowledge for logistics design processes covers methodological know-how, modern design concepts and knowledge in best practices. Benefits are more excellent design alternatives and improved ramp-ups. This area is only been very few supported by ICT systems yet. The solution that has been developed in this project targets this area.
- **KM for Management Tasks:** This includes the monitoring of the operating logistics systems (capacity, inventory, orders, positions etc.) the management of historic data for analysis and the management of workflows (forecasting, dispatching, bidding etc.) for the collaboration. Additional training and qualification offers are essential. Here, target groups can be found on the management and on the administrative level

being prepared for a flexible alert management and skilled to perform improvement and innovation processes.
- **KM for Execution Tasks:** For the execution of logistics processes the work force, which often belongs to different companies, has to be trained and educated for their tasks.

Available solutions for KM put their emphasis either on internal or on external participants. Traditionally, requirements of knowledge management can be fulfilled by existing enterprise resource management systems (ERP), SCM-systems and other systems for communication and data analysis. Specific solutions also based on internet technology are internet portals, extended services of trading exchanges, integration platforms of competence networks and e-learning solutions. These new solutions allow fulfilling future requirements of modeling specific knowledge.

To meet all requirements, a deep understanding of the possible use and existing IT-structures is crucial. Beside this, a cooperative and communicative staff is necessary for the successful implementation of KM in logistics networks.

4. BUILDING-UP PROCESS OF A KNOWLEDGE BASE

As a normal information and communication, technology system (ICT) the Workbench at first only provides a knowledge base containing data objects, which can be linked together by the implemented works. As the knowledge base is empty at first it has to be filled or built up in a process of input. The users, either logistics planners or experts, who carry out and supervise this process, will be called here “editors”.

During the building up of the knowledge base, an analysis of real application fields of logistical networks by these editors is necessary. Either they analyse the logistical network itself or the planning process, which led to its realisation. The ideal state of affairs is the combination of both. As mentioned above, it surely will be possible in future to complement the knowledge contents by direct usage of the workbench in planning projects or by storing of intermediate and final results. This knowledge doesn’t have to be entered by editors but only, if necessary, has to be processed and checked.

The greatest problem for the editors is the identification of relevant knowledge contents. The following general procedure for logging knowledge has proved successful in the past. It is structured into several steps and does not exclude iterations.

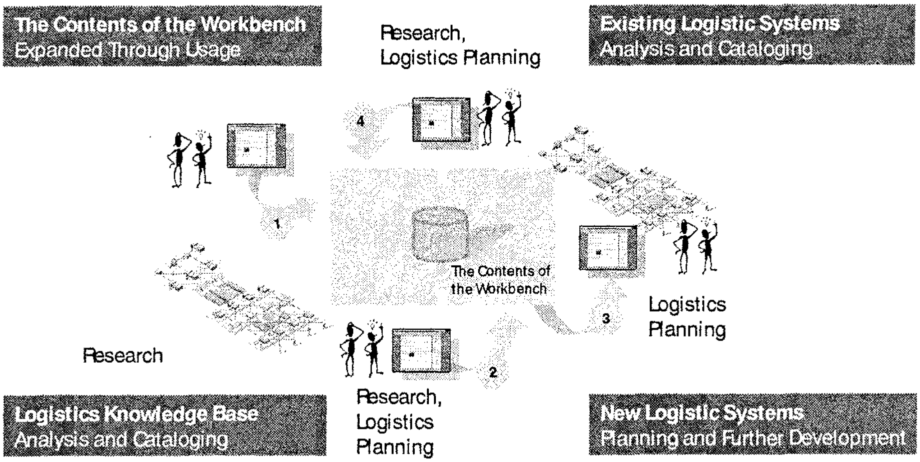

Figure 1. Use Cases for a Collaborative Knowledge Management Application for Design Projects of Logistics Networks

- **Selection of a subject:** the knowledge contents of the workbench can only be building up during a long-term process. Therefore it is functional that the editors concentrate on single subjects for which they should enter utmost complete knowledge into the workbench. One example for reactively complete knowledge would be the "Sourcing Process" as an example for processes. Another subject would be "Packaging Material" as an example for resources.
- **Delimitation and cut away:** the selected subject and, if necessary, the individual case of application are the range of analysis which has to be delimited sharply from things not to be taken into consideration. This is done by a mental border between those facts which are to be displayed in the following and those which are disregarded for the time being. A key word list which is structured corresponding to this pattern is helpful as well.
- **Pre-analysis of every single component:** the analysis of the analysis range has to identify roughly the knowledge elements which can be mapped in the workbench. For further details see chapter "data input" below. Concerning the subject Sourcing process we have to consider Sourcing processes, Sourcing concepts, transportation means, material flow systems, planning projects for the delivery chain and so on. This step is still done without using the workbench.
- **Collection of knowledge objects:** In the next step, after a rough pre-analysis, the knowledge objects in detail have to be collected. The matter in this case is the completeness of the collection of elements. A distinct

structure is not yet necessary here. For example all identifiable processes concerning procurement can be collected. In the first step the names of the processes and textual descriptions are put together. This information can either be directly entered into the workbench or can be registered in tables in standardised form.

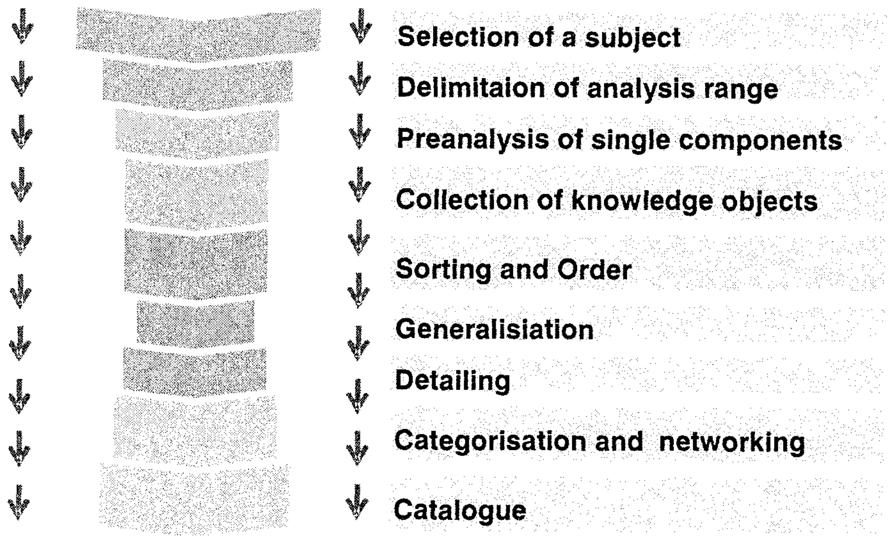

Figure 2. Procedure for building up the knowledge base

After this step a substantial intermediate result of the documentation of the knowledge concerning this subject is reached. Much relevant basis information has been registered as knowledge objects in structured form and is available for further working. This working can be done by the same editor or by other users.

– **Sorting and order:** If on the preliminary stage of collecting knowledge objects a certain number of similar ones have been put together it is practical to sort, structure and file them afterwards. This simplifies the finding of stored objects as well as the linking to other objects later on (for instance the linking of planning data to planning methods). The found procurement processes for example are subdivided in processes concerning information flow and processes concerning material flow. Main processes are set over partial processes.

This step introduces a number of other possible working stages. Yet superficially these are only further steps.

– **Generalisation:** During the collection of knowledge objects there may be equal or similar facts registered separately. These are put together to a comprehensive object during the sorting process. This leads to a consolidation and reduction of the collected knowledge on relevant information. Typical example for this are registered processes for which no general mapping rule can be developed. Single partial processes are put together to a comprehensive process and the contents are integrated.

- **Detailing of identified knowledge contents:** a model of knowledge can only develop by abstraction of real facts while the essential structures and features are supposed to be kept. In this case the task of the editor is to find a suitable middle course between closeness to reality and mapping expenditure. An example for this is the logging of planning projects and the description of the planning steps carried out. Surely one can find many recurring processing series. Here the editor has to recognise these steps as independent planning method, to abstract them as such and to insert them into the collection of methods.

The workbench provides several techniques for structuring and sorting the knowledge contents. The most important techniques are categorisation and cataloguing.

- **Categorisation**: the category system consists of several roots, the so called main categories, and the categories. Thus, the category system looks like a tree with several stems. But also possible are associations between categories so that single branches can be subordinated flexibly to other categories.
- **Cataloguing**: Thematically coherent knowledge objects can also be put together in catalogues. For this purpose first of all a catalogue for a particular subject is set up. Then already stored objects are attached to this catalogue. Within the catalogue, there are functions to sort and to typify the embedded objects.

An important component of this procedure is the review of the collected and stored information to ensure a high quality of the information and knowledge. It is obvious that at the first time the quality is a question of the design of the process of collecting and structuring the information. Secondly it is a question of additional features of the IT-System used for the knowledge management. Thirdly, it is a question of the motivation of the users and stakeholders of this system. These aspect will be the focus of the further steps in the project.

5. CONCLUSION AND OUTLOOK

In this research project the use of the Workbench will give further requirements for the design of additional features of the workbench.

However, the most interesting aspect of the use of this software pilot is the experience in using a knowledge workbench for sharing information between logistics planners in projects.

Successfully proven modeling elements like methods, construction elements and design process patterns [3], [4] will extent the knowledge base of the workbench. The Process Chain Model outlines the powerful combination between interdisciplinary approaches coming out of information technology, engineering, industrial engineering, economics and logistics.

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REFERENCES

1. Beckmann, H. (1996). Theorie einer evolutionären Logistik-Planung. Praxiswissen.
2. Kuhn, A. (1995). Prozessketten in der Logistik. Entwicklungstrends und Umsetzungsstrategien. Praxiswissen.
3. Beckmann, H. (2000). Supply Chain Method Handbook. Praxiswissen.
4. Laakmann, F. (2002). Knowledge Management and Applications for Supply Chain Design. *Proceedings of the 6th International Conference on Engineering Design and Automation (EDA) – „Engineering Practice and Education". Maui, Hawaii, USA, August 7-8*