Trend Database Design for Effectively Managing Foresight Knowledge

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Purpose

In 2010, the German Federal Government launched one of its largest research initiatives in the area of logistics and supply chain management with the central aim to secure tomorrow's individuality, in the sense of mobility and distribution, with 75% of today's resources. One of the projects, the 'Competitiveness Monitor' (CoMo) develops an innovative, web-based foresight platform, which supports strategic decision-making and contingency planning as well as competitive and environmental intelligence.

Sophisticated Architecture to Support Foresight Processes

The development of an innovative Trend Database (TDB) is part of an extensive cluster initiative that was launched by the German Federal Ministry of Education and Research in June 2010. The 'EffizienzCluster LogistikRuhr', synonym for leading-edge cluster in logistics and mobility in the German Ruhr area, aims to boost innovation and economic growth in Germany by bridging the gap between science and industry (BMBF 2010). The cluster involves 130 companies and research institutes that cooperate in a strategic partnership in order to shape a sustainable future for the region and beyond. The determined challenges of future logistics (e.g., urban supply) are currently being addressed in more than 30 joint research projects. In this way, the cluster contributes to finding new ways to growth and employment that gear not only Germany's but the European Union's economy towards greater sustainability (see, e.g., Schütte 2010).

One of the joint research projects is developing an innovative foresight tool, the Competitiveness Monitor (CoMo), which will contribute to the validity and robustness of foresight activities by digitally combining quantitative and qualitative forecasting methods. The CoMo aims to enhance cooperation in multi-stakeholder environments through a fully integrated web-based software solution that utilises existing knowledge and users' conceptions. The tool links several applications for forward-looking activities as well as the development, processing and storage of foresight knowledge. The goal is to provide decision-makers from business, academia and government institutions with a valid knowledge base for future-robust decision-making.

The CoMo consists of three innovative foresight tools – Trend Database, Prediction Market app and a Future Workshop ("Zukunftswerkstatt") app – which are implemented in an IT-based Futures Platform (Figure 1). The Futures Platform will serve as login portal in form of a dashboard and can be adapted by each user according to his or her individual interest. Within the TDB, future-oriented numbers, data, and facts on specific logistics-related topics or technologies can be stored or collaboratively developed by its users. Furthermore, the TDB shall not only include trend-related data but also handle weak signals, wildcards and disruptive events. The high practicability of the Trend Database is planned to ensure filtering of the query results through an intelligent algorithm.

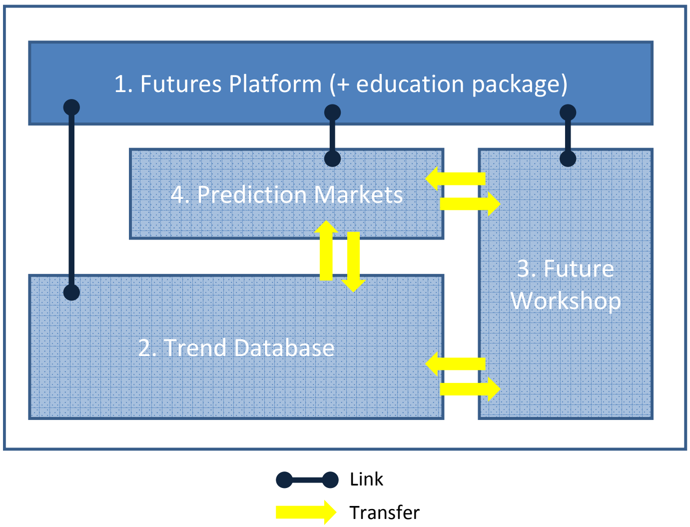

Figure 1: Conceptual framework of the Competitiveness Monitor

Development of Trend Database Requirements

In the beginning of the TDB development process, we analysed and evaluated eight relevant TDBs in order to identify the state of the art. After that, we conducted several creative workshops and interviews with more than 40 interdisciplinary cluster partners and futures researchers to identify further requirements.

First of all, we compiled an extensive list of requirements and constraints in several participatory workshop sessions, which are considered relevant to our TDB. After conducting a requirement analysis according to the 'Volere Requirements Specification Template' (Robertson and Robertson 2006), we derived four categories and adapted them to the CoMo project concerns: (1) functional requirements, (2) non-functional requirements, (3) design requirements and (4) constraints. Whereas functional requirements describe the fundamental functions and processing actions a product needs to have, non-functional requirements are the properties that they *must* have, such as performance and usability. We clustered the final long list of 160 collected requirements in 9 categories as presented in the following:

1	Automated analysis functions
2	Guided analysis functions
3	Individualisation
4	Input by user
5	Innovative & multimodal output options
6	Standardised trend information
7	Incentivisation
8	Internal & external linking
9	Integration & compatibility

In the next step of the TDB development process, we conducted a stakeholder analysis in order to generate possible use cases. Different use cases were defined according to the specific needs and organisational structures of the CoMo project partners and members of the *EffizienzCluster* involved. In doing so, we were able to conceptually test and complement the identified requirements and constraints.

Finally, we revised the results of the trend database analysis and specification analysis and summarised our research results in a specification sheet, which now provides a clear and structured collection of TDB features for the programming process of a prototype.

Challenges and Differentiators

For the identification of the key challenges, we evaluated best practices and innovative features of existing TDB concepts regarding their applicability and efficiency. For this purpose, we focused on the surrounding conditions and primary objectives of the presented TDB, determined by its purpose within the CoMo and the cross-project objectives of the leading-edge cluster. We identified four main challenges of utilising a TDB, which we will discuss in the following: (1) extent and quality of trend information, (2) cooperation within the TDB community, (3) linking mechanisms and (4) creating incentives for users.

Extensiveness and Quality of Trend Information

Most of the TDBs analysed provide an extensive set of opportunities to describe and evaluate a certain trend or future signal. Since it is hardly possible to decide without further knowledge about the user's purpose or what the right amount of information is, we continued to compare the ways in which future knowledge is contributed to the TDB. We see two main strategies within the examined sample of TDBs: (1) input from experts and futures researchers or (2) active participation of the user community. In the latter strategy, information is revised and complemented by the community, which more accurately meets the CoMo objectives of realising cluster potentials. However, in case of low interest in a certain trend, the information may remain fragmentary and lack reliability.

The combination of both strategies seems to be promising since it ensures certain quality standards as the information provided is subject to scrutiny from two sides: an expert review process, on the one hand, and user participation, on the other. Against the background of all our analyses, we propose that providing a certain amount of trend specifications (e.g., short description, key words, time horizon etc.) should be obligatory when entering a trend into the TDB. In addition, the CoMo TDB is planned to offer a regulator for the 'level of aggregation', which will enable users to constrain the trend search results regarding time, geography, economic scale and further aspects.

Cooperation within the TDB community

The so-called "wisdom of the crowds" is based on the logic that many people (a "crowd") know more than single individuals (Surowiecki 2004). Consequently, the sharing of knowledge can improve the knowledge basis of different stakeholders as well. Therefore, it is useful – particularly in dealing with future-relevant knowledge – to motivate users to co-operate and to develop their knowledge further.

Regarding our TDB architecture, users shall therefore evaluate trends in terms of impact or likelihood, participate in surveys or add further evidence or aspects to existing future-oriented knowledge (Kane and Fichman 2009). Especially the stakeholders of the leading-edge cluster, who are aiming to improve their competitive situation through collaboration, are interested in sustaining topicality, validity and relevance of future-relevant knowledge in the trend database. Our TDB is expected to contribute to an improved quality of data and provide a more accurate basis for decision-making processes.

Linking Mechanisms

The CoMo TDB will be linked in three dimensions. First, the trends within the TDB will be linked among each other. This supports users by providing a more comprehensive causal picture of the future and allows decision-makers to identify early warnings and weak signals. Second, the trend database is linked to two other CoMo apps: the Prediction Market and the Future Workshop. Both apps require raw data from the TDB for purposes of evaluation (i.e. prediction markets) or analysis (i.e. future workshops). Furthermore, they define data sources by providing new or evolved future-oriented knowledge, which needs to be re-imported into the TDB. Third, the trend database will be linked to external data pools. Facilitating the idea of linked data, relevant external information can be included, increasing the basis to be drawn on in making future-relevant decisions (Auer and Lehmann 2010). Thereby, we aim to link our dataset intelligently by attaching metadata using the Semantic Web approach. This not only facilitates the process of finding relevant and recent data but also enables identifying related topics.

Motivation of Users

In contrast to the traditional World Wide Web, the application of a Semantic Web offers information that can be sorted by relevance, topicality and quality (Berners-Lee, Hendler et al. 2001). However, the Semantic Web requires the linkage of datasets first. Therefore, users have to be encouraged to tag, for instance, the trend information as good as possible, and the community needs to be motivated to edit and complete the tagging process.

In the process of developing the CoMo TDB, we discussed several concepts and ideas to address the challenges involved in motivating users. One concept that is planned to be applied in the CoMo is the lead users approach (Leimeister, Huber et al. 2009) in which users are incentivized by an awareness of the measurability of their contributions. Considering that most of the existing trend databases use an expert-based concept instead, we infer that this was thought to be the only efficient way of providing and processing future-oriented knowledge so far. However, current tendencies, such as the disclosure of previously protected data (i.e. open source/innovation) or the increasing activity in social networks, suggest that existing concepts need to be adapted to the new requirements forward-looking activities must meet.

Metadata Approach Using the Semantic Web

Future-oriented knowledge as a basis for decision-making is always critical due to its inherent uncertainty. Therefore, innovative concepts and tools need to be developed in order to provide users with the most valid, relevant and up-to-date information possible. With our new TDB concept, we try to acknowledge current challenges such as motivation and collaboration of users, usability of information and modern linkage methods. To meet these challenges, we aim to link our dataset intelligently by attaching metadata using the Semantic Web approach. This not only facilitates finding relevant and recent data but also enables identifying related topics. However, the linkage of the data has to be conducted manually. Thus, motivating users to share their knowledge within the community is essential to provide an accurate and comprehensive picture of the future reflecting the wisdom of the crowd. Finally, we will design our TDB to present future-oriented knowledge in a sufficiently comprehensive and detailed manner with an emphasis on clarity and thereby aim to contribute significantly to the robustness and quality of future decisions.

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