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# Development of a Benchmark System for Collaborative Online Knowledge Management Systems

## Benchmark System and Visualisation for Analyzing Personal Knowledge Behaviour

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### Abstract

Network knowledge management in companies do not work without proactive motivation of their users. This paper describes the development of the different benchmark means of quantifying work together in measuring and assessing users' performance and thus stimulating their willingness to cooperate in their collaborative work as well as shows an example of how the benchmarks can be visualized.

**Keywords:** network knowledge management; incentive system; motivation; measurement; benchmark system; data visualization

### 1 Introduction

Well-established and popular groupware systems like Atlassian Confluence, Microsoft Yammer and many open source projects show the high standard of computer-based support of knowledge communities and work groups. Growing competition makes knowledge an increasingly important success factor for enterprises. The resource based view rates creation, organisation, and use of intellectual capital an essential competitive issue. Since knowledge is often exclusively attached to interpersonal exchange the cooperative and communicative aspect becomes highly important when it

comes to knowledge management. In accordance with the paradigm of cooperative and communicative knowledge management it is necessary to get over the dominating approach of knowledge warehouses and recognize the value added functions of electronic communication and interaction platforms for knowledge generation. The assumed supremacy of collaborative knowledge management is based on the productive exchange and sharing of knowledge among virtually connected groups which balances knowledge asymmetries. It has been shown that the participants in such electronic systems need to be proactively motivated and supported (Schanz, 1999). We want to introduce such a system.

## **2 Developing a Benchmark System for Social Media Enterprise Tools**

A key method to support and encourage employee motivation is to allow them to understand how they and their colleagues deal with knowledge. To create this understanding, it is necessary to define appropriate benchmarks. The significance of individual benchmarks is limited without knowing the context, so there is the risk of an inadequate interpretation of the individual benchmarks. To avoid this, it is necessary to present the benchmarks by means of suitable visualizations. The lack of meaningfulness of individual benchmarks is countered by the combination of a selected set of benchmarks. It makes sense to link several factually related benchmarks to a benchmark system that describes the relationships and mutual effects of the individual benchmark. To develop benchmarks for knowledge management, the well-known basic systems of bibliometry, as presented by Havemann (2009), can be used, adapted and extended. Such a benchmarking system must also provide the participants with appropriate feedback.

Starting at the basic functions in knowledge management tools, the following three basic variables for the development of benchmarks can be presented:

1. "Element": An element is a user, or any form of an entry, a "like", or other elements.
2. "Activity": An "element" is created by a certain activity by another element. This can be coded as subject-predicate-object triple.  
Examples:  
User (element) -> opened (activity) -> a blog (element);  
User -> comments -> blog entry  
Blog entry -> was commented -> by a user  
Space -> has been opened -> by a user
3. "Time": Each "activity" occurs at a time

With the aid of these triples (Element-> Activity-> Element) it is now possible to display various benchmarks. The activities can be differentiated by number (quantity) and by content (quality) and allows the development of different benchmarks.

To show the individual performance of users, automatically generated benchmarks are used. For setting up the incentive/motivational benchmarking component, it is not helpful to use a hierarchic method, since not all benchmarks are mathematically related. The more useful approach is to have the measures in an order defined by subject and content criteria (Hummel, 2003, p. 555). Grob (2004, p. 50) suggest a benchmark system for LMSs (learning management systems) from which we borrow the benchmarks: coverage, relation, and time range that are registered on different levels: system level, group level, and individual level. Coverage is generated from measures like number of participants and entries and is given as absolute numbers (and sums). The combination of absolute numbers generates relation figures. They are shown as percentage or index numbers (Schwicker & Wendt, 2000, p. 8). Time range figures are derived from monitoring long-time user performance. By analysing timelines, changes in benchmarks can be identified. To create qualitative benchmarks, text analytical methods must be used. Due to the partly very short contributions, it is difficult to carry out a meaningful content analysis, therefore such contributions have to be additionally enriched with metadata (descriptive keywords) by an author. This method can be used to determine which author writes on which topic. By combining certain benchmarks, then it is possible to identify a user is an expert on a specific topic.

### **3 Visualization of Benchmarks in Collaborative Knowledge Management**

A visual aid in the form of a graphical representation can considerably simplify the interpretation of the benchmarks by the observer. This is due to the shift of the mental interpretation process from the analytic to the visual part of the cognition. For the visual representation of communication relations, so-called knowledge maps are particularly suitable. Knowledge maps are virtual and represent immaterial data objects which are not related spatially to one another. The knowledge maps are divided into the two categories "concept maps" and "associative maps". The concept maps represent the subject areas in a specific arrangement and size. The size and extent of the subject areas characterize the semantic structure of the map. Concept maps are used in collaborative knowledge management, particularly to present the contributions of an individual actor, as well as to present the discussion context, and thus the knowledge distribution. The fact that concept

maps are not particularly suitable for the visualization of a hypertext-like system such as collaborative knowledge management lies in the fact that the edges are not explicitly represented. This problem is solved by associative knowledge maps (Däßler 2002, p. 13-18). The associative maps visualize only objects and their object relationships. In associative maps, two types of associative structures can be distinguished, the "tree structures" and the "network-like structures". The former only allow relationships between certain objects, while network structures in principle allow each object to be related to any other object. With this type of visualization, it would be possible to represent the discussion structure of whole groups. The analysis and visualization of the relationships in social networks is its own research field. The complexity of such networks is determined by the analyzed characteristics, such as centrality in networks, grouping, distribution of roles, different relationships of the same set of actors, or the comparison of different networks. The fundamental measures to characterize the centrality of an actor in a community and the measures to characterize the importance of an actor provide an excellent basis for analyzing the activities in a collaborative knowledge management tool (Dehmer, Emmert-Streib & Pickl, 2015, Cross & Parker, 2004).

The Atlassian Confluence tool is used as basic software. At present, 150 employees of an entrepreneurial research department, which are distributed over six locations worldwide, share their knowledge through this tool. The goal is to analyze the communication and the written texts (in the form of wikis), which person has what knowledge and how this knowledge is exchanged between the employees. In doing so, the employees should be given a transparent feedback on their actions through visualizations and thus be motivated to pick up the knowledge of colleagues, but also to hand over their knowledge voluntarily.

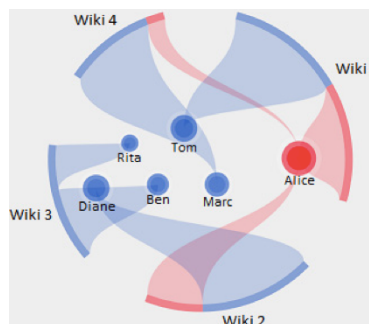


FIG. 1. Example of a wiki collaboration map for network knowledge management

Figure 1 shows at the individual and the overall contributions for selected wikis. Each node represents an author, red is the author who contributed the most, and blue is the author who contributed the least. The larger the node, the more contributions that author has contributed. Each arc along the circumference represents the overall contributions to a specific wiki. Each section of the arc and corresponding chord that connects to an author's node represents the contributions to a given wiki.

#### 4 Future Development

The comparison of the individual scores and making it visible to every member is also a strongly motivational momentum. It is also a proof of discourse control. It has, however, to be kept in mind that this benchmarks work on a quantity basis and do not reflect quality issues. To rate the quality of discourse objects, it is necessary to analyse content (intellectually and/or automatically). The first evaluation of the benchmark system showed that the benchmarks have to be refined and that advanced visualisations will be helpful. For the future, automatic text analysis is planned to be further developed, in order to be able to identify experts and thematic clusters better. Furthermore, it should then be possible to analyze questions from users and forward them automatically to the relevant experts for the purpose of answering them. In addition, the visualization system will be extended by extensive interactive presentations. With the aim of motivating the participants to exchange their knowledge with their colleagues more and more, methods of gamification will be used.

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