

# DYONIPOS

## *Redesigned Knowledge Management*

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**Abstract:** Traditional knowledge management is often combined with extra work to collect the information again which is already electronically available. Another obstacle to be overcome is to make the content of the collected information easy accessible but. At present conventional searching tools provide only documents and not the meaning of the content. They are often based on the search after character strings, deliver many unnecessary hits and no or less context information. DYONIPOS offers a new way. The research project DYONIPOS focuses on detecting the knowledge needs of knowledge workers and automatically providing the required knowledge just in time, while avoiding additional work and violations of the knowledge worker's privacy. This knowledge is made available through semantic linkage of the relevant information out of existing artifacts.

## 1 INTRODUCTION

Current Knowledge Management approach: a knowledge worker shortly wants to prepare an important topic but he neither knows where the according information is stored nor what colleagues he can ask for expertise. To get an overview about the topic, he normally proceeds in the following way: he successively searches in the available sources (server drive, own hard disk, internet, e-mail archive, specific applications, etc.) for important information with different "search tools". Therefore he has to run each query individually. In addition he must know the various functionalities of the different "search tools". Finally he has to screen the delivered search results if they adequately describe the relevant topic.

Knowledge Management with support of the DYONIPOS prototype: after activation of DYONIPOS, all keyboard entries and mouse moves are recorded as well as the reactions of the computer system. For instance, if the knowledge worker begins to create a power point presentation DYONIPOS is looking the knowledge worker over

his shoulder. DYONIPOS calculates information needs to the entered words. The knowledge worker edits for example the title page for his presentation and writes "DYONIPOS (DYnamic ONtologybased Integrated Process OptimiSation): Effective and Efficient Knowledge Management science and research hand in hand". DYONIPOS detects the knowledge needs, e.g. "DYONIPOS", "Knowledge Management" etc. In addition, DYONIPOS calculates so called "resources". These are corresponding documents, PDF-files, links to websites, electronic record management data (ELAK) which cover the information needs. The knowledge worker gets these resources indicated only by request. In fact, constantly local and global search results are delivered only if the button for this function is pressed. Apart from this associated concepts of the topic and the detected information need are indicated. These are for example individuals or organizations which deal with this topic. Besides the proactive support, DYONIPOS also offers active search for information.

This is done similar to conventional search tools via entering of a search item in a search window.

Moreover DYONIPOS enriches the further handling and analysis of the indicated search results. For example important key words can be displayed which represent the content of the knowledge resource as well as association graphs that visualizes the relations of the associated concepts. DYONIPOS also classifies the detected resources and visualize them in topic landscapes. In these topic landscapes, thematically similar resources are mapped closer together. Through the use of DYONIPOS knowledge workers get an impression of the content of search results without having ever read them. Furthermore, existing knowledge in an organization becomes available, transparent and semantically enriched.

## 2 KNOWLEDGE MANAGEMENT

"Knowledge is relevant information in context"; this is the underlying definition of the DYONIPOS project. In public administration knowledge has always played a central role because the production of public services would not be possible without knowledge. As a matter of fact knowledge workers need more and more knowledge for processing their daily knowledge intensive work. Furthermore the ad hoc part of the processes increases steadily. Knowledge acquisition also becomes more complex because the amount of information increases continually and heterogeneous systems are used to obtain the needed knowledge. In addition the multitude of found information complicates the selection of the really needed knowledge. This leads to the fact that already existing knowledge gaps grow, respectively available information is not used. It is often not recognized that knowledge gaps exist or that information is available – even in the own organization – which could be used for streamlined processing or better results. Implementing e-Government is intended to solve these problems not just by using information and communication technologies to exchange information with and to provide services for citizens and businesses. What is more, e-Government should also provide better and more efficient working conditions for civil servants in order to boost agility of public administration and quality of public services. DYONIPOS aim is to provide personal, agile and proactive support for the knowledge worker by means of proactive, context sensitive knowledge delivery. The DYONIPOS vision of knowledge management is that knowledge management works for people, not that people work for knowledge management. Additionally the system should adapt to the wishes of the peoples and not the

other way round. The main idea is to release knowledge workers from additional work for knowledge management. For reaching the project visions, a completely new approach with technologies „on the leading edge“ was used to develop the prototype DYONIPOS. Conventional search applications currently deliver only documents – DYONIPOS also delivers the knowledge stored in these documents.

## 3 KNOWLEDGE DISCOVERY TECHNOLOGIES

The identification of knowledge gaps, the just in time delivery of relevant information, the supply of associated concepts related to the corresponding topic and further analysis through filtering and evaluation of the delivered information are the major functions of DYONIPOS. To provide these functions DYONIPOS captures the user's knowledge work, discovers inherent tasks, and supports the knowledge worker with information.

The first challenge is the observation of the knowledge worker's interactions with and reactions to the system and existing application data. This data is the so called low-level sensor data on the application and operating system level (Maier, 2005, p. 443). The second challenge is to develop adequate techniques to discover work patterns and to automatically support users with appropriate information. The third challenge is to detect how knowledge workers can be effectively supported (Tochtermann, 2006).

In order to capture the worker's patterns a java tool called DYONIPOS Task Recognizer has been implemented (Rath, 2007). At first DYONIPOS records all interactions between the users and their computers; these are so called "events", e.g. mouse clicks or key strokes. Different sensors of the context observer module observe all interactions of the user with the desktop environment. DYONIPOS uses a key logger program to record and log all recognized events (Kröll et al., 2006; Rath et al., 2007). The observed events are stored in the so called event log. This monitored data is the basis for determining the work patterns. The next step is to reduce the immense quantity of data and to assign events to event blocks by filtering and relation analysis. This allows the elimination of irrelevant data, e.g. mouse movements. Owing to relation analysis a set of events can be bundled into an event block. At present, generic rules, application based

rules and web browser based rules are applied for bundling events into event blocks (Rath, 2007). Generic rules are based on the title of the window currently opened by the user. A reason for the assignment of events to an existing event block is e.g. the title of the window currently opened. The implementation of further rules for assigning events to event blocks can easily be accomplished. The methods used for learning task assignments are k-nearest neighbor classification, Support Vector Machines based on graph kernels (Rath et al., 2007). Additionally there is the possibility to train the classifier, i.e. the above mentioned bundling agent, by means of task assignments is done by the user. A method for detecting tasks, which is the next level of semantic enrichment, is clustering based on similarity between content and structural features and the scatter/gather approach. During the first test phase the assignment was initially performed by the key-user but in the second test phase the classification of features and tasks worked automatically and had only to be controlled by the key-user.

#### 4 SEMANTIC TECHNOLOGIES

DYONIPOS is a modern information system which supports users by proactive delivery of contextual information (resources) while knowledge workers are doing their daily work. The use of ontologies is useful in such a system, because they ensure interoperability and the development of "new" knowledge. Furthermore, ontologies are used for the learning process of the user context. Not only the structure but also the recognition of context is based on ontologies. The knowledge base and also the internal program flow are based on ontologies. In addition ontologies can be used for the unambiguous description of information resources. As a consequence, Resource Description Framework (RDF) is a key technology of DYONIPOS. RDF is an ontology and a formal language used to encode ontologies. All events, event blocks and tasks described in section 3 are represented and stored by RDF-Triples (Kröll et al, 2006).

#### 5 THE USE-CASE PROJECT DYONIPOS

Parallel to the research project DYONIPOS the use-case project DYONIPOS is implemented in the

Directorate General for Information Technology (DG-IT) of the Federal Ministry of Finance, Austria. In order to handle their daily work, knowledge workers in public administration need the following additional knowledge:

- Where is the relevant information stored?
- How can this information be found?
- How relevant is the delivered information?

The challenge is to provide administrative employees automatically with information they need. Consequently the above mentioned additional know-how is made available by DYONIPOS. Other objectives are to support the employees of the DG-IT without creation of additional work by means of knowledge management and to ensure privacy of the knowledge workers. DYONIPOS contribute to the resolution of these challenges by an efficiently and an effectively support of the daily work of the individual employees in the DG-IT. The DYONIPOS Task Recognizer provides employees with the necessary knowledge produced by semantic cross-linking of the relevant information from the existing repositories and processes. Additionally, DYONIPOS independently develops new relations between sources of knowledge. This explains why the DYONIPOS Task Recognizer at the one hand supports the user by visualization of existing documents, files or websites etc. and on the other hand displays the new generated information such as the name of the person who has the specific know-how. The ministry or rather fifteen employees support the research consortium. Together they work on the realization of the research results and they ensure the transformation of current scientific results into an easily useable software solution. The staff of the ministry shares its domain specific know-how with the research consortium, by supporting the development of DYONIPOS base technologies.

Initial interviews with employees were carried out to get both, an impression of the kind of work and how this work is done. The results of these interviews provided information which sensors should be developed and which events the sensors should observe. The researchers found out that employees work mainly with standard applications such as Microsoft Office tools, Internet Explorer and the e-mail system Novell GroupWise. That is why a first research step was to develop sensors to observe events of these applications. In addition to the observation of these standard applications the final DYONIPOS prototype records all electronic artifacts from the electronic record management system (ELAK), the file-system on the servers, the Livelink-system (a system to store office documents in a

specific server environment) as well as the specific application KOMPASS, a system to administrate persons, resources and authorizations.

## 6 THE RESULTS OF THE FIRST AND SECOND TEST PHASE

Through evaluation of the log files, questionnaires and the analysis of the first and the second test the following information and operating figures about the key-user and the DYONIPOS Task Recognizer were derived. A basic result of the evaluation of the first test was that key-users always worked on several tasks at the same time. This information represented a challenge for DYONIPOS, because it is an objective of DYONIPOS to provide just in time information based on the context. Furthermore we found out that a key-user used different searching tools and searched in very heterogeneous sources. Another objective of DYONIPOS is to support the work of the user by proactive and context sensitive information delivery. DYONIPOS therefore searches for information in different repositories and implements the function of a searching tool. Moreover it creates cross-links between the context of different repositories in order to deliver existing and new generated information. By using DYONIPOS knowledge workers receive transparency over the existing sources of information.

DYONIPOS gives additional references about the relevance of the found search results which include all currently available information. The parallel implementation of the funded research project and the use-case project made it possible to exchange ideas between research and practice constantly; this was useful for both projects. Furthermore the inclusion of all stakeholders (Makolm & Orthofer, 2007, p.391) such as researchers, users, IT experts and also the staff council – in the development process assures that the results of the research project DYONIPOS can and will be transformed optimally and in real time into a practical application.

The second test phase was started in January 2008 and took approximately two months. A fundamentally improved version of the prototype DYONIPOS was released. It established an organizational knowledge base with new functionalities and also included artifacts stored on the server.

The third prototype enables the classification of detected resources and the visualisation of topic landscapes (see Figure 1). In the topic landscape, thematically similar resources are mapped to close regions. Moreover, the selection of different resources and the display “how similar they are” is possible. In addition, DYONIPOS allows the selection of artifacts according to sources e.g. file system, KOMPASS, ELAK and Web.

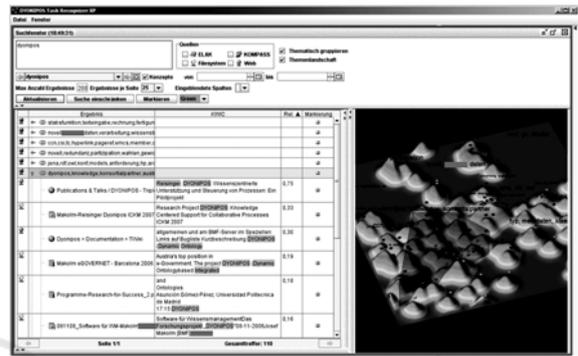


Figure 1: DYONIPOS enables the display of information in topic landscapes.



Figure 2: The graphical user interface of DYONIPOS.

Figure 2 shows the DYONIPOS user interface. When the task recognizer is started, all mouse clicks and tasks are registered. Information needs for a certain topic are recognized. On demand the user is provided with information that he searches for or that is related to the content of his work. If the user works for example on a power point presentation concerning the topic DYONIPOS, the task recognizer shows all web resources, presentation, word documents etc. related connected to this topic in the “global search results”. To every newly entered word or sentence, DYONIPOS searches for information or concepts in the personal and organizational database which could be useful for the knowledge worker. While the user is working on

a particular topic, the DYONIPOS task recognizer is always shown in the right front of the desktop. As a consequence, information found by the application appears permanently. If this is not wished the task recognizer can be minimized.

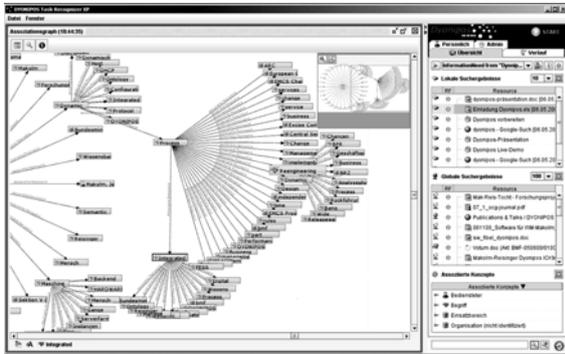


Figure 3: Screenshot of the DYONIPOS Task Recognizer.

Figure 3 shows the graphical user interface of the DYONIPOS Task Recognizer window for the third test phase. Like in the second test phase, different tabs allow the navigation between the various delivered supplied resources and functionalities. On the screenshot the tab “Übersicht” (overview) is opened. On this tab the so called “Information needs” are mapped at the top. The deduction of “Information needs” occurs automatically, but for performance reasons the related resources are measured only after clicking on the activating button. Afterwards the detection of the individual and global resources related to the “Information Need” gets started. With the help of filter criteria e.g. filtering on associated persons or organization, the located search results can be improved once again. In addition also the associated concepts such as the name of experts, terms, application areas and organizations corresponding to the particular topic are offered. “Information needs” will be stored and may be calculated again at a later date. All located resources are opened directly in its operational application. For example, a located e-mail can be opened in the associated e-mail application with a double click. A key-user has also the possibility to search actively for information in the iteratively generated resource repository by using the search field. This search field is displayed on the screenshot at the bottom next to the magnifying glass. On the left side of the screenshot an association graph is opened. This graph shows different associated concepts regarding a selected resource. On the tab “Persönlich” (individual) the adjustment of personal DYONIPOS functionalities can be carried out, e.g.

the deletion of knowledge, which is stored at the organizational knowledge base. On the tab “Verlauf” (progress) all finally opened resources is displayed. Furthermore the release of these resources to the organizational data base is possible on this tab. The tab “Admin” with the corresponding authorizations is only available for administrators. This tab contains diverse control functions for assembling of the index, the internal system procedures, the KOMPASS-mappings etc.

Figure 4 shows the star-shaped graph of the associated concepts. Because of the identified information needs, the DYONIPOS task recognizer also indicates associated persons with certain concepts. The graph which shows these concepts is mapped star-shaped here and has the name of the person in the centre. In the association graph, those persons, organizations etc. are identified that are connected with several topics linked to information need. Furthermore it is displayed for which company respectively which department the person works and contact details are given. In the same way the graph points out, for which other projects the person works or rather with which concepts he or she is identified. Consequently links to further information are available by clicking on a symbol. For example if the person is responsible for semantic technologies, information about “semantic technologies” can be received.

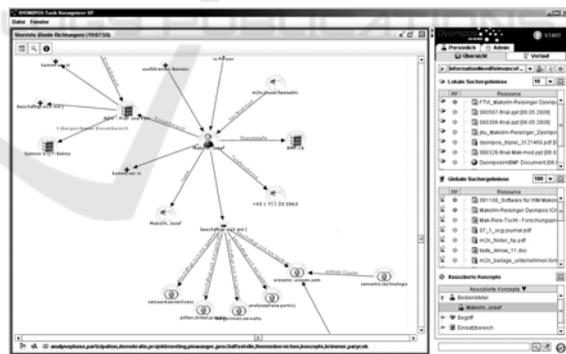


Figure 4: Screenshot of the DYONIPOS star shaped association graph.

Finally the third test phase starts in November 2008. Starting in February 2009 the whole DG-IT or rather all 180 employees will take part in a final test of the prototype DYONIPOS. The final evaluation will be done after one year of practical experience. The documentation and evaluation of this final test provides the basis for the decision whether DYONIPOS will be used in the DG-IT further on. In the same way the decision will be made whether

DYONIPOS should be proceeded as a commercial tool or not.

## 7 FUTURE TRENDS

In the DYONIPOS project, the Directorate General of Information Technology of the Federal Ministry of Finance is innovation driver and solution provider at the same time. Altogether 15 key-user from different areas and selected experts support the research consortium directly with the implementation of the pilot software. Through the joint venture of science, economy and public administration good results could be generated. DYONIPOS supports above all organizations which collect knowledge in a written form, which do a high part of knowledge intensive activities, which are active in a very dynamic environment and implement ad-hoc processes. DYONIPOS is a very flexible system. For the implementation of DYONIPOS open standards such as RDF, OWL and Jena are used. The DYONIPOS system is model-based and can be individually configured. The connector principle enables the integration in different IT-landscapes. The scale and the performance allocation can also be individually adapted.

## 8 CONCLUSIONS

The use of DYONIPOS leads to an increase of the effectiveness of the knowledge organization. This is because not only the own individual knowledge is available for the handling of the daily work but also the global organizational knowledge is supplied proactively. Likewise, more knowledge can increase the quality of products since important information can be considered for the creation of products. DYONIPOS can also contribute to a reduction of double work because similar work that is already done is automatically indicated to the present topic. Due to the fact that work can (partly) be used again valuable work time can be saved and consistency can be assured which ends up in a more efficient work method. Furthermore DYONIPOS improves the individual work situation of single knowledge workers. Workers of a knowledge organization can concentrate on their core responsibilities as bureaucratic activities are reduced. In addition, DYONIPOS links individual employees through the indication of potential conversational partners and

therefore encourages the cooperation and the exchange of information in a company. Newest leading edge technologies are tested in the DYONIPOS research and use-case project. It can be concluded that the joint venture between research, economy and administration was successful.

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