TRANSFERRING KNOWLEDGE FROM RESEARCH TO INDUSTRY: EXPERIENCES FROM GERMANY

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Abstract

In the past 10 years a research cluster in engineering science has been set up to create completely new materials as well as appropriate machines and production processes. To support the collection, storage and analysis of complex process data within that cluster several IT & process management methods and tools have been developed. Now entering the final stage of the cluster, the focus changes to the efficient usage of the created knowledge. To support the technology transfer process the previously created methods and tools are enhanced. In this paper, a software system supporting the controlled and secure transfer of engineering knowledge from research to industry is presented.

Keywords: Knowledge transfer, engineering science, software development.

1 INTRODUCTION

Energy efficiency is one of the main goals in industrial engineering nowadays. One way to meet the challenge is the usage of lightweight structures (Milwich et al. 2006). In 2004 a research cluster was initiated in Germany to develop new materials (mostly textile-reinforced composites), necessary machines and appropriate production processes (Hufenbach 2006 and 2011). To help the engineers in dealing with the huge amount of data from simulation and real life experiments a special IT project was initiated.

The main goals of that project were to create methods, tools and software for the engineers supporting the collection, documentation and analysis of data (Weller et al. 2010). Thereby the following challenges arose:

- Huge amount of data
- High complexity of the data with hundreds of (process) parameters affecting each other
- Distributed research centers
- Creating data analysis software for engineers with no or less mathematical knowledge

To address these challenges methods under the term “technology data management” have been created in the past years (Großmann and Wiemer 2010, Großmann et al. 2011, Hufenbach 2011), which help researchers to handle innovative process chains by attending all process steps and creating a holistic approach for process understanding, data collection and analysis. Additionally an online software tool has been created (Großmann et al. 2013, Wiemer 2013).

After more than 10 years of research the cluster enters its final stage. Thereby the focus of the IT project changed from supporting knowledge creation to supporting knowledge transfer, especially the transfer of research results from the R&D departments to industry.

This paper deals with the aims of such a transfer, the kind and structure of the knowledge items to transfer and the requirements regarding a software system supporting technology transfer. Additionally a possible design of a technology transfer platform is discussed.

Therefor the paper is structured as follows. Section 2 shortly summarises the research of the past project phases and discusses the aims of the technology transfer platform. In section 3 the functional requirements for a software system are presented. Section 4 discusses the design of an improved transfer process in detail and finally, section 5 shows some prototypical GUI blueprints. The paper ends with a discussion, summarising the research results and exposing open questions regarding the remaining implementation.

2 FROM KNOWLEDGE CREATION TO KNOWLEDGE TRANSFER

2.1 Project description

Product and production improvement are main tasks of todays production engineering (PE) research Hufenbach 2006). Caused by the degree of innovation of materials (or composites) and the appropriate technologies and processes, a holistic approach had to be found, which supports handling innovative process chains (Großmann and Wiemer 2010). Hence, a sub-project dealing with IT-based support was found within the Collaborative Research Centre (CRC) 639, which was founded by German Research Foundation (DFG). The task of this IT project within this cluster is to ensure reproducible manufacturing for innovative process chains especially of textile-reinforced thermoplastic composites (Hufenbach et al. 2011). In detail a chassis, based on a new kind of composite materials, should be produced. Within this production process all data for every material and process step have to be collected and combined in order that traceability along the whole process chain will exist in the end. The project-underlying example is simplified shown in figure 1.

2.2 The development of technology data management

Out of this project a method was developed, which should help researchers to generate, collect and analyse process data. Based on this data a solution had to be found, how gained knowledge could be utilized. Figure 2 shows the developed method, which can be deployed once but also incrementally repeated. For detailed information read e.g. Großmann and Wiemer 2010, Weller et al. 2010, Großmann et al. 2011 or Hufenbach 2011.

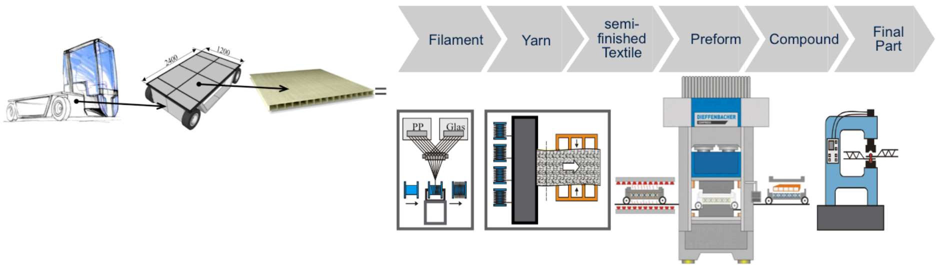

Figure 1. Simplified process chain of CRC 639 in dependence on Hufenbach 2011

Within project duration this approach develops further, right up to a concept for "technology data management" (TDM). TDM is a generic concept, which can be used in different kind of scenarios. Due to this it was used in other projects too (e.g. Großmann et al. 2011). Out of CRC 639 and the adaption to other research fields a long and continuous list of application relevant requirements could be inferred. In consideration of fulfilling these requirements best, a web application has been developed. It is based on a central database. This combination allows users to access TDM everywhere without special software needed and to get access to their process knowledge like in cloud computing.

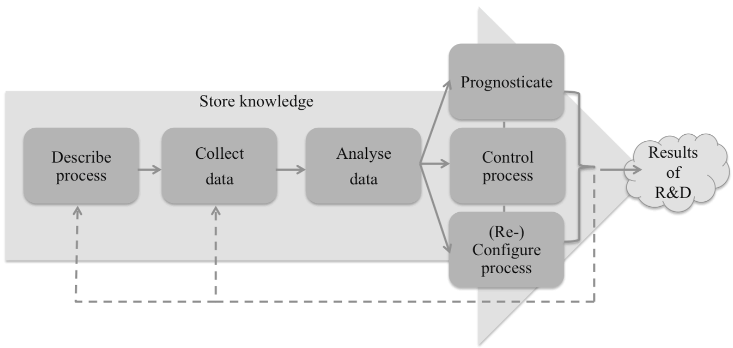

Figure 2. Process-driven approach in dependence on Großmann and Wiemer 2010

The application contains of three modules: process modelling as the base for all further steps (Weller 2010), data gathering and data analysis to support generating knowledge (Großmann et al. 2013). The integration of interfaces between TDM and other software or even machines, as well as functions for im- and export data, increases user acceptance. The main advantage of TDM is the holistic set of functions, which allows a continuous documentation along the whole process chain, which is fundamental for traceability and comprehensive analysis. Hence, TDM is a holistic data driven approach for effective development and improvement of PE processes, which is fitting for complex technologies and process chains, because of its generic method in connection with the set of functions for centralising and analysing data (Wiemer 2013).

Having contact to PE companies, similar requirements for handling data were identified. For that reason we started to adopt TDM for industrial issues like: improve process understanding right up to continuous process improvement, starting up new processes or guaranteeing traceability, which leads to better product and process quality.

Achieving good results with TDM in research and industrial field, further development tend to utilise the pool of knowledge as base for transferring research results from R&D to PE. This might help to speedup innovation time as getting the chance to access up-to-date R&D results and adopting this knowledge to PE. This transfer of technology knowledge (TT) is focused within this article. For this purpose requirements are identified, a design concept is generated and in the end a prototype implementation is introduced, which closes the gap between R&D and competitiveness through innovation by the use of TDM.

2.3 New project task: Transfer of technology knowledge

Due to the huge amount of competitors in the sector of production engineering a fast enhancement of technology and relevant knowledge is necessary (Engel 2005). The current ways for TT between R&D and industry are too slow to keep up at the worldwide market. Transfer of technology means transfer and benefit of generating the utilisation of academic findings and knowledge between R&D and enterprises. In general this process includes all activities starting with initialisation of contacts and ending with commercialisation of a new and innovative product (Schmauder 2011, BMBF 2014). These days TT is a difficult and mainly manual process (Schmauder 2011). To get up-to-date knowledge for further innovation, engineering industry is forced to link with researchers. There are different ways to do. First possibility is mission-oriented research, which means to hire researchers or fund projects. This option might have advantages, but takes some time before first results flow back to innovation. Research takes place also there are no special missions from industry. Nevertheless this outcome is relevant for innovation. To get the knowhow, which saves competitive advantages when early adapted, there are different possibilities as well. Therefor trainings, workshops and conferences can be visited. Otherwise face-to-face contact to researchers as well as reading corresponding literature or papers could help getting to know the state of science (Schmauder 2011). Extensive and time-consuming investigation is mostly necessary. Furthermore knowledge networks or social media for organisations can be used. All existing solutions offer types of knowledge or types of networking, but they are usually restricted in scope or access and often are very slow (BMBF 2014). Most of existing ventures for the transfer of technology knowledge try to connect researchers and industry at an administrative level by making relevant contacts (e.g. www.transferverbund.de). They work as intermediaries, but do not give possibilities to deal with knowledge basing on existing data sets. There is a lack in direct, innovation data based TT.

To fulfil the aim of supporting the PE sector in innovation process, a concept and implementation of an accelerated TT has to be developed. Therefore an extension of TDM in terms of a knowledge platform to link researchers and engineers is thinkable, because innovative data already exists within the TDM system. This proposal for solution should be considered within this paper. Next section gives requirements analysis. Based on that, design and implementation of a TT platform are discussed later on.

3 REQUIREMENTS ANALYSIS

As described above traditional TT by searching in books e.g. is very time-consuming and less effective. For faster usage of that kind of bound knowledge it has to be preselected and dedicated to topics. The success of a platform for TT depends on how effective such a tool is. The following superior target properties were identified in a first requirements analysis based on project experiences and should enlarge user acceptance:

- Low-loss (complete transfer must be possible; knowledge must not get lost neither in R&D nor during transfer or in innovation)
- Effective (easy and fast; good usability for archiving, sorting and finding solutions; integration in existing working procedures might be preferred)
- Transparent (technology holder might see who is searching and who is buying; customer might see knowledge source and for what kind of usage the offered knowledge is needful; transfer conditions might be transparent)

- Safe (knowledge protection has to be guaranteed; data security; researchers' confidence has to be improved)
- Economic (there must be an additional benefit for all parties)

Web-based systems are able to access such bound information fast. There are already some platforms for utilisation of technology and material knowledge, but they are very special and highly limited. A regional example is the database of materials of IMA Dresden. Thus, the further objective is going to find an approach, which is able to access different content and formats of technology knowledge as well as creating a win-win situation relating to economy, benefit and security for all participants. Such a kind of platform could improve transfer of technology and organises it in a more effective way. A research of existing platforms follows, based on these requirements. If there are any good practices a TT platform might orient on them and requirements can be specified.

When talking about "selling knowledge" likeness to other types of trading is visible. Taking a look at traditional marketplaces, salesmen and customers where confronted with similar problems like researchers and industrial production engineers nowadays. Customers had to visit different shops until they found the product they were searching for. Shop's product range often was restricted by storage area, for this reason purchase of special products was usually not as easy as today. For salesmen traditional types of selling mean also additional expenses. These are only a few deficits in conventional trading. The introduction of virtual marketplaces (VMP) is an extension of common trading and can be seen as an improving solution. According to this comparison we came to the assumption, maybe the concept of VMP (like e.g. Amazon, Ebay or Intershop-based VMPs) could be adapted for designing a TT platform.

Taking a closer look at VMP's structures to confirm this thesis, we found similarities as shown in table 1.

Virtual marketplace	**Transfer of technology knowledge**
(Salesman)/ supplier Offer / product / service	Researcher R&D knowledge
Marketplace operator Virtual marketplace	Intermediary Transfer platform
Customer Demand	PE Organisations Innovation

Table 1. Analysis of similarities between VMP and TT

All structural elements of VMP can be identified in a similar way in the transfer processes of technology and knowledge, which is a further evidence for adaption possibilities. To conclude this comparison, requirements for VMP should be analysed in order to find similarities again. Literature research (e.g. Heinemann 2009, Hoffner et al. 2000) explored a large number of requirements. Having a closer look nearly all of these can be adapted to be TT platform requirements. The results of this literature analysis confirm and refine our supposed needs from the beginning of this section, so a requirements list based on this VMP literature research and taken-in-practise experiences can be prepared.

Req.1: *support reliability and security for all participants, including e.g. issues of privacy or risk minimisation*

Req.2: *support different treatment for different customers and products*

Req.3: *support economic issues like business concept, marketing and acquisition*

Req.4: *support transparency about processes and products, including e.g. ratings*

Req.5: *support up-to-date knowledge transfer*

In addition to located requirements, the following issues will refine design and usability demands a little bit more, which might be important for user (customer and trader) acceptance.

Req.6: *support fast and easy access for terms of offering and searching*

Req7: *support fast and effective search usability and advisement for customers*

Req.8: *support fast and effective data cataloguing and providing*

Req.9: *support well-structured information access and clarity*

Req.10: *support personalisation*

Req.11: *support interaction and communication*

Req.12: *support general usability needs like recurring inputs, save and edit inquiry functions, etc.*

A difference between VMP and TT exists in the special type of goods in TT. To purchase knowledge some issues have to be considered separately. These issues are characterised by very strict security aspects (no illegal TT like industrial spying is allowed) and different forms of customer contact and interaction, as well as by a very detailed and specific business and financial concept. With the exception of these issues VMP concept might be adapted for TT.

Based on TDM experiences similarities within requirements were found. Figure 3 illustrates a high intersection potential, so assumption of combining concepts for TDM and TT in design and implementation occurs. These similarities might on the one hand help to find design concepts, on the other hand it will be the base for further consideration of combining both approaches.

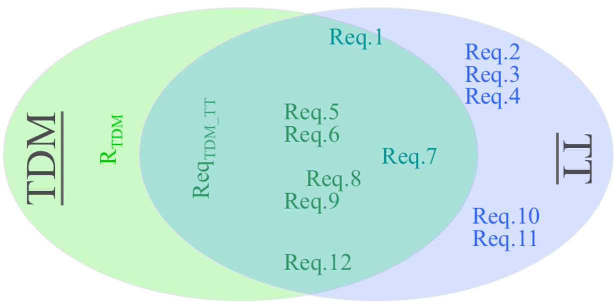

Figure 3. Intersection potential between TDM and TT

4 DESIGN

As already mentioned the usage of a one and only application seems to be a main condition for creating a holistic approach. It is possible to include different types of data or to connect different tools, but it is becoming more complicated. Combining several solutions will be taken in mind, when working at implementation. Nevertheless the idea of a central application and database should persist.

Developing a computer-bound tool is not acceptable. To guarantee easy access (Req.6) a barricade of special software installation must not exist. A better approach consists in using existing resources. Nowadays nearly all computer or mobile devices have an integrated web browser, so, if access should be as easy as possible a web application has to be developed or used. According to different types of web applications a specific and adapted implementation of cloud computing will be a good lead. This includes a central database as the foundation for all activities within the application. This concept allows accessing data everywhere, to share data and to support local spread work. Demanded specification equals to the already implemented TDM approach, so further utilisation might be useful.

4.1 Concept of habitual IT environment

As already mentioned, TDM and TT should be combined within an over-all approach. The plan for a TT platform occurred chronological after TDM already was introduced in R&D and also in PE that means there has already been a base, which has to be added. Using this habitual IT environment supports effective work, because users get to know software handling yet. This allows easy orienting in range and functions. Another advantage is the usage of original data, because "knowledge producing system" is directly connected (although database might be decoupled). In this way it is easy to keep knowledge base up to date (Req.5). Transfer between R&D and industries can be executed much more faster than on traditional ways.

Continuing, the approach of a web application includes all advantages and possibilities of web-based systems besides. There are no restrictions of format, therefore different kinds of knowledge description can be added. This inures to the benefit of transparency (Req.4). Different types of ratings also bring a plus in transparency and are already standard in virtual marketplaces, which we want to adapt. With the help of such functions a comparison of expected and real benefit of TT knowledge or even a backflow of industrial knowledge to R&D or experiences with and quality of transferred knowledge is possible.

Using the same base application means, having only one login with maybe different roles and rights. All relevant data of knowledge holders already exist within the system. Establishing contacts is direct, fast and easy (Req.11).

Miscellaneous requirements like functions for inserting and remembering, personalised views and other clarity and usability needs will make TT more effective and can be adapted promptly from good practises of virtual marketplaces (Req. 10+12).

4.2 Functions for publishing information

Before discussing a concept for publishing information, an overview of what is meant by knowledge in fields of PE has to be given. During literature research a lot of (partly varying) definitions of knowledge can be found. A common approach are the "stairs of knowledge" (North 2011), which is shown in figure 4. Knowledge is always bound to human experiences, values, opinions etc. that means information will be handled as knowledge when considering within a context. Adding process relevant abilities we achieve knowledge of a higher level. Abilities belong to implicit knowledge, which means they could not be explained at all. Thus, for TDM and TT consideration, knowledge includes all knowhow belonging to process execution, which can be explained. There are different kinds of detailing knowledge. Hence, knowledge means on the one hand process results like material characteristics, constitutive equations, tables of technology, process regulation models, work and test plans, but also subjective experiences, ratings and comments; on the other hand documentation and data can also be considered as knowledge. This type of knowledge items can be reduced to a minimal context including process structure and data. Process model implies all relevant information for a solid knowledge base, though other aspects can be added (project aims, data source, documents, belonging literature, etc.). Linking all these aspects, knowledge in field of PE is described.

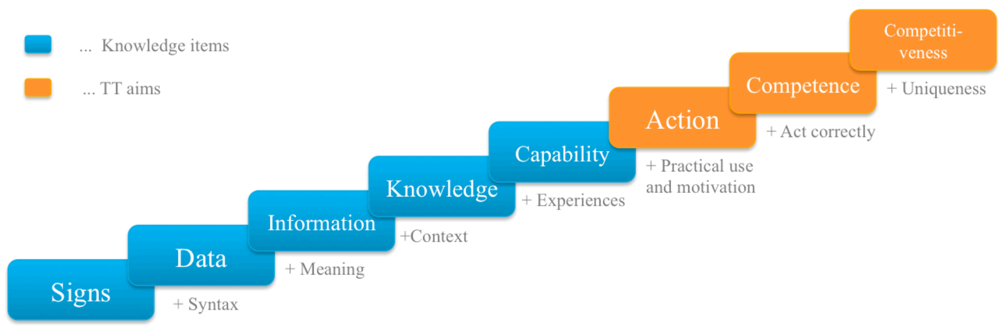

Figure 4. Stairs of knowledge in dependence on North 2011

To enable easy and fast access to this information, a suitable publishing function is needed. Figure 5 presents sequentially functions and participants, which are involved in publishing R&D knowledge. TT starts by choosing results, which should be offered. This selection has to be approved by the R&D leader. Afterwards these results were prepared for TT, details have to be reduced if necessary. In consideration of data security, data has to be decoupled from basic system to virtual marketplace. Within the TT platform knowledge items have to be sorted and supplemented with information of author and project. This could happen mainly automatically, because information has already been acquired in TDM. Sorting and cataloguing can be implemented by using intelligent tagging methods, as well as special keyword and reference systems. In this way a search for technology holder, project, suitability of materials/technologies, types of knowledge items or categorisation/rating by customers can be executed.

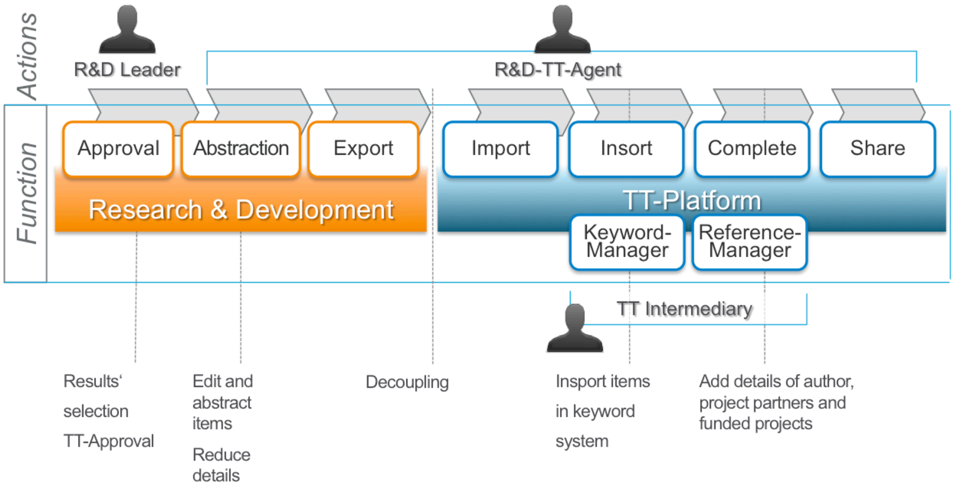

Figure 5. Functions for publishing R&D knowledge (Req.8)

Material and technological knowledge will be linked within a matrix of compatibility when sorting knowledge items. Thus, the reference has been created, what kind of material can be produced or handled with the help of which technology. This is useful for an advising and for a comparing function of different solutions, which are needed later on (Req.7). After creating the matrix of compatibility knowledge items have to be connected with keywords (figure 6).

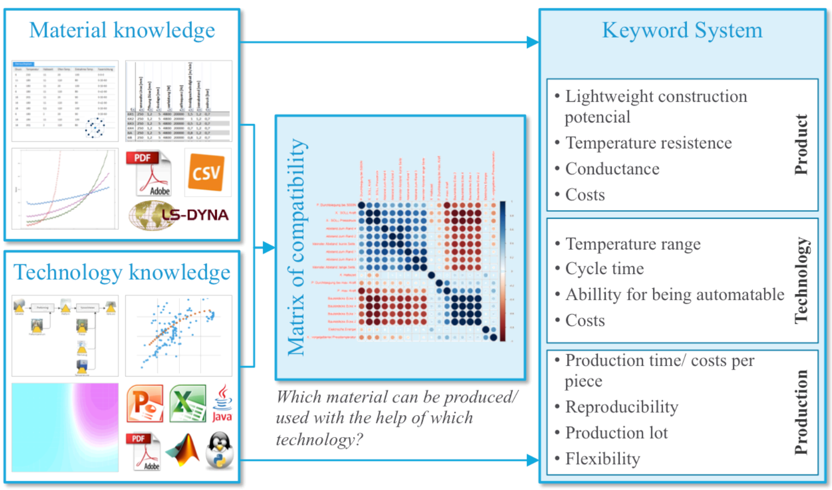

Figure 6. Example for sorting knowledge items

Knowledge items can be related to different categories. It can belong to properties (physical, chemical, economical, etc.), functions (electronic, mechanic, etc.), raw materials (metal, non-metal, organic, matrix, etc.) or technologies (master forming, forming, separating, joining, coating, etc.).

There are different possibilities for implementing, which all have advantages and disadvantages. Tagging in combination with a hierarchical keyword system for example might be possible. Combining different approaches enables users to refine and search by different kinds of criteria. More details are shown in the next section.

4.3 Functions for researching information

Counterpart of publishing is researching knowledge items, therefore it is connected with customer side. Figure 7 gives an overview of a functional concept for research. A technology scout has to define a searching inquiry. Therefor all property and functional requirements, which are essential for developing new products, have to be collected. An inquiry can be send to TT platform with the help of these specifications. Then, a hit list has to be presented and rated like usual when execute a searching. If research was successful, belonging items and contacts can be downloaded. For further contract issues technology holder has to be contacted before knowledge can be transferred. Based on successful TT customer is able to develop products and processes having regard to up-to-date research knowledge.

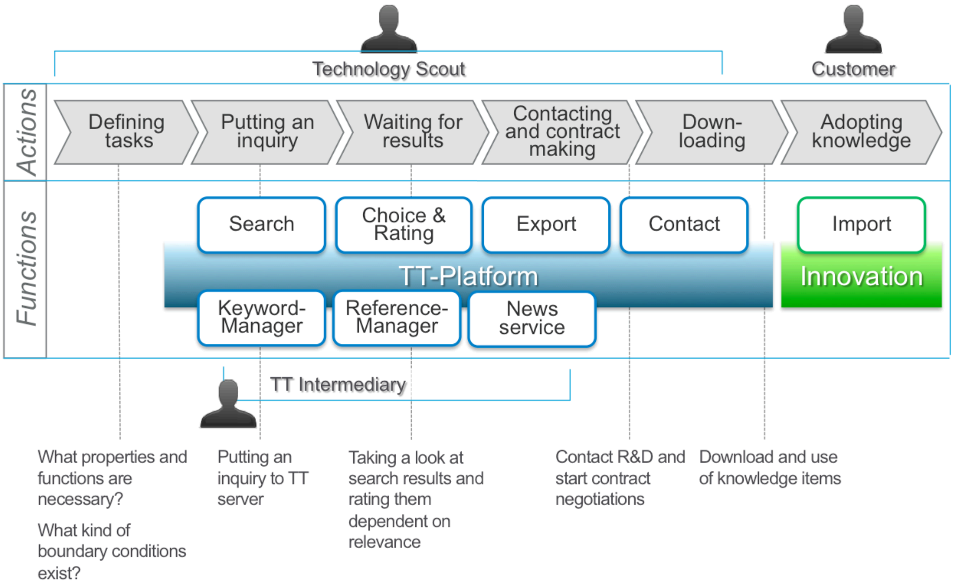

Figure 7. Searching for knowledge items (Req.7)

A detailed scenario could be as followed: Requesting properties, materials and maybe alternatives are displayed based on analysing a fitting matrix. Within this fitting matrix belonging technologies are chosen and existing knowledge items are shown. With the declaration of additional conditions for costs, lot, etc. searching results are going to be rated and shown in a situation-oriented ranking. Afterwards knowledge items can be purchased in different formats (e.g. constitutive equation for a simulation tool or characteristics). Presentation, format and allocation can be configured specifically for different types of customers (Req.2). Not only a differentiation between internal customers and external scouts is possible, but also a classification for project investors, who are able to control project transfer requirements. Therefor no detailed inquiry is necessary; a list of TT activities might be enough.

To fulfil TT requirements as well as effectiveness needs search inquiries have to be saveable. In this way complex research progresses can be edited, detailed or supplemented at a later date (Req.12).

A structured, fast and easy research function has also advantages for technology holders. They might search for customers, who “bought” similar knowledge as they offer now; customer approval of this information is preconditioning. Having this information of customers, individual advertising can be done. Customers can be informed that there is new research knowledge in field of their interest.

Alternatively this information can be used to get contacts with same interests for generating cooperated projects or for transferring staff.

4.4 Concept of a role management for TT

The already mentioned user-specifics attend usability efforts. Therefor platform can be configured in the way each role get only these functions they need to achieve their tasks (Req.2). The R&D leader (who is the administrative head of the R&D department) for example gets access to functions “Describe process”, “Approval knowledge”, “Publishing” and “Researching”, while R&D employees (on operative research level) do not need the last ones, in contrast they need “Planning experiments”, “Gathering data”, “Analysing data”, “Prognosticate”, “Store knowledge”, “Control process” and “Configure process”. Intermediary would need “Searching” and “Publishing” and in task-specific addition also functions for platform management. Project investors instead only need research functions.

Next to utilisation, a well-functioning role concept is also important for security issues (Req.1). One major task is to regulate the degree of detailing knowledge items. Figure 8 explains a possible linking within this context. At the highest level, research would only lead to contact data or public information for instance. A further degree refinement can be discussed when writing specifications.

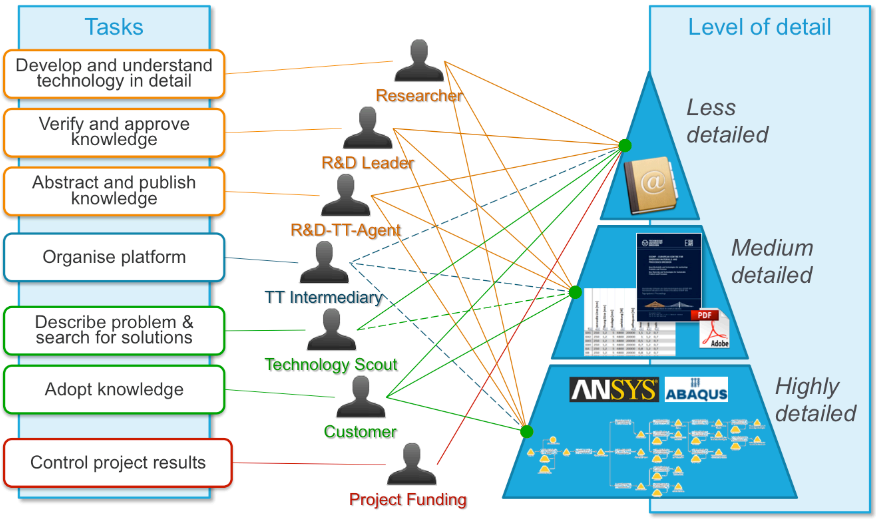

Figure 8. Role management effects on the degree of detailing research results

4.5 Security issues

In some concepts of solution a few security issues have already been discussed. The existing way of implementation TDM as well as role management are the foundation for arrangements for customer and seller protection. This includes, among other things, privacy protection and safety in financial transactions. These examples, as well as other security aspects, did not deviate much from security concepts of virtual marketplaces. Based on existing experiences an adoption of good practises for this sector will be advisable. Transparency of transfer process and goods attends also participants’ feeling of trust and safety.

Knowledge safety and transfer security require special consideration. Already mentioned decoupling of data is only one approach. TDM includes the entirety of all relevant research data, processes, experimental and simulation data up to analysis, results and verbalised research results. However, for TT only that information will be provided, which is approved by R&D leader. In this manner every R&D institution can operate its own developing environment, which can be accessed with TDM frontend. However for transferring knowledge a common platform can be accessed, which contains approved knowledge items as well as fitting and compatibility matrix and miscellaneous meta information. Using of transferred knowledge is also decoupled. Production engineers have to download knowledge items and to import into the target system. Thus, it is guaranteed that only the knowledge is provided which should be provided and also that no internal industrial information is involuntarily abandoned. For the security of TT itself, which means transferring as low-loss as possible, are e.g. concepts similar to software/music or movie download platforms possible (Req.1).

4.6 Business concept

TT has to be economic, that means there must result an additional benefit for all participants. Technology holders would aspire a financial benefit in most cases. A gain of knowledge, which is important for innovation, will be purpose for PE. Therefor knowledge is the good of TT in a virtual knowledge marketplace. Decisions about trading conditions, business and financial concepts are fundamental for a TT platform, but are characterised politically. Because there is no business concept introduced by responsible administration yet, at this point no closer consideration will be done.

Further aspects of economy are customer acquisition and marketing, but there is also no concept introduced, how advertising for this platform should look like, but there might be no drawback to use todays TT initiation methods (Schmauder 2011) for customer acquisition. Technology holders have to be acquired too. On the one hand the "pressure" for TT initiated by project investors might be helpful to convince researchers to join, on the other hand a lot of efforts have to be done to enlarge trustfulness. Summarising a usage for both sides comes only into question, if requirements are fulfilled at the best (Req.11).

During consideration of economic issues also negative aspects has to be looked at. There must also be possibilities of return when trading goods. In case of services usually supplementary performance or loss adjustment is offered. If a TT customer is not satisfied with the purchased knowledge or he could not achieve an innovation with it, then other possibilities have to be found. Decisions for this kind of problem handling are also administrative, but to prevent such situations the good/knowledge items have to be described as detailed as possible, so customer gets clarity about what he has to expect (Req.3).

A large amount of design concepts for a TT platform has been found within this section. If all aspects can be fulfilled, a TT approach is developed, which supplements TDM in terms of providing an enhancement of traditional ways of TT. The already mentioned gaps of e.g. innovation time can be minimised by using the described design concepts, because transferring technology knowledge starts at its origin, that means at the point of knowledge creation.

Until now TDM is mainly implemented, but for TT only a prototype for university environment has been developed yet, which is based on TDM. Next section should provide some insights of how these concepts have been achieved and where do still gaps exist, which have to be closed in further work.

5 IMPLEMENTATION

As already considered TDM was implemented as a web application based on a central database. This database is also the fundamental base for our TT platform. For that reason functions had to be added, but basic structures could be maintained as outlined in figure 9.

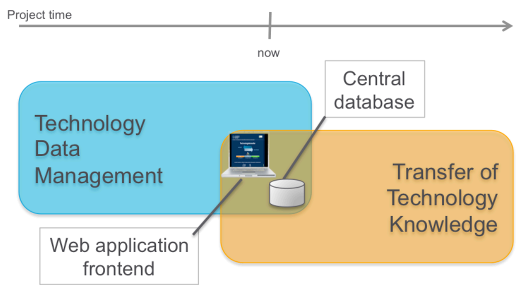

Figure 9. Intersection of implementation demands

Providing some insights into TT platform's prototype figure 10 illustrates a possible implementation of the publishing function (see section 4.2). It shows an insert mask for adding meta data to existing process data. For this purpose "relating to a project", "sorting into categories", "adding level of detail" and "assigning keywords" are relevant functions.

Figure 11 is a blueprint for a research prototype (see section 4.3). Nested inquiries of different kind of properties and settings generate a results list, where all fitting solutions are displayed. For a better understanding of the knowledge item's content, a fitness report (referring to different properties) can be shown. With the help of this report, customers get a better overview of which items might be most useful for his purposes.

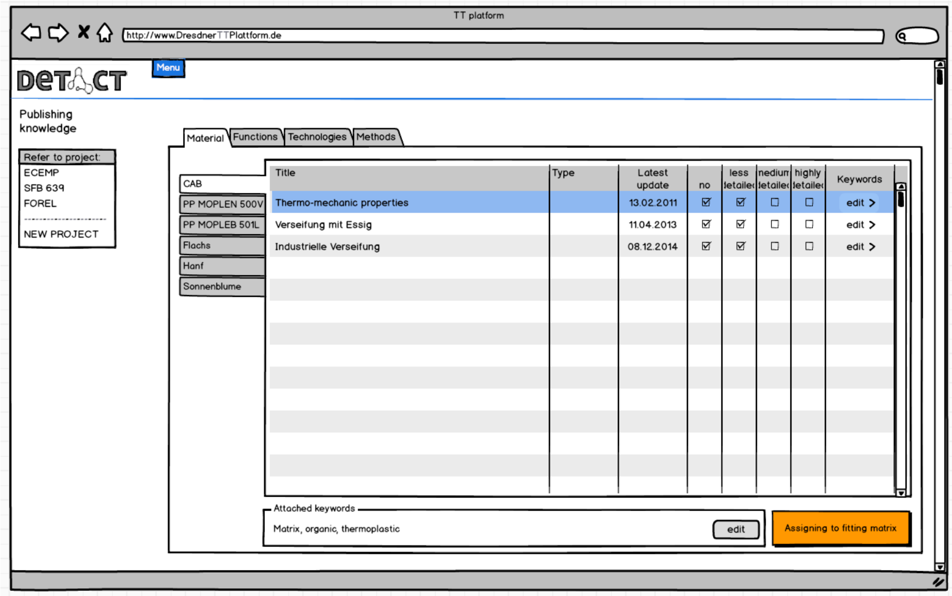

Figure 10. *Prototype for the function of publishing knowledge*

There are also other searching scenarios possible. Within a special individualised research mask project investors can monitor, if their project transfer restrictions are fulfilled. Therefor no process data access is needed, but a summary of written research papers, patents, dissertations or other defined factors of success will be given.

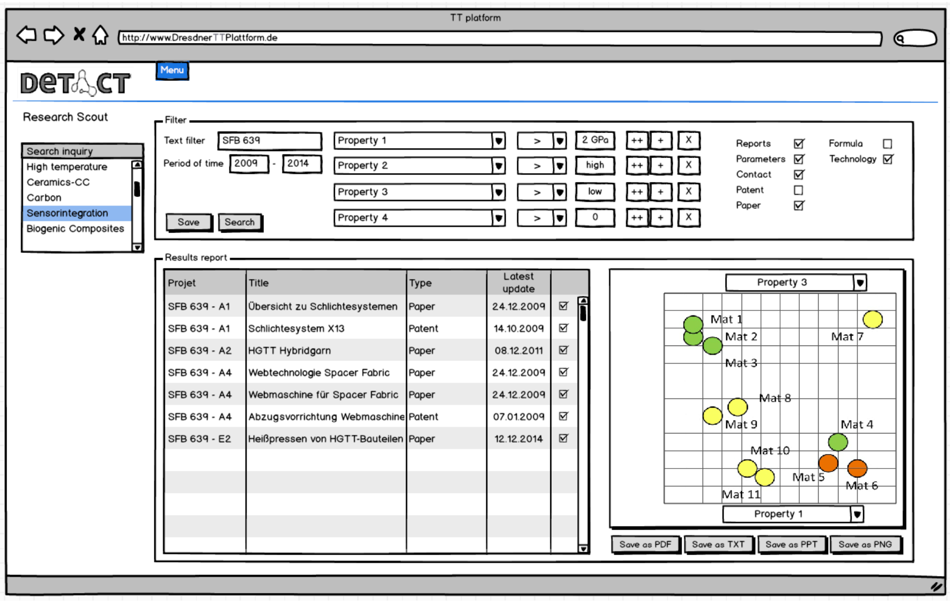

Figure 11. *Prototype for research scout functions*

The platform prototype satisfies requirements in research field. Different R&D departments can use it for better cooperation or to reduce the amount of experiments, because they have already been done in other departments. Also project investors can benefit of this prototype, because of a fast and easy way of monitoring. The transfer between R&D and PE, which was the origin of our method generating work, is not implemented yet, but it will be focused to be available to the end of project time.

6 CONCLUSION AND OUTLOOK

This article illustrates the needs for supporting transfer technology knowledge between R&D and PE. When looking for support methods for TT, similarities between a possible TT platform and virtual marketplaces were found. Therefor conceptual design for a TT platform can adapt from good practises of virtual marketplaces. Under the assumption to develop a holistic approach to simplify data and knowledge gaining and handling for engineers, methods of combining TDM and TT were discussed. At the end an overview of todays prototype implementation state was given.

Within our approach we are able to fulfil found requirements nearly complete on the research side. The annexation of industrial customers of TT is subject of further work. It will complete the implementation of our holistic method, but depends on project-intern political decisions.

To enlarge customer acceptance and satisfaction, the whole system is still in development. In other words there are regular user surveys to identify new requirements. TDM and TT development is therefore subject of continuous design and implementation improvement.

Acknowledgements
The works presented in this paper are funded by the German Research Foundation DFG (Deutsche Forschungsgemeinschaft) within the Collaborative Research Centre (CRC) 639 „Textile-reinforced composite components for function-integrating multi-material design in complex lightweight applications“.

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