A FRAMEWORK TO MEASURE THE IMPACT OF KNOWLEDGE PROCESS SUPPORTING TECHNOLOGIES

An Integrated Approach for a Technology-oriented Business Benefit Analysis

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Abstract: Within the last decade a plethora of different technologies emerged claiming to support knowledge worker in their everyday working life. Based on these technologies many different solutions for knowledge process support in enterprise environments have been developed. However the impact of these solutions is mostly considered intangible due to the fact that the overall costs and benefits are not clearly traceable. Traditional approaches for the evaluation of the costs and benefits often cover only a part of the overall scope, leading to an imminent need for a fitting assessment methodology. This paper presents a research approach to develop an integrated cost-benefit-framework, which integrates traditional aspects and related methodologies with emerging, knowledge process based aspects.

1 INTRODUCTION

Due to increasing competition in global markets, enterprises are constantly facing the need not only to revisit their products and services, but also their processes. While great enhancements in productivity have been achieved by formalizing business processes (Hill, Yates, Jones, Kogan, 2006), Knowledge experts, who primarily deal with informal knowledge processes, are weakly supported on the enterprise level (Brown, 2007). They often depend on tacit knowledge and undocumented, unformalized knowledge processes. To enhance the productivity of knowledge worker it is essential to make important information easily accessible. Therefore, the fields of Knowledge Management and Information sharing are constantly gaining importance for knowledge process support.

From a system perspective, users often had to rely on personal communication and ad hoc collaboration to receive the information needed. Those situations were leading to context switching and a loss of time and productivity for involved people. With the appearance of web 2.0, a plethora of different technologies arose that offer new possibilities to support knowledge processes. Instant messengers, wikis, weblogs, social networking tools and podcasts are common tools which are also available for knowledge workers in enterprise environments. However recent reports show that an extension of numbers of tools does not necessarily enhance the productivity (Forrester Big Idea, 2006).

Current research approaches focus on simpler, yet richer integrated workspace solutions on the one hand and formalizing knowledge on the other hand (Active, 2008). New developments in the fields of collaborative technologies, context aware technologies and ontologies enable new possibilities of knowledge process support.

Prior to invest into these arising technologies or during the evaluation of the existing IT support, organisations need to assess the impact on their own processes and evaluate the related cost and benefits coming along. However existing tools and methodologies often cover only a small part of the relevant aspects, especially regarding knowledge process related aspects coming along with these emerging technologies and concepts. This fact is quite problematic and companies are often left with an estimated guess as a basis for decision.

This paper embraces a new approach to assess the impact of knowledge process supporting technologies, focusing on knowledge process related aspects that are hardly covered by existing methodologies.

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2 STATE OF THE ART & RESEARCH PROBLEM

Determining the impact of technologies on knowledge process support in form of costs and benefits is a highly complex task that includes various aspects from different areas of expertise. According to Ramirez and Nembhard there are no effective methodologies to measure the productivity of knowledge worker (Ramirez, Nembhard, 2004). Thus leading to the situation that organizations dealing with knowledge processes either not measure them (Ahmed et al., 1999) or use established cost and benefit models, that have proven themselves in the field of manufacturing, to evaluate their investments in information and communication technology (Pietsch, 2003). The most frequently used traditional methodologies are introduced in the following section.

One of the earlier methodologies for cost benefit analysis is Return-on-Investment (ROI), which analyses the net benefits and divides them by the overall costs. Using this profitability equation ROI can identify past performance or future expectations (Schachner, 1973). The methodology Total Cost of Ownership (TCO) has the aim to identify every cost driver generated by using information and communication technology during their complete lifecycle and evaluate them in a financial manner. It considers direct and indirect costs. While direct costs are easily to asses, for the assessment of indirect costs the Gartner Group recommends using interviews and surveys (Pietsch, 2003). The Hedonic Wage Model analyses shifts in each job profile towards more value creating activities, thus determining the benefit in a monetary manner (Pietsch, 2003). As a more process-oriented model, Activity Based Costing splits the direct costs into several parts and allocates each part to the process that determines the costs (Pietsch, 2003). In doing so, processes costs become more transparent as their sources can be traced back to the respective sources.

To determine the potential benefits and hence evaluate investments in fields of knowledge management, organization need more than the traditional financial measurements. An exclusive technological perspective leads to a neglect of the true potential benefits of knowledge management (Ahmed et al., 1999). According to Ahmed, Lim and Zairi, characteristics of a good knowledge measurement system are:

- performance is reflected at various levels of organisational systems. It is measured at the strategic, tactical and operational levels;
- performance measurement is a distributed activity reflecting various levels of ownership and control;
- performance measurement reflects a blend of measures for individual tasks/activities to manage processes;
- performance measurement highlights opportunities for improvement in all areas with leverage points.

Therefore a series of approaches have been developed. Ahmed, Lim and Zairi developed a matrix-system that considers a lot more than the financial ratios. Their approach regards four different perspectives on knowledge management, the customer, organization, supplier and technology perspective. Within these perspectives the fields capture, share, measuring and learning shall be measured by various key data, thus giving managers a more transparent illustration of used knowledge management systems than a traditional financial approach (Ahmed et al., 1999).

The approach of Haas and Hansen differentiates between two types of knowledge sharing: electronic documents and personal advice. The knowledge sharing dimensions are separated in content - level of quality and process - level of rework for electronic documents and content - level of experience and process - lack of effort for personal advice. As measurable benefits Haas and Hansen identified time saved on task within the type of electronic documents and quality of work and signal of competence within the type of personal advice (Haas, Hansen, 2007).

The three steps model of Eschenbach and Schauer aims at identifying potentials for improved knowledge work productivity. In step one the knowledge intensity of the organisation is identified by measuring information intensity, interdependencies, variability, innovation rate and qualification requirements. In step two the current level of knowledge work productivity is detected by interviews regarding information processing, communication, decision making and the adaptation of an organisation to changing circumstances. In conclusion step three analyses fields for improvement (e.g. knowledge exchange, double loop learning) (Eschenbach, Schauer, 2008).

Even though there are specific knowledge management measuring approaches, often they are not able to quantify their conclusions and are not able to explicitly implicate potential benefits of evolving technologies in the fields of collaborative technologies, context aware technologies and

ontologies.

Altogether existing models alone cover only fragments of the full scope of knowledge process support. There is an imminent need for a fully integrated methodology which goes beyond traditional approaches and combines traditional cost and benefit aspects with as yet neglected aspects coming along with emerging technologies, knowledge management and information sharing. The related research questions are:

- How can the impact of emerging collaborative technologies for knowledge process support be measured?
- What are the relevant cost driver and benefits that have to be considered and how can they be assessed?
- Which existing methodologies can be integrated in this approach?

The next section introduces the research environment as well as the research approach on this topic.

3 RESEARCH ENVIRONMENT AND RESEARCH APPROACH

The ACTIVE project aims to support knowledge worker by leveraging tacit and unshared knowledge, the "hidden intelligence of enterprises", and convert it into transferable and actionable knowledge (Active, 2008). Therefore, concepts and tools from the fields of social software and Web 2.0, Semantic Technologies, Context Mining, Context Modelling, and Context Sensitive Task Management, as well as Knowledge Process Mining, Knowledge Process Modelling and Pro-Active Knowledge Process Support are integrated into highly innovative application systems. Key results of the project are dedicated software systems, which target the specific needs of the case study partner, coming from consulting, telecommunication and manufacturing industries.

To determine the impact of the developed software systems, a business benefit analysis is currently conducted and based on the results, respective business models will be developed accordingly. Vague requirements for the approach have been formulized at the beginning of the project, which include

- the instantiation of a cost benefit matrix for multilateral business benefits concepts,
- scenario and trend-based estimations of the economic costs and benefits as well as
- the development of business cases which compare the costs and benefits and provide an assessment of the ACTIVE project results in the context of the case study environments.

Against this background a reference framework has been developed, which acts as a basis for the approach on the business benefit analysis and business model generation for the results of the ACTIVE project and is illustrated in figure 1.

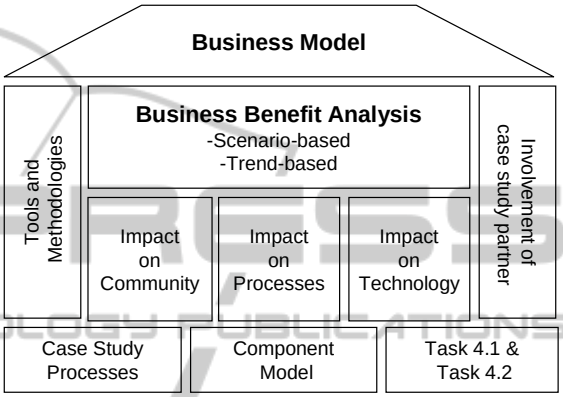

Figure 1: Reference framework for the business benefit analysis.

The framework describes the overall structure of the analysis, including the involvement of the case study partner and the considered existing tools and methodologies. On a content level the foundation of the framework are the elaborated case study processes as well as the component ACTIVE model and results from previously finished tasks, which looked into costs and benefits of existing web 2.0 technologies. Process descriptions and component model specify the developed solutions on a detailed level and therefore allow a detailed business benefit analysis which looks into the three pillars that cover the whole area of influence of the developed solutions within the case study partner:

- impact on technology,
- impact on processes,
- impact on community.

In addition to the reference framework, a course of action has been agreed on which is based on the three in figure 2.

During use cases and consists of three different phases with, two sub-steps each. The course of action is visualized the first phase, a cost-benefit-framework is developed which aims to evaluate all three pillars of the reference framework. The

development includes the identification of related key aspects, covering the full scope of the pillars, as well as the allocation of respective costs and benefit factors to these key aspects and the definition of qualified assessment methodologies. Ultimately the cost-benefit framework should be highly scalable, so that it can be dynamically adopted for the specific business cases of the three case study partners. Additionally, the framework is developed in a way that it can easily be adopted for the evaluation of other collaborative technologies.

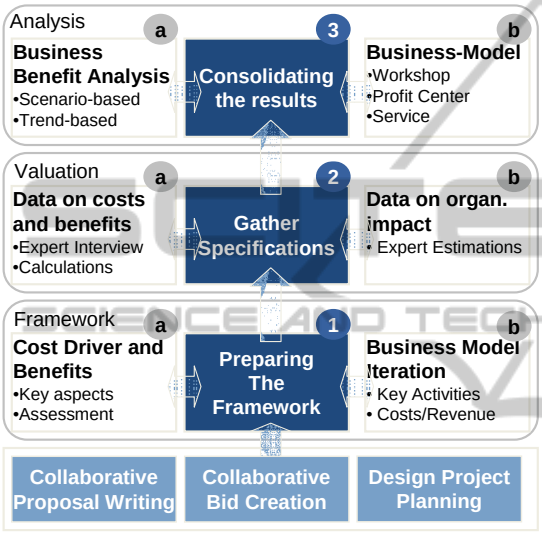

Figure 2: Selected course of action.

Consequently three distinctive and complementing sub-categories have been identified for each of the pillars, which are illustrated in figure 3 and represent the key aspects of ACTIVE solutions. To measure the impact from a technology perspective, IT-related costs and benefit factors have to be considered. This is a rather traditional field which includes the key aspects of IT investments, IT adoption and IT administration. Evaluation of the impact of collaborative technologies on company processes can be achieved by looking into the key aspects of business process support and training, which are also kind of traditional, as well as knowledge process support. The impact on community is the most difficult of the three pillars. It includes the key aspects knowledge management with 2.0 technologies, information sharing with 2.0 technologies and use of context, which are difficult to measure due to their supportive and therefore more qualitative nature.

In a next step, relevant cost driver and benefits which are considered relevant for the ACTIVE solutions have been identified. The cost-benefit-framework looks into these factors from three different viewpoints: economic perspective, private perspective and social perspective (Plum, 2008). Additionally it differentiates between fixed and variable (O'Sullivan and Sheffrin, 2007)(Garrison, Noreen and Brewer, 2009) as well as direct and indirect factors (Pietersz 2007)(Scott, 2003). The underlying schema is displayed in figure 4.

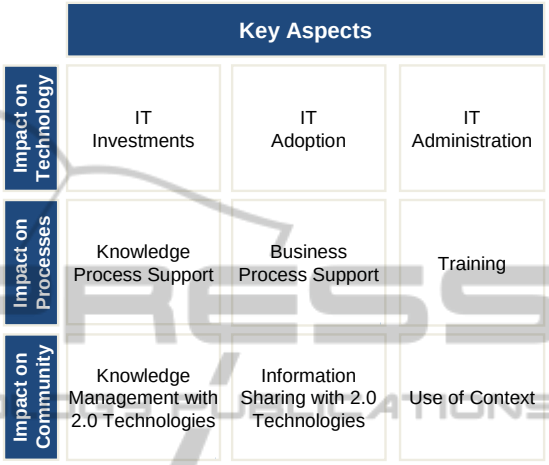

Figure 3: Cost-benefit framework.

Subsequently the identified cost and benefit factors have been categorized into this schema and integrated into the cost-benefit framework. Each factor is allocated to at least one key aspect. As an example, training costs is a fixed and direct economic factor which can be allocated to the key aspect training, while personal time saving is a variable and indirect private factor which fits into the key aspects knowledge process support and business process support. Naturally economic factors are more direct and quantitative while private and social factors are more indirect and qualitative.

For the purpose of evaluating the factors of the different key aspects, different methodologies have been examined. For the traditional aspects IT investment, IT adoption, IT administration, training and business process support exist a plethora of different tools and methodologies which can be utilized to assess the economic impact (Pietsch, 2003). Relevant existing tools and methodologies have been identified and will be adopted to match the respective factors. Finally they will be integrated into the framework to measure the traditional aspects where possible.

However the impact of the four remaining, more knowledge process related aspects, is difficult to determine due to their qualitative and supportive nature. Existing methodologies are not able to cover

the full scope of these key aspects and can only be partially integrated. Therefore the framework will be complemented by dedicated, innovative methodologies to assess these knowledge related factors. For this purpose, approaches from other fields will be examined and adopted, e.g. models from the area of network theory will be used to explain the influence of context on corporate networks.

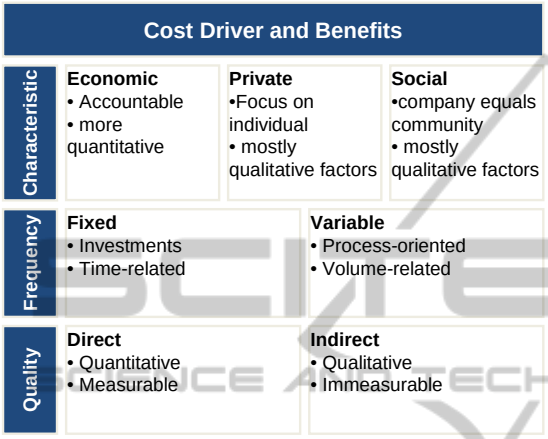

Figure 4: Classification of costs and benefits.

The first phase is completed by a first iteration regarding the business models which will be conducted together with the case study partners. The business model canvas will be used, a tool that allows to generate a high-level description of business models in a workshop manner (Osterwalder and Pigneur, 2009). The first iteration will look into the key activities and resources, the cost structure and the revenue streams of future business models, which go along with the developed cost-benefit-framework. The results of the workshop will complement the framework and also be used for its validation. Furthermore the relevance of the different key aspects for each use case will be determined in cooperation with the case study partners and the respective factors will be adjusted to their respective situation to generate three case study specific cost-benefit-models. This especially includes the assignment of the variable costs to the respective process steps they are relevant for.

The second phase (Valuation Basis) is focused on gathering the required data regarding the case study specific cost-benefit-models and the overall impact on the organization. Therefore expert interview will be conducted and the gathered data will be used as a basis for the following cost benefit analysis. Where applicable the data-basis will be complemented by adequate estimations on respective, non-determinable factors.

Finally in the third phase (Analysis) a scenario- and trend-based business benefit analysis will be conducted for each case study use case using all gathered data and pointing out the specific cost and benefits not only from an economic, but also from a personal and social perspective. On top of this, business models will be finalized in workshops with the case study partner. Again the business model canvas will be used, utilizing the business benefit analysis as value proposition.

4 CASE STUDY

In the scope of the ACTIVE project, different use cases for the application of the developed technologies have been identified for each of the three case study partners coming from consulting, telecommunication and manufacturing industries. For the business benefit analysis, one use case for each case study partner will be considered. The selected use cases differ in their utilization of the developed framework, setting a different focus on the key aspects.

The consulting use incorporates collaborative technologies for context-sensitive search and browsing, therefore linking experts that work within similar contexts and making common documents accessible for each other. Based on this, a collaborative proposal writing process has been developed which targets the consultant's ability to react on incoming requests for proposals and quickly mobilize the relevant resources. Easy and dynamic access to relevant information is the deciding factor for the success of the proposal, therefore a collaborative proposal workspace is utilized which provides swift access to knowledge and people. The focus of the use case lies on the key factors IT investments, IT adoption, IT administration, training, business process support, information sharing with 2.0 technologies and use of context

The manufacturing use case targets the planning and execution of chip design projects and with special focus on the reusability of existing work as well as the sharing of experience between the company's design teams. The planning process is supported by the semantic media wiki, which is an advanced form of a media wiki allowing semantic queries. It has been extended to visualize knowledge processes, which is a necessary feature to share information between teams. The design process itself is a very complex procedure, consisting of a

series of formal, semi-formal and informal tasks which are not predetermined. There is a strong connection between the experience of a team and the result of the process; therefore it is most valuable to share knowledge between the design teams to get optimal results. ACTIVE technology is utilized for task mining, i.e. recording the series of steps from each team, formalizing them into knowledge structures and sharing them with other teams. The use case doesn't focus on the business processes itself, but more on the results as well as the formalization of the process. Therefore the important key aspects are IT investments, IT adoption, IT administration, knowledge management with 2.0 technologies, information sharing with 2.0 technologies and knowledge process support.

The telecommunication use case utilizes collaborative technologies for collaborative bid creation, i.e. to support their sales department in dealing with incoming requests for bids. Time is a critical factor within this use case; therefore it is essential that sales people are able to access relevant information, documents and people. The case study partner utilizes so called activated applications, which are frontend-tools like word or excel that have been enabled by a plug-in to interact with the ACTIVE knowledge workspace in the backend. Information, knowledge processes and contacts are gathered, processed and shared within the sales team, therefore making best use of the collective wisdom of the group. This use case covers the full scope of the developed technologies; therefore all key aspects have to be considered and assessed.

5 CONCLUSIONS

This paper presents an integrated approach to evaluate the impact of knowledge process supporting technologies. A reference framework is introduced which defines the scope of the approach and a respective course of action has been introduced. Three areas of influence have been identified and a cost-benefit-framework has been developed, which describes these areas with nine different key aspects. Cost drivers and benefits from different fields have been integrated into this framework and assessment methodologies for each of them have been described.

Due to its high scalability and covered scope, the introduced cost-benefit-framework seems to be very promising. Additionally the framework seems to be adoptable beyond the scope of the ACTIVE project. However research is still ongoing and some open questions still need to be answered. On the one hand, the cost-benefit-framework has to be finalized, gathering all relevant factors and categorizing them into the existing schema. On the other hand, methodologies for the evaluation of knowledge process related aspects have to be finalized. Therefore, existing methodologies from other areas are currently examined regarding their relevance and eventually need to be adopted for this specific case. Finally the quality of this schema has to be validated with real world data from the case study partner.

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