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4 Supporting Knowledge Management Instruments with Composable Micro-Services

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1 Introduction

Despite the fact that knowledge management (KM) challenges cannot be solved by installing a technical system alone [1], technical support for KM initiatives is still an important issue and nowadays requires handling of context, intelligent content analysis and extended collaboration support [2, p. 27]. Since information systems have significantly improved in the last ten years with regards to implementing Web 2.0 features [3] and semantic content analysis (e.g., [4]), knowledge workers can expect better support from IT than ever. After the human-oriented, technology-oriented (documents), process-oriented and social KM phases [2, p. 2], KM support now needs integration of those beneficial technologies instead of hyping one and neglecting the other. The true nature and potential of social media does only manifest when people incorporate them into their day-to-day work routines or even “live” the social media idea [5]. The same is true for business process management (BPM). If BPM tools are not integrated into the existing, well-known information systems, acceptance will be low. Practice shows, that employees often do not even know in which process they are currently working.

This paper proposes a highly modular yet integrated approach to support KM instruments and shows how this approach is implemented based on open source collaboration systems in the case study SCHub (Social Collaboration Hub, funded by the BMBF as part of the FHprofUnt funding program, <https://www.sc-hub.de>).

The remainder of this paper is structured as follows. The basic architecture of a holistic IT support for knowledge management is introduced in section two. Afterwards, three KM instruments are described together with their implementation in SCHub. Finally, the improvements in contrast to existing solutions are discussed.

2 From Web services to composable knowledge services

While Delic & Riley envision a portal, search engine, content and workflow management system as the basis for a cloud-based KM system [6], the SCHub project goes one step further and also includes a groupware system. An enterprise’s KM architecture needs to be loosely-coupled, and should evolve into decoupled, completely pluggable, intelligent KM appliances capable of interfacing with cloud services [6]. Organizations of all types live in an increasingly dynamic world driven by innovations in technology, especially information and communication technology

[7]. They have to take advantage of that and create new products and business models in order to prosper (ibid.). The IT infrastructure has to support this and therefore adapt cloud computing principles within enterprise IT as well (private cloud).

Advanced KM systems are traditionally challenging to deploy and operate, which led to significant costs and derailed many KM projects [7]. Especially integrated solutions were therefore reserved for larger organizations with a knowledgeable IT staff or large budgets for consulting companies. Cloud computing proposes a solution for that problem both in public clouds as well as in private clouds by offering scalable and secure solutions packaged in a more elastic and economical form [7].

Driven by cloud computing, RESTful Web services (RWS) have received a lot of attention lately [8] and with them the micro-services architectural style as a match for cloud computing needs [9]. Micro-services can be briefly summarized as an architecture pattern that aims at “developing an application as a set of small independent services”, each of which is running in its own process (ibid.). These services can communicate (usually over HTTP) and could be deployed independently.

Looking at existing collaboration solutions today, they can be described as modular with respect to a component architecture ([10], e.g., Liferay) or are even as highly modular relying on the OSGi standard (e.g., OX App Suite), but still as monolithic from the micro-service point of view, as they are a single large deployment unit [9]. They are reusing components during build time, e.g., Apache Lucene as a search engine, but not during runtime. That leads to the fact, that users have to search in each system separately and there is no runtime reuse.

A dynamic composition of RESTful Web services during runtime would be desirable, but in contrast to SOAP-based Web services, composition of RWS is still in its infancy [8]. However, a fully automated composition [11] may not be necessary. It seems much more important to enable IT staff or even business users to quickly compose integrated solutions including a Web front-end without the need to program [12]. To accomplish this, Web services can be enriched with a user interface to become a micro-service. A graphical environment to integrate them into a portal page and connect them with other components is further required. Whereas server-side technologies for this kind of integration were already described over ten years ago [13], [14], client-side approaches recently achieve more attention with technologies like OpenSocial gadgets and W3C widgets [15]. Instead of integration at the presentation layer, an alternative is to integrate Web services as tasks into a BPM engine that in turn provides a graphical editor (e.g., for BPMN, Business Process Model and Notation) and a user interface for end-users (e.g. via forms).

Knowledge services are special, often composed Web services, whose functionality supports high-level KM instruments as part of on-demand KM initiatives, e.g., finding an expert, submitting an idea or publishing a skill profile [2, p. 71]. They may require content templates in order to specialize general purpose tools like Wikis into a knowledge service for lessons learned. An enterprise knowledge infrastructure proposes a “targeted combination and integration of knowledge services for selected KM instruments” (ibid., p. 68).

3 Implementing support for KM instruments

One key element of the success of Web 2.0 technologies is the availability of open source implementations and the resulting low implementation costs [16]. Today, the maturity of open source systems (OSS) allows their production use in other software categories like portals [17] and enterprise content management as well [18]. However, large commercial closed source vendors like Microsoft and IBM still have advantages regarding integration between systems in different categories [7], since it is easier for them to integrate their own systems than for OSS to integrate with systems built by a different community. The SCHub project is an effort to change this and built an enterprise knowledge infrastructure from open source software, following a micro-service approach. Three KM instruments were selected [19] to demonstrate the applicability in the areas people, contents and processes. The overall structure of micro-services is shown in figure 1: knowledge services provided by SCHub (own illustration). The lower layer represents the systems whereas the upper layer represents knowledge services provided by them. These knowledge services are not atomic. Often, they are composed of multiple systems and most systems provide more than one knowledge service.

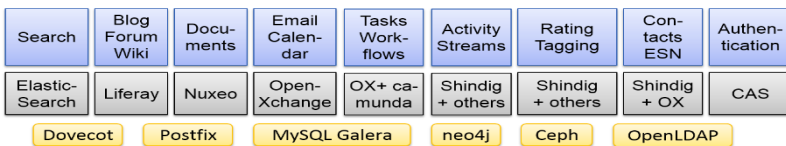


figure 1: knowledge services provided by SCHub (own illustration)

These knowledge services are not yet micro-services since they are still large deployment units (100-300,000 lines of code) and could be further decoupled, especially the document management system (DMS) Nuxeo. However, they represent a significant step from two huge systems (Liferay and Open-Xchange, both about 5 million lines of code) to seven smaller ones. The implementations described below are composed of these knowledge services and pay special attention to supporting the phase transitions of the knowledge maturing model [20].

3.1 Collaborative competence management (people)

Competence management is the systematic recording of employees' competencies, planning of their advancement, assessing the target achievement as well as aligning competencies with organizational goals [19]. Measures include yearly employee interviews, creating and updating job descriptions, maintaining a taxonomy of desired competencies, mentoring, planning and executing trainings as well as creating searchable employee profiles that show skills and experiences (ibid.). Collaborative competence management is implemented as suggested in [21]. People profiles are shown in Liferay as a portlet. Some data is read-only and stems from the corporate directory. Other data can be edited by the user (e.g., project experience, skills). Contacts can be managed through Open-Xchange (OX) or Liferay (only internal ones), so that an enterprise social network arises [22]. Data is stored in Apache Shindig. Users can suggest skills for their colleagues (endorsing). The latter can accept the proposal or reject it. Other users can confirm the skills, once they are listed in the profile. Despite auto-completion, a large list of different terms for skills will arise in this way. In order to aid finding experts, e.g. for team staffing, an administrator can use these terms, map synonyms and bring them into a hierarchy, so that a taxonomy is formed [23]. In order to foster a shared understanding of the meaning of a skill tag, each term is linked to a wiki page where it can be described [24]. An embedded search query on the wiki page will display a list of users tagged with the respective skill. Depending on the needs of the organization, related projects or documents can be linked as well. Finally, the tagged skills can also serve as a basis for periodical skill development discussions between employee and superior.

3.2 Idea and proposal management (contents)

Idea and proposal management involves organizational, human-oriented and technical measures like establishing processes for evaluating and rewarding ideas, fostering discussions to further improve promising ideas and software to support both [19]. It is a good example of content maturing [25] and already implemented within the ongoing SCHub project. Ideas are described in blog posts. The Liferay blogging portlet was extended, so that a discussion in a forum can directly be started from a link underneath (see figure 2: Screenshot of the idea maturing enhancement for Liferay blog posts). Alternatively you can directly move forward to collaboratively create additional content around the initial idea in a wiki page. Contents from the blog post are copied and can be edited afterwards. Ratings give an impression of other employees' opinions regarding the idea. An additional portlet displays the current status of the maturing process (see figure 3: Screenshot of the idea maturing (left) and wiki export portlet (right), left). It can also be used to easily navigate between the different systems. Links are also displayed in each portlet (blog, forum, wiki). The final step from the wiki page to the formal document in the DMS is an extension

of the Liferay's wiki export tool (see figure 3: Screenshot of the idea maturing (left) and wiki export portlet (right), right). You can chose between PDF and DOCX (MS Word document format) export.

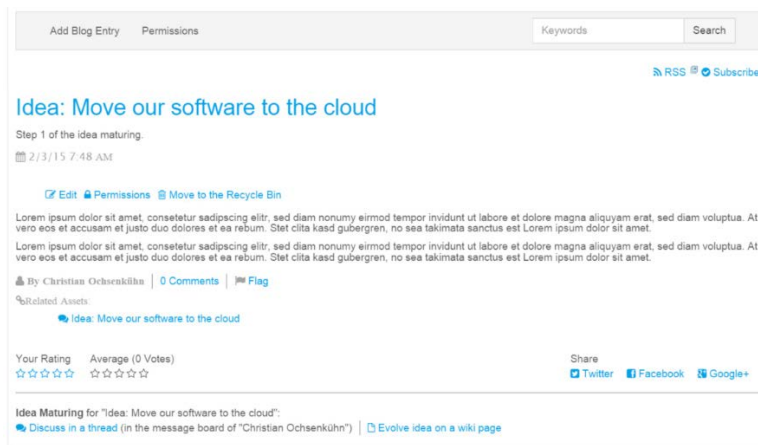


figure 2: Screenshot of the idea maturing enhancement for Liferay blog posts

The content of the wiki page is converted using a customizable Word template and the result can be downloaded or directly stored in the DMS. The location can be chosen in a file chooser dialog showing the DMS's structure.

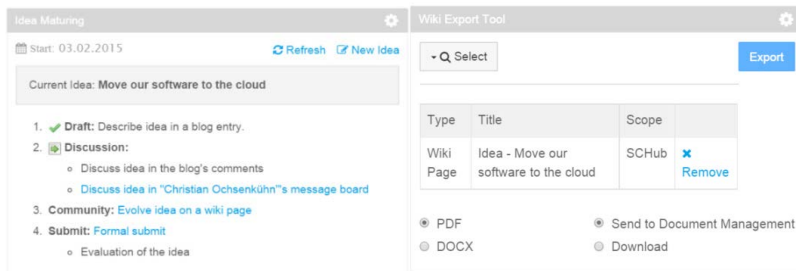


figure 3: Screenshot of the idea maturing (left) and wiki export portlet (right)

A further step could be tracking of the approval of the project proposal and the resulting project workspace (Liferay) or project plan in a Web-based project management solution, which would be easy with the chosen micro-service approach.

3.3 Collaborative business process & case management (processes)

Knowledge process reengineering aims at redesigning business process from a knowledge perspective, continuous analysis of processes for improvement potentials and their implementation [19]. Measures include business process modeling and creating an organization handbook, which describes not only processes and structures, but also exceptions, case-based experiences, reasons for decisions and so on. Lately, adaptive case management (ACM) was proposed as an adequate IT support for process-oriented knowledge work [26]. From the process maturing perspective [25], a case can be seen as a less mature form of a process.

SCHub aims at providing a semi-automated support for maturing processes by using activities from an activity stream and a case from an ACM system if existing as a basis for mining emerging task sequences or patterns and suggesting new (sub) processes based on extracted patterns [27]. Initially, when there is no case, the creation and final publication of a document of a certain type (e.g. project proposal or software specification) is used as the context for mining. Tasks performed by users involved in the advancement of the document and found in multiple document creation instances are suggested as tasks in a case. Users can edit those, introduce milestones and use them as checklist for further creation of this type of documents. They can further comment and rate tasks and thus collaboratively enhance the case structure. Additionally, the case serves as a new context for mining activities and task sequences that are found in several instances are suggested as sub-processes of the case (cf. [28]). Therefore, the case gradually matures into a process. To achieve this, Camunda's support of both BPMN and CMMN ("Case Management Model and Notation) is leveraged. A Web-based modelling tool is provided that also supports both notation and allows direct integration of functionality from the integrated systems. Task assignments and task completions can be reported to the activity stream in Shindig, depending on the privacy preferences of the organization.

4 Discussion

This paper has shown how IT support for KM instruments can be composed of micro-services. Available OSS is suitable for implementing those micro-services. Following the micro-service architectural style allows runtime reuse instead of built-time reuse, which fosters infrastructure-wide unification, as well as good scalability and extensibility. Social features are swapped out from the core systems which leads to centralization, so that the activity stream can report all events instead of only system-specific ones. The triad of people, contents and processes that is tied together by social features and enterprise search is well suited to support KM initiatives and overcome the overstressing of certain aspects by trendy hypes. Single Sign-On removes the need for additional log-on actions by the user. Enterprise search is finding emails as well as

documents, blogs and wikis with a single search query. Email attachments can directly be stored in the DMS without a detour to the local file system. Personal files can be accessed from the portal's personal site, the DMS's personal workspace as well as the groupware's file space. Important knowledge processes and maturing activities are directly supported with predefined solutions and content templates. The BPM engine together with the Web-based editor facilitates company-specific, process-driven KM solutions without coding. The ACM capabilities further improve the options for supporting semi-structured processes. Activity mining helps in detecting emerging patterns and further structuring cases with sub-processes. The unintegrated systems installed side-by-side provide none of these benefits. The results of the project will be published as open source, so that other projects can directly benefit from them. The solution will further be offered as Software as a Service, so that customers have the choice of running the solution on premise or renting it from the cloud. Preliminary results of the project show, that building an enterprise search solution purely from open source components is still a complex undertaking requiring coding, although the search engine itself offers commercial grade features and performance. A formal evaluation of the overall solution with selected customers and users of competing collaboration solutions is scheduled for Q2/2016.

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