From a Social Wiki to a Social Workflow System

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Abstract. This paper presents an approach for using wikis in an organizational context and a proto-type implementation for developing a wiki-based workflow system. We provide general considerations and requirements for changing a wiki's application context from public to organizational and will describe consequences for wiki architecture and policy management. The presented workflow system is based on an open-source wiki tool and is targeted at collaborative workflow design and activity management.

Keywords: workflow, social software, wiki, groupware, collaboration, social proxy, social awareness, business process, computer supported collaborative work.

1 Introduction

Traditional software architecture in enterprises exhibits a coexistence of workflow applications primarily supporting structured processes and collaborative applications focused on unstructured communication and sharing. The latter kind of software is often referred to as groupware [1]. Several theoretical approaches and practical attempts have been made by research groups and industry to offer integrated solutions (e.g. [2,3,4,5,6,7,8]). Recent developments in software industry show yet another driver, the so-called *social software* [9,10]. It extends collaborative features of groupware with social aspects. When we take a look at market leaders in business software production we see social software components like blogs, wikis, instant messaging, chat and shared document editing on their feature lists indicating that there is a market interest for business software with improved social functionality. Breaking down social functionality to their basic elements we find characteristics like ease-of-networking, ease-of-communication, ease-of-sharing, rich media, accessibility, awareness, presence and visibility as the main drivers (adapted and extended from [10]).

Research in the field of business process management recently pays more attention to improve the flexibility of business process management. For example, individualized or adaptive work-flows, ad-hoc workflows, dynamic business process management [11,12,13,14,15] have become common terms in academic discussions. What we encounter is a shift from top-down approaches in business

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process design and deployment to an approach where also bottom-up reengineering and adaptation from the user side is welcomed and as various research prototypes show technically possible (e.g. [16,17,18]).

Summarizing outcomes of recent developments in academia and industry we may conclude that the frequently stated fast changing business world and unpredictability of processes [11,12,13,14,15] is searching for concepts to enable businesses easily and quickly adapt to changes. Changes are not only emerging in an organizations environment - market or society - but also within its organizational structure (fluctuation, restructuration of business units, process change). Here social software paradigms come into consideration, featuring adhoc collaboration and communication apart from rather static rules derived from business process definitions and organizational charts.

In this paper we will give some general considerations when using wikis in an organizational context and describe how social functionality was integrated into a well established web application platform. We will describe a prototype that uses wiki technology to collaboratively create and deploy workflows. The web application platform used for this prototype is based on OpenACS [19], the wiki used is XoWiki [20] - a highly flexible wiki framework.

2 Wiki versus Workflow Management?

Looking from a high abstraction level a wiki system and a workflow management system represent opposite ends of a spectrum when considering their way of dealing with objects of work. While a wiki system deals with a webpage (or a set of web pages), a workflow management system deals with a variety of business objects including orders, invoices, delivery notes, payments, goods receipts etc.. While a wiki is typically accessible to the public, a workflow management system is typically confined within organizational boundaries. While a wiki allows typically editing content pages equally to any person, workflow management systems usually underlie strict policies determining who may change a workflow definition and who may access which business objects. While wikis invite anybody to participate in composing, reading and reviewing a webpage, work-flow management systems assign people explicitly tasks according to their competencies and roles. While wikis are easy to use even for non-technophile persons, workflow management systems generally require deeper understanding of the business processes and technical constraints.

Finally and that is in our opinion the most inspiring difference, wikis use the common *wisdom of crowds* (Tim O'Reilly) to reach completeness rather than expert knowledge to create sound workflow definitions.

The first wiki systems were focused on easy-to-use, quick collaborative editing of knowledge (e.g. Ward Cunningham and his WikiWikiWeb [21]) in the form of webpages on a dedicated website. Soon features for searching, revision management, enhanced formatting and linking appeared. With the evolution and growth of Wikipedia as the most prominent representative several new requirements occurred. Especially the huge amounts of articles created and the

degree of participation in authoring and reviewing articles required more attention to version management and control. Although public participation in collecting knowledge remains a basic idea behind a wiki, business software industry put wikis in organizational context and developed wikis into a tool for team collaboration. Changing the application context from public to organizational implies a change in access policies as well. Access policies have to comprise all operations on wiki content like in more traditional content management systems and must be modeled per wiki instance to fit both intra-organizational and inter-organizational demands of an application.

As for this quick analysis we can summarize that three aspects may be considered when evaluating wiki-scenarios in organizations:

1. The degree of organization of the involved community
2. The degree of specifity of wiki objects [22]
3. The degree of desired completeness

The first aspect reaches from bottom-up to top-down development of a shared knowledge space within a well-defined organization or in the public and defines to which degree collaboration and access policies have to be introduced. The second aspect symbolizes the data structure of a wiki-object and to what degree it underlies a formal definition. As a third aspect, one could consider the degree of desired completeness or continuous evolution versus development of a final version (infinite versus finite number of review cycles).

Figure 1 shows the three aspects described and their possible values. While wikis for web page creating and editing require not too much concern about consistency and have a simple underlying workflow, a sales order wiki would involve various assignees from different organizational units and would have to be based on strict transactional rules to ensure data consistency. In between these two extremes we might find numerous use cases where a moderate degree of completeness is required, a middle sized department is involved and collaborative development of a business document with a semi-formal structure (e.g. contract, project plan, business blueprint ...) is in focus. From the social intelligence point of view we can observe that the more collective intelligence is required the lower the degree of organization has to be. In other words, a broad community participating in development of an artifact increases probability of its completeness. The web-based architecture of wiki-software is an ideal facilitator for exposing artifacts to a broad audience increasing the number of potential contributors. While public wikis and team wikis for web based knowledge collections have become widely popular, using wiki-systems in business application areas is still uncommon. The next two sections show development areas to improve the fit of wikis in such situations.

2.1 Application and Business Needs

While purely textual based wiki systems like Wikipedia have a book-like content creation in mind, wiki systems in project or business style application areas

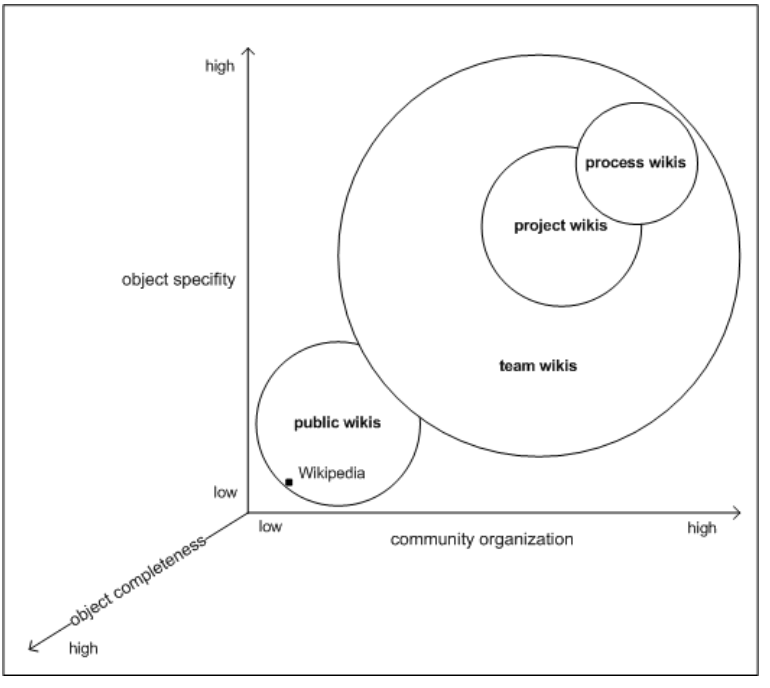

Fig. 1. Aspects of wiki scenarios

require good application integration (for example computed summaries in a wiki-style code management system) and different content views (e.g. time-lines vs. contextual display via e.g. categories).

2.2 Social Clues and Group Awareness

The more people get involved in a wiki creating or contributing to artifacts the more the need arises for making activities and participation transparent. Providing information on collaboration by visualizing the relations between actors and their collaborative actions can improve the awareness and accountability of individuals' activity. Making visible individuals' actions to the community may initiate a self-regulating mechanism in group behaviour that is triggered by the individual's motivation to return to the norm [23].

3 From Wiki-Applications to Wiki-Based Workflow Systems

Let us summarize in a first step some key properties of traditional and advanced wiki systems. Key properties of public, primarily text-based wiki systems:

– Ease of content creation (request for a content can be communicated by a link to a non-existing wiki-entry).

- Use of named objects to ease references to wiki objects.
- Revision management to improve transparency and avoid loss of work.

Key properties of advanced wiki systems for team/project applications:

- Policy management for potentially fine-grained rights-management for view, edit and other operations on wiki objects.
- Application integration to combine textual and graphical content with computed results.
- Social proxies to create social awareness and provide transparency of collaboration structures [23].

Most of these properties are as well desirable for lightweight workflow systems for managing for example casual business activities. The most predominant missing property for workflow wiki systems is the application based state and workflow management. The next section presents an implementation together with a small application for technical improvement proposals.

4 An Implementation of a Wiki-Based Workflow System

Our implementation is based on the OpenACS framework [19], which is a robust and stable web application platform and has a long track of application areas [24], including web-community platforms and e-learning applications [25]. OpenACS stores objects with unique IDs persistently in a relational database (PostgreSQL and Oracle are supported as relational database management systems [19]). Revisioned ACS-objects can be stored in the content repository. Based on this framework, XoWiki [20] is an advanced wiki application implemented in the object oriented scripting language XOTcl [26] (hence the name). XoWiki supports the basic and advanced properties for wiki systems. One of the interesting properties of XOTcl is the support of transitive mixin classes, which allow for a flexible composition of behaviour [27]. This way it is even possible to mix in workflow properties into the XoWiki package. The workflow behaviour is provided by the newly developed content flow package, which might be merged into future versions of XoWiki. The content flow package is based on the following basic design concepts:

- A workflow definition is a wiki page containing a formal definition of a workflow in terms of states and actions, implemented via the State Design Pattern [28].
- From a page with a workflow definition, one can create a workflow instance page, which references the workflow definition page.
- Every state has an identifying name and might contain a set of attributes of various types. These attributes are stored in the workflow instance pages.
- In every state, a different form can be used to edit these variables. The form itself is as well a wiki page.
- State transitions are triggered via actions, which are presented as submit buttons of the forms. It is possible to add arbitrary methods and conditions to every action.

– Every transition causes a new revision of the workflow instance page to be written. Every transition can be commented. This is exactly the same mechanism as writing a revision of textual wiki page and allows to track back the workflow history and allows making e.g. an old revision of the workflow instance again the current one.

Furthermore, it is possible to provide for every state role-specific views and actions. In the small example below, we show an example of a *Technical Improvement Proposal* workflow.

This simple workflow uses a form to allow users to propose a technical improvement for a product during development process. Once the proposed improvement is submitted it changes its state from `initial` to `proposed`. In general, one could send the proposal to assigned members of the development team, but in our simple example, we simply mark it as such for everybody visible. In this wiki instance every user can see all proposals in all states. Users can as well subscribe to the wiki instance and obtain notifications on changes via email or RSS. Users assigned to the role `admin` can accept or reject a proposal. In case the decision whether to accept or reject the suggestion needs further input it may be saved and processed later. While the action `reject` leads to a final state `rejected`,

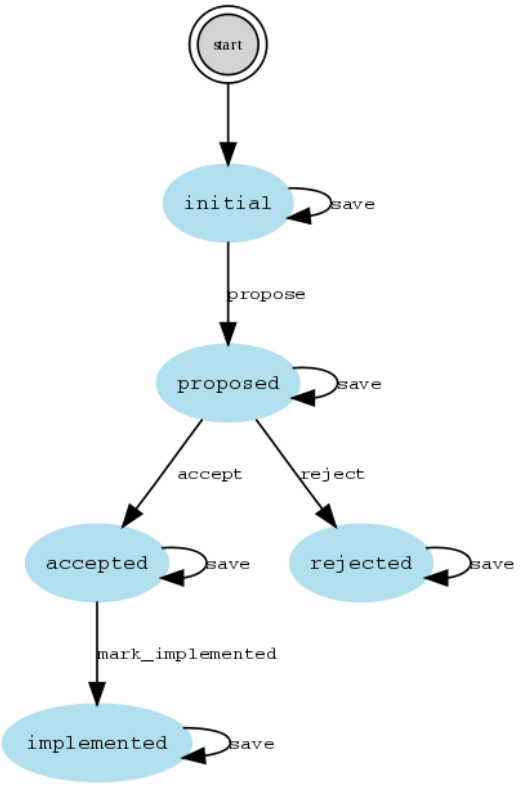

Fig. 2. XoWiki workflow visualization for Technical Improvement Proposal

the action `accept` needs further action to mark the proposal as `implemented` thus giving the user feedback upon successful implementation.

For the definition of this workflow a wiki page (a wiki form) containing a workflow definition is used. The workflow definition is coded using an easy-to-learn syntax.

```
# Actions are used here with the following parameters:
#   next_state: state after activation of action
#   roles: a list of roles; if the current user has one of these
#          roles, he is allowed to perform the aciton
#          Currently implemented roles:
#            all, swa, registered_user, unregistered user, admin,
#            creator, app_group_member, community_member
#
Action save -roles admin
Action propose -next_state proposed -proc activate {obj} {
   my msg "$obj is going to state [my next_state]"
}
Action accept -next_state accepted
Action reject -next_state rejected
Action mark_implemented -next_state implemented

# States
#   - form: the form to be used in a state
#   - view_method: Typically "view" (default) or "edit"
#State parameter {{form "en:tip-form"} {view_method edit}}
#assigns the specified form to all states

State parameter {{form "en:tip-form"}}

State initial  -actions {save propose}
State proposed -actions {save accept reject}
State accepted -actions {save mark_implemented}
State rejected -actions {save}
State implemented -actions {save}
```

Within the workflow definition an entry form is defined and associated with states. Also actions may be defined and have to be related to different states. Field-value checks and execution of business logic either internal or external may be defined for certain field-types and can be referenced within action procedures. Saving a workflow definition, a diagram is automatically drawn using the Graphviz-system [29] (Figure 2).

From the view of a workflow definition, a link is offered to create a new workflow instance or to list the current workflow instances. Furthermore, the system provides links to the referenced form pages. Note, that the wiki-system offers revisions of workflow definition, of workflow instance and of the used form

pages. Especially the revisions of the workflow instances can be a valuable resource for analyzing business process usage and filing business cases. Also a recommendation system based on these instances may be implemented to guide decision-making in complex business processes [30,31].

Furthermore, the revision history makes business processes transparent in terms of collaboration awareness. XoWiki supports two visual proxies [23] for social awareness using undirected graphs, which can be used without modification for plain wiki pages as well as for workflow instances.

Both graphs visualize the collaboration based on the analysis of people's activities on shared artifacts. If two persons work on the same artifact, it is assumed that they work on the same topic. The graphs are computed on the fly, therefore showing always an actual status of collaboration activity.

Analysis of collaboration activity may be varied between a comprehensive view of a whole wiki instance and a view which is focused on one individual only. These graphs are called activity graph and the personal collaboration graph [20].

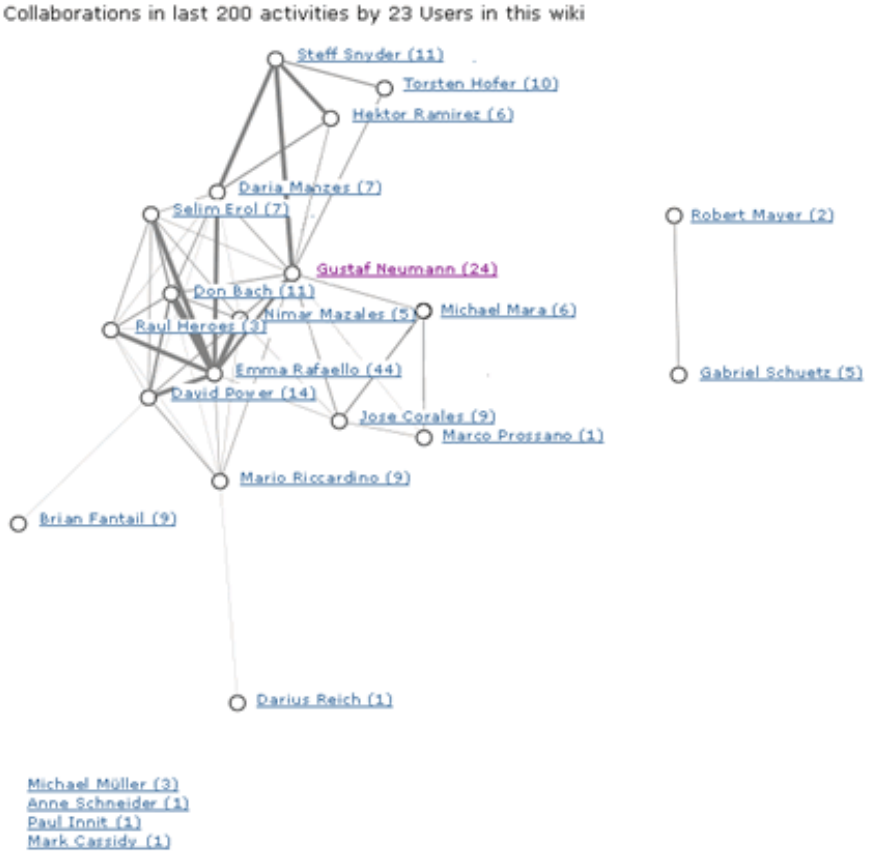

Fig. 3. Example of a XoWiki Activity graph

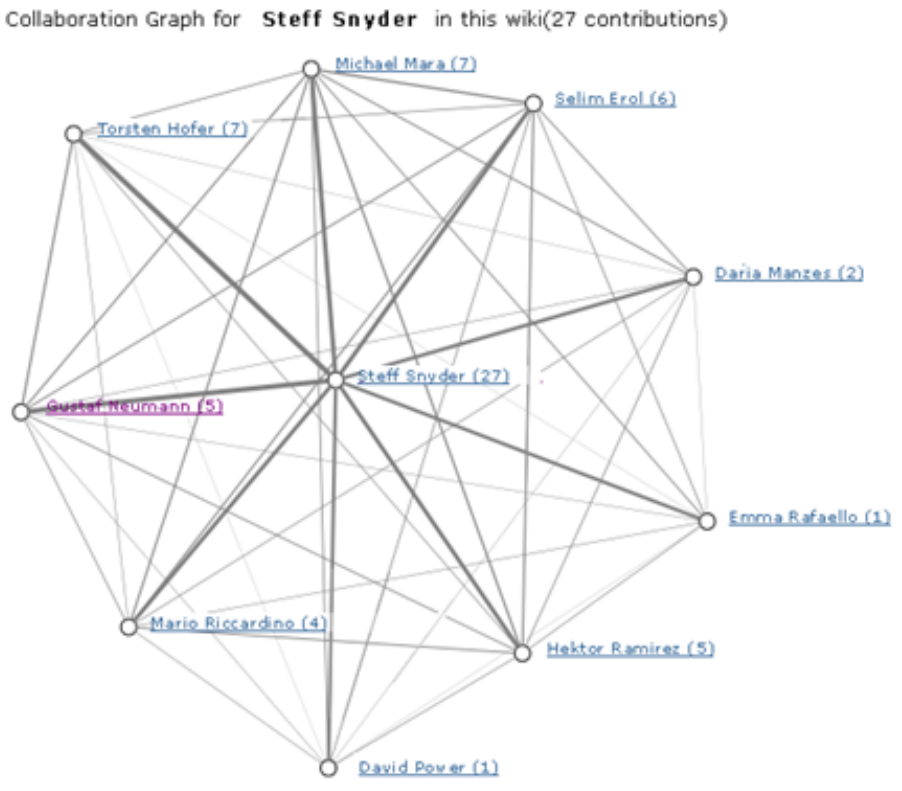

Fig. 4. Example of a XoWiki Personal collaboration graph

The activity graph (see one example in Figure 3) is computed of the most recent n (e.g. 200) activities in a wiki (workflow) instance. The large network on the left in Figure 3 shows a high degree of interdependence and collaboration as many individuals are involved and strong edges signalize frequent interaction. The small network consisting of only two participants is not connected to the large and therefore indicates that these two people work on separate artifacts. The list of users in the bottom part of the graph finally shows individuals that do not work together beyond a threshold degree in the time window. The personal collaboration graph (Figure 4) displays collaboration activities for a single user. It answers the question *who has contributed to the artifacts which I have worked on* and shows a personal collaboration network. While the activity graph is the same for every user, the personal collaboration graphs are different.

5 Summary and Conclusion

The approach given in this paper is intended to give orientation when using wikis in a business context in general and in a workflow context in specific. We pointed

out several aspects that need special attention: e.g. the type of object and the characteristics of the community involved. The workflow example above is a very simple example, but it clearly shows the possibilities *social functionality* offers for workflow management. The system is certainly capable for much more complex systems and was used so far for about 50 workflow definitions ranging from the simple *Technical Improvement Proposal* to ticket tracking and assessment processing based on QTI [32]. It has been tested with a few thousand workflow instances per workflow definition. At the time of the writing, role management, import/export of workflows and workflow instances are under work.

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