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Role and task recommendation and social tagging to enable Social Business Process Management

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Abstract: Traditional Business Process Management (BPM) poses a number of limitations for the management of ad-hoc processes, where the execution paths are not designed a priori and evolve during enactment. Social BPM, which predicates to integrate social software into the BPM lifecycle, has emerged as an answer to such limitations. This paper presents a framework for social BPM in which social tagging is used to capture process knowledge emerging during the enactment and design of the processes. Process knowledge concerns both the type of activities chosen to fulfil a certain goal and the skills and experience of users in executing specific tasks. Such knowledge is exploited by recommendation tools to support the design and enactment of future process instances. We first provide an overview of our framework, introducing the concepts of role and task recommendations, which are supported by social tagging. These mechanisms are then elaborated further by an example. Eventually, we discuss a prototype of our framework enabling collaborative process design and execution.

Keywords: Social BPM, Social Tagging, BPM, Task Recommendation, Process Knowledge.

1 Introduction

Business Process Management (BPM) is a discipline widely used across almost all large corporations. According to [1], BPM is defined as a field for involving any combination of modelling, automation, execution, control, measurement and optimization of business activity flows, in support of enterprise goals, spanning systems, employees, customers and partners within and beyond the enterprise boundaries.

Traditional approaches to BPM consider a traditional BPM "lifecycle" comprising process design, deployment, enactment, monitoring, and improvement [2]. Each phase is supported by different components of a Process-Aware Information System (PAIS) [3] and involves a specific set of different stakeholders.

Such a traditional approach to BPM presents the following limitations:

Lack of Information Fusion: BPM normally follows a top-down approach, where processes are designed by a group of individuals and passed on end users to follow [4][5].

Model-Reality Divide: The top-down approach of traditional BPM drastically limits the participation of end users in the design of processes. This often results in

the processes not being followed correctly, which consequently creates a gap between the designed process and the process which is executed [6][4][5].

Information Pass-On Threshold and Lost Innovation: Useful feedback from end users is not captured in process design due to rigid hierarchical controls in the design and deployment phases. As a result, valuable first-hand knowledge to improve processes may remain unused [6][4].

Strict Access-Control: This is present in most traditional BPM approaches, that is, only actors which have been selected and given specific access are allowed to execute them [7]. This will limit the users who are able to participate into the business process life-cycle.

These properties of the standard BPM cycle make it unsuitable for so-called ad-hoc processes which are under the consideration in this paper.

To address the above limitations of traditional BPM, over the recent years there has been much research done around the emerging idea of Social BPM (SBPM). Social BPM can be defined as an approach to enhance organizational performance through a controlled participation of external stakeholders, in order to improve process design and execution [8]. Offering BPM as social software is a promising approach that fosters improved communication and collection of knowledge by allowing multiple users to work on the design, operation and improvement of a business process simultaneously and without many of the access control restrictions typical of traditional BPM [9].

Overall Social BPM can have a number of benefits, such as exploitation of weak ties and implicit knowledge [10][11], increased transparency of information sharing [11][13] and decision distribution [11] [12], and improved knowledge sharing [8][12][13]. At the same time, a number of potential limitations of Social BPM have also been identified, including the steep learning effort [14][10], security [8][13], lower quality of input in process design and enactment [8], and difficulties in evaluation [13].

Researchers have proposed an extension of BPMN to include features of social software, such as setting up polls [15]. Others [16] have also discussed agile and flexible business process development to overcome some of the limitation of the traditional BPM systems and discussed different types of process flexibilities (*by change, deviation, underspecification, and design*) [14]. However, such approaches do not change the rigid sequential nature of the traditional BPM lifecycle, as they only increase the number of features available in process design and enactment.

Social tagging in the context of social media networks has increased immensely over the recent years, as powerful and effective tools to capture and share user knowledge. However, these have not been used in the context of BPM so far. In this regard, only [17] has touched upon this briefly discussing where social networks are used to support process models by providing recommendations to people and supporting collaboration.

This paper builds on the existing works in the area of Social BPM [18][17][4] and aims at proposing an innovative framework for Social BPM. Our framework exploits the benefits of social tagging to capture process knowledge from users during the enactment and design of the processes. Such knowledge may refer to either design-time concerns, such as the type of tasks successfully considered in the past to fulfil a certain goal, or run-time concerns, such as the experience and skills of users

demonstrated in previous execution of the processes. Process knowledge is exploited to support role and task recommendation in the phases of process design and enactment. In other words, task fit for purpose and users' experience and skills as emerged during the design and execution of processes is captured via social tagging to be reused in current or future enactments of processes.

Overall, our framework is more geared towards 'ad-hoc processes' [19], as opposed to structured processes where the process steps are pre-determined and remain unchanged, or even semi-structured processes. According to [19] in ad-hoc processes the execution path is defined during the enactment of the processes and the participants are free to choose the course of action they wish to follow. In terms of the ratio of flexibility and rigidness of the processes as introduced by [20], our approach starts from the *exploration* of the processes and then potentially moves to the process *standardisation*, once the structure of processes has converged to a stable state. Exploration requires flexible processes and collaboration inside loosely structured teams whilst standardization requires division of responsibilities [20]. Organisation of social activities in organisational contexts or unstructured problem solving involving a large number of potential participants with different expertise are typical examples of ad-hoc processes.

The paper is structured as follows: Section 2 introduces our framework discussing the static and the behavioural. This section also provides background about social tagging and then moves on to explaining the recommendation components of our framework. Section 3 illustrates with an example the proposed design, while Section 4 presents highlights from the proof of concept implementation of the design. Conclusions and future work are presented in Section 5.

2 Social Business Process Management Framework

Our framework is defined by a static 'conceptual' view and a dynamic 'behavioural' view.

2.1 The Static View

Figure 1 shows the conceptual model underpinning our framework. A *process* in our framework may have one or multiple *tasks* that need to be fulfilled in order to be completed. As far as actors are concerned, we distinguish between community members and process owners. The *community members* participate in the design and execution of processes. The community determines when new instances of *processes* should be started. Community members collaboratively discuss to design processes, i.e. deciding which tasks should be part of a process, to assign community members to tasks, and to capture the knowledge emerging from process execution, through tagging. The *process owner* is responsible for the overall design and execution of the process, to ensure deadlines are met and that the discussions among community members related to the tasks come to a decision and conclusion. Generally, the process owners have more experience and expertise for one or more given processes.

T*ags* are keywords used by community members to capture certain segments of the discussion among community members during the design and execution of

process instances. There are two categories of tags, the *system-defined* tags are used for tasks that are populated by the system and refer to the process the tasks are related to, while *user-defined* tags are added by the community members or process owners to the tasks to specify the skill-set the task refers to. The *tag cloud* is a method of presenting tags where the more frequently used tags are presented and re-emphasized, to facilitate reuse [21].

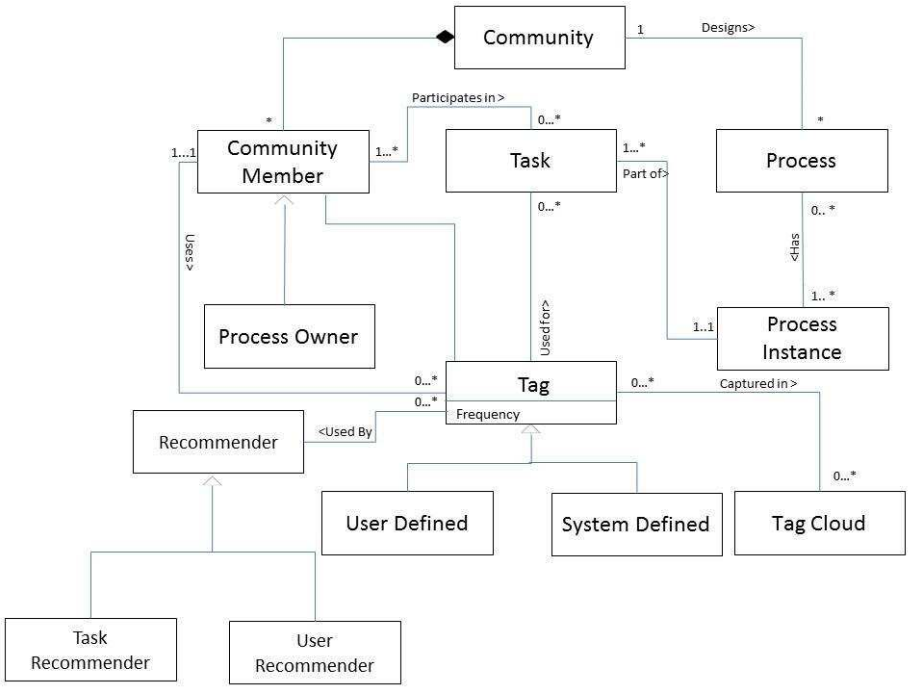

Fig. 1. Social BPM Framework

Tags represent the basis of the *task* and *role recommender*. For any given process instance, the framework recommends to the community all the tasks performed in previous instances of similar processes (task recommendation). The role recommender suggests a list of community members with their expertise which is based on their performance, as well as the tasks they have previously participated in that specific process. The two main mechanisms of the model assist the members in reusing previously captured process knowledge and recommend tasks, as well as present community members with their skill set which have been recommended and tagged by previous process owners.

Having presented a static conceptual model of our framework, the following section presents a more dynamic view of the framework.

2.2 The Behavioural View

The process model in Fig. 2 presents the behavioural view of our framework, illustrating the different activities from the outset of process initiation until the end of its execution that are supported by our framework.

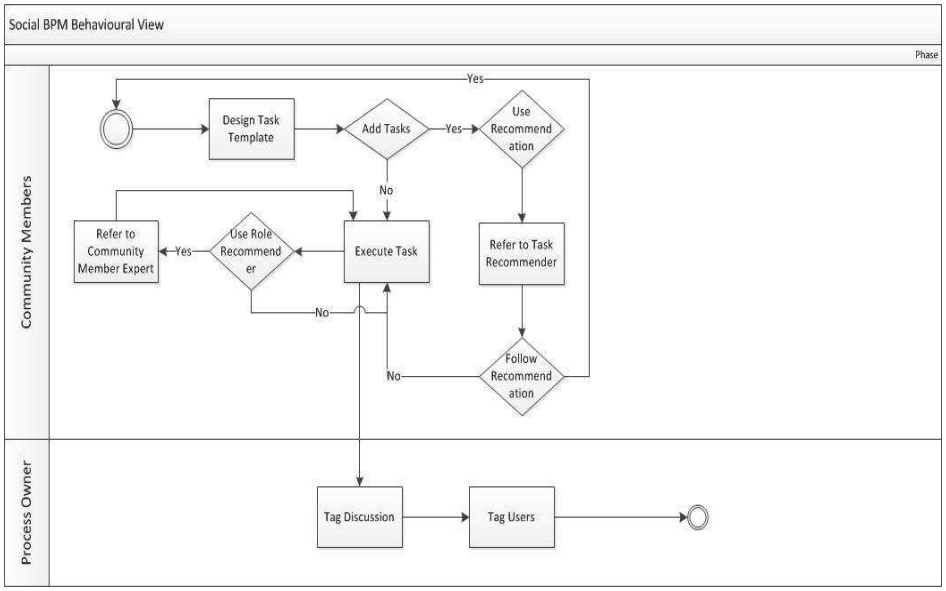

Fig. 2. Social BPM Behavioural View

Fig. 2 shows that the task design and execution in our framework are blended, as typical of ad-hoc processes. While defining and add tasks to the process, the community members may use the recommendation provided by our framework. During the execution of task or after those have been executing, process owners are responsible for making the knowledge captured in terms of tasks and processes and skills set of community members to fulfil such tasks through tagging.

2.3 Social tagging for capturing process related knowledge

Tagging is the assignment of unrestricted keywords to all kinds of content and it becomes social when tags are shared among users and different users are allowed to tag the same content unit [22]. Social tagging has become part and parcel of most of the social networking sites over the past few years. In other contexts social tagging assists in integrating models into knowledge management systems [23]. Existing models consider tagging as an activity where an individual user assigns a set of tags to a resource [24], however so far this has not been applied in the context of business processes in order to exploit process knowledge.

In our research we are incorporating and utilising social tagging into the context of social BPM for the purpose of process knowledge discovery. In the proposed social BPM model as discussed below, there are two types of roles, the community member

who contributes towards accomplishing the tasks, and the process owner who is a community member which in addition to contributing is responsible for the guiding of the process to completion and also to tag the discussions.

The user interaction model during execution has been discussed previously in [25]; in social tagging we are focusing on the post-execution phase. After or during the execution of the tasks related to the process, the process owner (or any community member) is responsible for going through the discussions and tag the segments which are useful process knowledge for future executions. The process owner tags the discussion based on his judgment and usefulness of the process knowledge captured in the discussions.

The following two sections expand on the role and task recommendation elements of our model.

2.4 Task Recommender

The task recommender in our framework presents all the tasks which have been executed in previous executions of a specific process. This is in order to benefit from previous process knowledge that has been accumulated. This process knowledge is captured with the content that it was executed in as well in order for the community member to benefit from the experience.

There have been various recommendation techniques for business process models that have inspired our task recommender approach. Attachment, structural, and textual recommendations [26] are examples of this. Specifically, our framework exploits the attachment recommendation, that supports designers during modelling tasks by finding appropriate services which are meaningful to the designer [27]. Furthermore, [28] discusses the same approach which helping process designers in modelling by providing a list of related services to the current designed model. In the task recommender component of our framework, relevant tasks are suggested to support community members during process design and execution.

The tasks are recommended for each process based on the tasks created in the past for the same type of process. There can be cases where a task is captured within another task. These tasks are those that have emerged throughout the discussion which has been taken as part of another task. In such cases it is primarily the responsibility of the process owner to create an independent task, so this can also be suggested as part of the task recommendation. For instance (see Fig. 3), task B has been completed and community members have provided their input, at this point the process owner has realised that, as part of task B, there is another part of the discussion in which a different task has emerged, which would be useful in the future to do as part of process X. This emerged task is captured and a new task (i.e, D in this case) is created. Task D will then be recommended going forward for anyone who is going to be running a process of type X in the future.

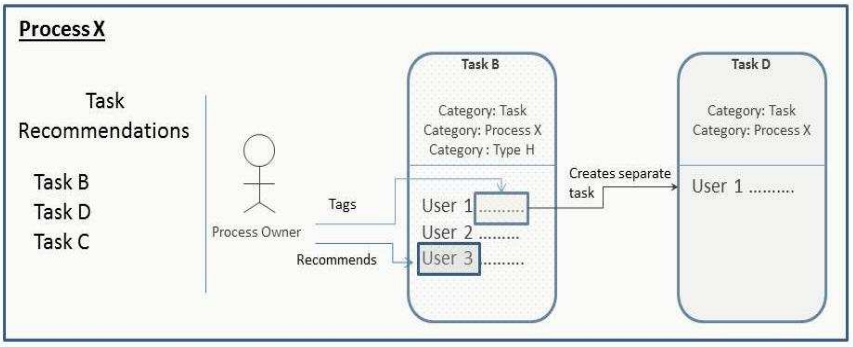

Fig. 3. Task Recommender in Social BPM

Therefore, the community sets the 'agenda', that is, it determines the list of tasks that need to be carried out in the context of a specific process (this could be added as they go along and might differ in different instances of the same process). The community decides the initial list of tasks and creates a new instance of the process in the system.

In order to get support from the system, a community member who participates in the process, e.g. a process owner, uses tags to describe the type of the process according to some taxonomy agreed within the community. This is in order to get assistance from the task recommender component. Going forward, every time the community is running a task, the task recommender will display a list of relevant tasks that were carried out in previous instances of the process. When the community decides that a task has been completed, someone from the community (the process owner for instance) needs to tag the task so that it can be reused in the future. This tag specifies under which process this task took place (System defined tag), and then the process owner (or/and other community members) classifies the main topic of the task (User defined tag). Since there is no standard classification agreed by everyone else, the one tagging is free to use any tag they like. The 'tag cloud' provides support to this phase, by showing the tags used in the past and their frequency of use.

2.5 Role Recommender

After the execution of tasks, the process owner is responsible to go through the execution log and recommend the community members who have offered valuable contribution to the tasks that have been executed. The process owner's two main primary roles, therefore, are *firstly* to ensure the discussion in fulfilling a specific task is followed up till completion and not left abandoned. *Secondly* the process owner goes through the discussions after the completion of the process and tags segments that would be useful process knowledge to be utilised in future executions. This process is illustrated in Fig. 4. The process owner has recommended community member 1 and 2 on Tasks A and N respectively. This is the decision of the individual who is tagging based on the community members' contribution.

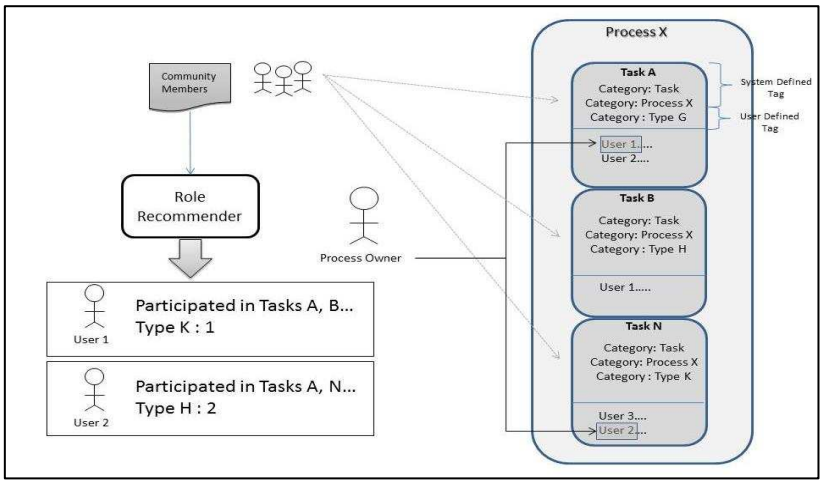

Fig. 4.Role Recommendation in Social BPM

Community members are listed with the previous tasks they have participated in, and also the number of times they have been recommended for having contributed in a task with a specific skill area. Skill sets are assigned to tasks by process owners as they see suitable and recommend community members who have contributed positively in the specific task. The list of community members, the number of times they have been recommended (tagged), as well as the tasks they have participated in are listed to allow community members to see who has expertise and experience and in which areas. This can be utilised either as taking up the role of being a process owner, or just a resource centre which community members can contact to benefit from the process knowledge other community members have.

After the execution of a process, the process owners (and the community) decide who is going to be recommended for their contribution to the tasks. This can be a collective decision so the recommendation is not biased. For instance assume James was of great help in the task that dealt with financial matters of a given process. If the community decided to recommend James for his contribution, this would add to James' profile rating by increasing his rating for 'financial expertise'. In the future when looking at member's profile, the accumulated scores for the different categories of tasks would be shown against each of the community members as illustrated in Fig. 4. This would help the community to select members for a particular task based on their previous contributions.

To conclude, the role recommender does not suggest specific community members for the task, because the knowledge of who has been good at what could be biased, incomplete or inaccurate, thus, such recommendations need to be used only as an approximate indication and not accurate measurements of members' skill sets.

3 Example

We clarify our approach by applying it in the context of a typical social business process, the organisation of a study circle in a non-profit organisation. This example is adapted from a real process, which is the object of the ongoing empirical evaluation of our framework.

A group of community members would like to run a process called "Study Circle", a type of an invited talk, in which a specific subject is discussed by an expert in a specific field. Some typical tasks involved in organising a study circle are setting a date and time, inviting a speaker, booking a venue, ordering food, designing a poster and advertising. The community does not have a standard way of executing such process, because the tasks involved will change every time, often during the organisation of the talk, because of several factors, such as the availability and preferences of the speaker, the number of interested participants, or the scheduled date. To support this in a social way, any of the community members should be able to initiate the process, setting an agenda as to what tasks have initially to be achieved. Our framework supports the definition of the process by capturing the knowledge of the community members via tagging and making it available to improve the design and execution of the process.

3.1 Task Recommendation

When a new process instance is enacted (for example a "Study circle in 2015"), the task recommender suggests all the tasks executed in previous instances for this process type of process, i.e. "Study Circle" (see under Task Recommendations in Fig. 5). This allows the community members to get ideas about potential tasks they could also be considering for the current execution.

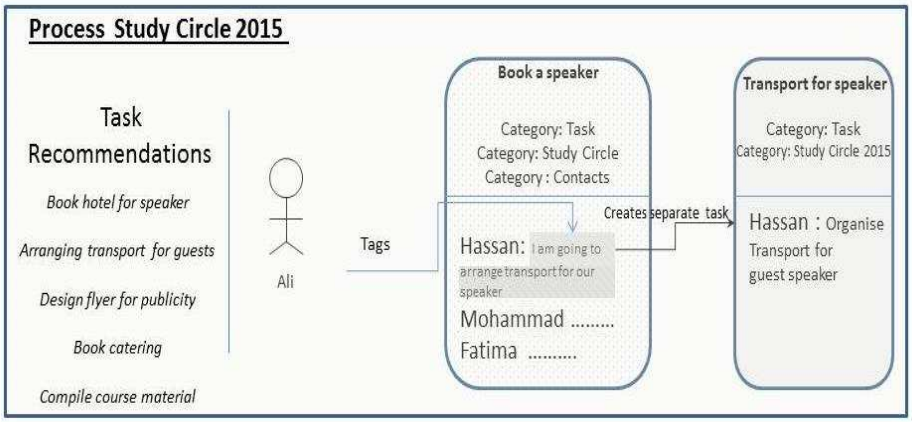

Fig. 5 Task-Recommendation in a Study Circle Process

The tags of tasks can belong to different categories (see Fig. 5). First, a category is used to identify tasks as opposed to other elements in our framework, e.g. the user

profiles community member or process owner. The second category of tags captures the process to which the task belongs to, which is Study Circle 2015 in this specific case. In the third category, task can be tagged to explain their type and the expertise that is needed by community members for their execution. For instance, Book a Speaker can be tagged with contacts to identify the skill set related to this task . The knowledge captured by this last category of tags will be used in the role recommender to identify the strengths of the community member who should execute tasks.

Additionally, if as part of the definition of a task, for example "book a speaker", a new task has emerged (e.g "organising transport for speaker") then the community members are able to tag this and create a separate task for this. The emerged task will then appear in the list of recommended tasks in the future to suggest to other community members to consider also arranging transport for their invited speaker when organising a study circle.

3.2 Role Recommendation

The knowledge captured through tags in the task definition (see Fig. 5) is also exploited to assign tasks to the community members who have the most experience and/or expertise to execute them.

In Fig. 6, Fatima participated in two tasks in the past ("Book a Speaker" and "Design Flyer") and was rated by Ali, the process owner of previous editions of the Study Circle, in the 'design flyer' task, for instance because she has volunteered to design a poster for the event and did that successfully and on time. This task has been tagged with the task 'publicity', which shows the skills of Fatima in the area of publicity. 'Publicity' is part of a specific set of tags used by the community interested in the processes "Study Circle" to specify competencies related to the types of tasks that are likely to be performed in the process.

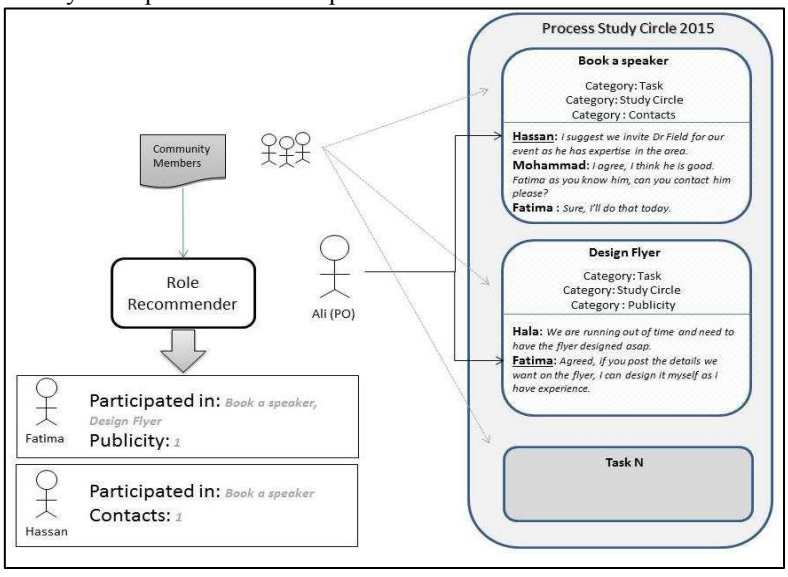

Fig. 6.Role-Recommendation in a Study Circle Process

The role recommender presents the list of community members with their skill sets, expressed as the number of times they have been rated by process owners for the execution of a given task. This helps community members to identify who in the community have experience in the required tasks. In our Study Circle example, this list is used to find out who has experience in finding and contacting speakers and designing a flyer, e.g. Hassan and Fatima, respectively, in Fig. 6, or has experience finding a venue and arranging transport for the speaker.

Note that in complex processes involving large communities machine learning techniques and algorithms [29] could potentially be adapted to assist data classification and tagging.

4 Proof of Concept Implementation

In order to validate our framework, we have produced a proof of concept prototype. Pimki, a Personal Information Manager based on Wiki technology, has been chosen as the basis for our implementation. The main reason for choosing Wiki technology is that it clearly supports community collaboration and it provides native mechanisms to capture tags. The prototype, however, required also ad-hoc extensions for specific aspects of our framework.

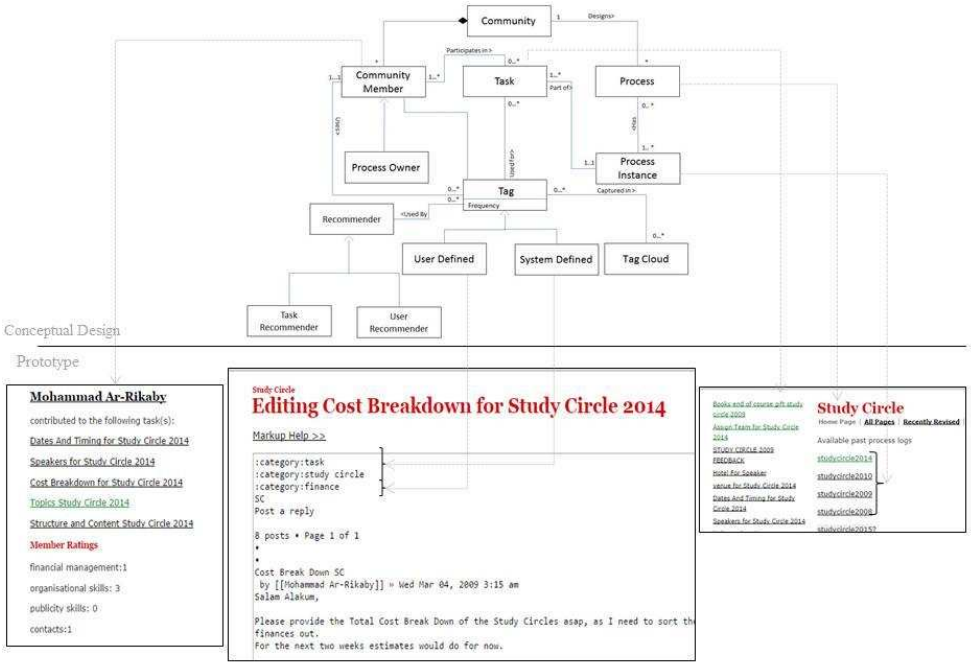

Fig. 7. Design - Prototype Mapping

Fig. 8 presents an overall picture of the mapping between elements of our framework to some screens from the prototype.

In our prototype tasks and processes are created as pages, which the community members can contribute to. Pages are the building block of a Wiki and can be uniquely named, stored and searched. The community decides the initial list of tasks and creates a new instance of the process in the system (in our prototype this refers to a new page for the process with links to each page that corresponds to a task). Every task is a discrete entity in the prototype, so that the system can store and index it (using tags) and retrieve them later on.

Fig. 9 shows an example of how a community member can be tagged for their valuable contribution in suggesting an innovative task, i.e. Suggesting present a gift to the study circle participants. The user-defined tag that most suitably explains the type of the task is populated by the process owner (or any member of the community) as shown below, i.e "publicity".

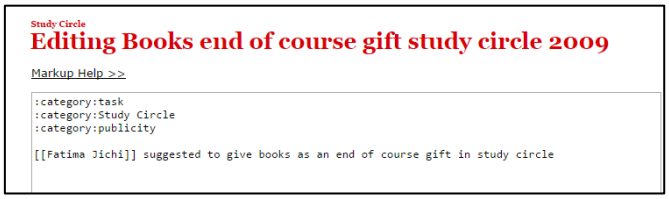

Fig. 8. Example of Recommending Role in the prototype

The community members' page in our prototype shows the tasks to which the member has contributed to and also what skill they have been rated for (see Fig. 10).

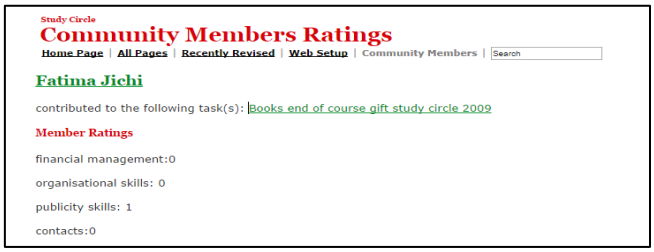

Fig. 9. Example of a Community Member Profile in the prototype

5 Conclusion

This paper presented a framework for social BPM using social tagging to exploit emergent process knowledge about user experience and skills to support the design and execution of future process instances. Our framework particularly addresses the limitations of traditional BPM, such as the model-reality divide and lack of information fusion. In our framework, process design and execution become blended, thus there is no or limited gap between the designed processes and what is actually executed. The utilisation of social tagging in order to benefit from previously captured

process knowledge in other occurrences of the same process is also an attempt to overcome the gap related to information pass-on threshold and lost innovation.

The applicability of our framework is limited to ad-hoc business processes, and it does not extend to highly procedural and codified processes.

In the framework proposed by [4], in the proposed SBPM model, during the initial runs of process instance execution, there is a loosely structured team which are free to participate in any process instance, however as process knowledge is accumulated and members are recommended for their positive contributions, the processes move towards stabilisation. Firstly, in fact, there are more tasks recommended from previous executions which would broadly consist of similar tasks, and secondly individuals with more experience and expertise are ranked, which can be utilised by other community members to assist in process execution.

Our framework allows for a large degree of flexibility in processes where the design and execution of each instance can benefit from the knowledge generated by participants in previous executions. In principle, each instance of the same process may deviate from the others and the community members have more possibilities to take a decision on how and in which order to act in a specific process instance.

There are generally two avenues to balance flexibility and rigidness in business processes. One approach is to start with flexible process and then add controls and restrictions in place. The second is to start with a rigid sequential workflow system and then add elements of flexibility to it [16]. Our framework is closer to the former approach, in the sense that social tagging and collaborative participation of users restricts the freedom of community members, by making knowledge generated in previous executions of the process emerge. Control factors in our approach are the process tasks which need to be achieved in order to completed the overall processes, and also the presence of a process owner who guides the process enactment to ensure the process execution is completed.

As far as future work is concerned, our work can be extended by integrating automated semantic tagging of tasks and roles and by providing more explicit support to process execution at the implementation level. An empirical evaluation of our framework is ongoing.

References

1. Palmer, N., Schooff, P., Dugan, L., Farina, C., Passports to Success in BPM; Real-World, Theory and Applications. Future Strategies Inc. Publication (2014)
2. R.G. Lee, B.G. Dale, Business process management: a review and evaluation. In: Business Process Management Journal, Vol. 4 Iss: 3, pp.214 – 225, MCB UP Ltd (1998)
3. Dumas, M., van der Aalst, W., Hofstede, A.: Process-Aware Information Systems: Bridging People and Software Through Process Technology. Elsevier Science & Technology Books, (2007)
4. Schmidt, R., Nurcan, S.: BPM and Social Software: In BPM 2008 International Workshops, vol 17, pp 649-658, Springer Berlin Heidelberg (2009)
5. Palmer, N.: The Role of Trust and Reputation in Social BPM: In Social BPM Work, Planning and Social Collaboration Under the Impact of Social Technology, Swenson, KD., Palmer, N., et al.: BPM and Workflow Handbook Series, pp. 35-43 (2011)

6. Filipowska, A., Kaczmarek, M., Koschmider, A., Stein, S., Wecel, K., Abramowicz, w., Social Software and Semantics for Business Process Management - Alternative or Synergy?, in Journal of Systems Integration, vol 2, No 3, pp.54 - 69 (2011).
7. Wohed, P., Henkel, M., Andersson, B., Johannesson, P.: A New Paradigm for Work Organization. In: Business Process Management Workshops, LNBIP, p.659 - 665. Springer Berlin Heidelberg (2009)
8. Brambilla, M., Fraternali, P. & Vaca Ruiz, C. A Model-Driven Approach to Social BPM applications. In Social BPM Handbook, BPM and Workflow Handbook series, Future Strategies, USA, 95-112 (2012)
9. Duipmans, E. Business Process Management in the cloud: Business Process as a Service (BPaaS). University of Twente. http://tinyurl.com/8f44g5l (2012)
10. Kemsley, S.: Leveraging social BPM For Enterprise Transformation: In Social BPM Work, Planning and Social Collaboration Under the Impact of Social Technology, Swenson, KD., Palmer, N., et al.: BPM and Workflow Handbook Series, pp. 77 – 83 (2011)
11. Brambilla, m., Fraternali, p., Combining social web and BPM for improving enterprise performances: the BPM4People approach to social BPM, In Proceedings of the 21st international conference companion on World Wide Web, pp. 223-226 (2012)
12. Richardson, C., Is social BPM a Methodology, A Technology, Or just a lot of Hype? 20 May 2010 [Blog Entry]. Available: http://blogs.forrester.com/clay_richardson/10-05-20-social_bpm_methodology_technology_or_just_lot_hype [Accessed Apr 2015]
13. S. Erol, M. Granitzer, S. Happ, S. Jantunen, B. Jennings, A. Koschmider, S. Nurcan, D. Rossi, R. Schmidt, P. Johannesson. Combining BPM and Social Software: Contradiction or Chance? In Journal of Software Maintenance and Evolution: Research and Practice, vol. 22 pp. 449–476, John Wiley & Sons, Ltd (2010).
14. van der Aalst WMP, ter Hofstede AHM, Kiepuszewski B, Barros AP. Workflow patterns. Distrib Parallel Databases 14(1):5, (2003)
15. Brambilla, M., Fraternali, P., Vaca, C.: BPMN and Design Patterns for Engineering Social BPM Solutions: In BPM 2011 International Workshops, vol. 99, pp. 219-230, Springer Berlin Heidelberg (2012)
16. Bider I., Jalali A. Agile business process development: why, how and when - applying Nonaka's theory of knowledge transformation to business process development. Information Systems and e-Business Managementhttp://link.springer.com/article/10.1007/s10257-014-0256-1
17. Brambilla, M., Fraternali, P., Vaca, C.: BPMN and Design Patterns for Engineering Social BPM Solutions: In BPM 2011 International Workshops, vol. 99, pp. 219-230, Springer Berlin Heidelberg (2012)
18. Rangiha, ME and Bill Karakostas, "A Socially Driven, Goal-Oriented Approach to Business Process Management" International Journal of Advanced Computer Science and Applications (IJACSA) (2013)
19. Burkhart, T., Loos, P.: Flexible Business Processes - Evaluation of Current Approaches: 2010 (MKWI '10), Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI. Göttingen (2010)…..
20. Bider I., Kowalski S. A framework for synchronizing human behavior, processes and support systems using a socio-technical approach. In: Bider, I. et al. (Eds.): BPMDS 2014 and EMMSAD 2014, LNBIP 175, pp. 109-123 Springer (2014)……
21. Smith, G., Tagging people – powered metadata for the social web. Published by Pearson Education CA, US (2008)
22. Cantador I., Konstas I., Jose J.: Categorising Social Tags to Improve Folksonomy-based Recommendations.: In Journal Web Semantics: Science, Services and Agents on the World Wide Web, V.9, Iss. 1, pp. 1 – 15, March (2011)

23. Bruno, G., Dengler, F., Jennings, B., Khalaf, R., Nurcan, S., Prilla, M., Sarini, M., Schmidt, R. and Silva, R.: Key challenges for enabling agile BPM with social software. J. Softw. Maint. Evol.: Res. Pract., 23: 297–326. (2011)
24. The State of the Art in Tag Ontologies: A Semantic Model for Tagging and Folksonomies, Kim, Scerri, Decker, Breslin, 2008 Proc. Int'l Conf. on Dublin Core and Metadata Applications (2008)
25. Rangiha, ME., Karakostas, B.: A Goal-Oriented Social Business Process Management Framework. In: Conference Proceedings The International Conference Business Process Management (ICBPM 2014), London, UK, 26 - 27 Sep (2014)
26. Kluza, K., Baran, M., Bobek, S., Nalepa, G., Overview of Recommendation Techniques in Business Process Modeling. AGH University of Science and Technology, Proc. KESE (2013)
27. Born, M., Brelage, C., Markovic, I., Pfeiffer, D., Weber, I.: Auto-completion for executable business process models. In Ardagna, D., Mecella, M., Yang, J., eds.: Business Process Management Workshops. Volume 17 of Lecture Notes in Business Information Processing. Springer Berlin Heidelberg (2009) 510–515
28. Chan, N., Gaaloul, W., Tata, S.: Context-based service recommendation for assisting business process design. In Huemer, C., Setzer, T., eds.: E-Commerce and Web Technologies. Volume 85 of Lecture Notes in Business Information Processing. Springer Berlin Heidelberg (2011) 39–51
29. Burkhart, T., Loos, P.: Flexible Business Processes - Evaluation of Current Approaches: 2010 (MKWI '10), Institute for Information Systems (IWi) at the German Research Center for Artificial Intelligence (DFKI. Göttingen (2010)