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A Goal-Oriented Social Business Process Management Framework

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***Abstract*—**Social Business Process Management (SBPM) promises to overcome limitations of traditional BPM by allowing flexible process design and enactment through the involvement of users from a social community. This paper proposes a meta-model and architecture for socially driven business process management systems. It discusses the main facets of the architecture such as goal-based role assignment that combines social recommendations with user profile, and process recommendation, through a real example of a charity organization.

***Keywords*—**Business Process Management, Goal-Based Modelling, Process Recommendation Social Collaboration, Social BPM.

I. Introduction

SOCIAL BPM (SBPM) is described as an approach for engaging users and including more diverse voices into the process improvement activities as stated by [9]. There have been proposals for integration of BPM and social software; however none of these have resulted in a formalised meta-model of a socially driven business process management systems [2], [3]. Additionally, the human perspective and user participation has been neglected in the discussions concerning SBPM and specifically during the execution of the business processes.

SBPM can benefit from related work in information systems and business processes such as goal-based modelling. Goal-based modelling has been proposed by recent research [12] as a way to achieve flexible process models and overcome the limitations of the traditional BPM systems. In goal-based BPM, goals are used to define the intended outcome of the process, rather than the means (steps/tasks) to achieve them. The approach presented in this paper proposes business process execution as set of goal driven social collaborations. It is more geared towards less rigidly structured (i.e. semi-structured or ad-hoc) processes, but it can be argued that these types of processes are of the most value in today's organisations.

The proposed SBPM system does not enforce tasks during execution but recommends them ('process recommender'), by monitoring the flow of the social conversation. Additionally, unlike in traditional BPM, role assignment is not based only on static user profiles but on a function of their social behaviour and on the feedback received from the social network participants.

In short, the paper proposes a way to execute business processes in a socially driven manner. The paper is structured in the following way: firstly in Section II an overview of social BPM and goal-based modelling approach in the context of SBPM is presented and some of the limitations and benefits of SBPM is listed. In Section III, a proposed architecture of a socially enabled SBPM model is presented with an explanation of its main components such as social user profiles, role assignments, process recommendation, and user interaction during the enactment of the processes. This is followed by a goal-based meta-model for SBPM in Section IV. Section V presents a real scenario example where the different features of the architecture are applied to a specific scenario. Finally in Section VI, an overall conclusion is drawn from the discussion and the plan for future research is discussed.

II. Social BPM

A. Social Software and Business Process Management

Business Process Management is a discipline where information technology and management intersect [24]. Its main phases consist of design, configuration, enactment, evaluation [25]. Limitations with the traditional BPM approach [13] have triggered new research that is inspired by other emerging trends such as the collaborative Web (Web 3.0) and new ways of deploying and using software online.

Social software provides a platform for collaboration between individuals and groups and it is a "general term encompassing a set of tools and applications that enable group interaction and computer-mediated communication" [26].

Social BPM is the intersection of social software and BPM and aims to integrate social aspect throughout the different stages of BPM. The key element in social BPM is user engagement [6], from the initial stages of process discovery all the way to execution and evaluation of the processes. In SBPM there is a seamless integration of design stage and enactment as the processes to achieve the set goals are often executed and discovered on the fly. Furthermore, SBPM accounts for the unplanned participation of different users in order to complete the enactment of the process steps more efficiently [1].

The benefits of SBPM have been argued in [5], [13] and, in combination with social software, in [12]. These include *exploitation of weak ties* and *implicit knowledge* [1], [2], *transparency* [2], [3], *decision distribution* [2], [16], and

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knowledge sharing [2], [3], [16]. Potential limitations of SBPM have also been identified namely: the *learning effort* required [24], [1], *security* issues [24], [3], *difficulty to evaluate the process effectiveness* [3] and the effort required for *process management*.

The authors of [31] have proposed a technical framework for social BPM and an extension of the BPMN which includes some aspects of social software and a visual design. However the core aspects of the traditional BPM model have remained unchanged, as the users are using social software in order to execute rigid sequential processes. Thus, social characteristics have not been incorporated across all different stages of BPM.

Therefore, a comprehensive framework for SBPM is still missing. In particular there is a gap in the execution stage of BPM [13] which needs to be discussed and investigated further.

B. Goal-Based Modelling

Goal-oriented modelling allows the capturing of the 'what' without specifying the 'how'. Essentially, goals are states which need to be achieved [7] through completing a number of steps. Goal-oriented modelling is not new and has been used amongst other purposes, in requirements engineering extensively [27], [10]. It has only recently, however, been proposed in an SBPM context [12]. Goal-oriented approach can be adapted to overcome the rigid sequential nature of process found in BPM and enable flexibility and collaboration of the users throughout the BPM lifecycle. Goal based process models can strike a balance between the flexibility required in social BPM and the structure and control measures needed to complete a process.

Goal based process modelling approaches, however, present their own challenges, especially regarding the identification of suitable goals without conflating them with steps and tasks [8], and managing conflicting goals.

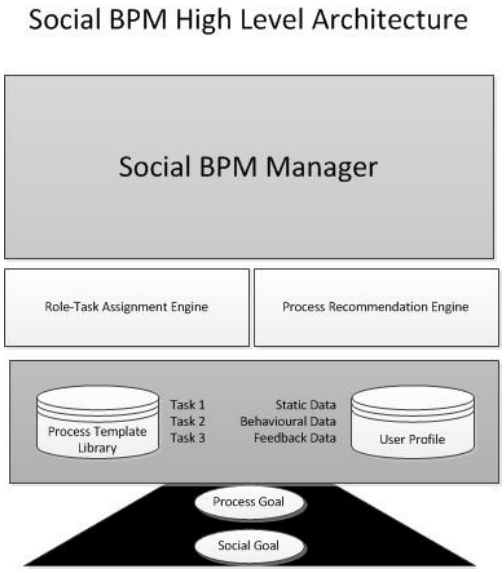

Fig. 1 Socially Guided Business Process Modelling Architecture

III. Architecture of a Socially Enabled BPM Model

A. Overview of the Architecture

The proposed SBPM architecture as presented in Fig. 1 is a system that is aware of the social environment in which processes execute. Fig. 1 illustrates the different facets of our proposed SBPM framework. It is capable of interpreting the social dimensions of the processes and exploiting social knowledge to execute processes, recommend tasks, and assign/propose roles. It contains a collection of goal oriented process templates that are customisable by the users. The Process goals are models that maintain dependencies and hierarchical relationships amongst goals. The other two main components of the architecture are the user task assignment module and the process recommender which are discussed below.

B. Social User Profiles and Role Assignments

In traditional BPM systems, tasks can be explicitly assigned by the administrator, or can be automatically assigned by the system based on the roles assigned to existing users. In some cases, tasks can be routed to different individuals based on their content, and on the individual's availability. The novelty in our approach is that role assignment is based on the user's social profile.

In this approach, we are proposing three main types of user profile data, collated by the SBPM system and used for role assignment and task recommendation. The first type of data is collected from the user known as 'static' (profile) data are gathered when the user registers a profile with the system, or retrieved from the social platform(s) of which the user is a member. The second type of data is captured by the system during the user's performance of tasks and activities. This is known as 'behavioural' data, elicited from the user's social activity, i.e. information such as conversations with other members, are captured and stored in the user's profile or the number of times the user has been involved in a particular activity. The last category of data is based on explicit ratings that SBPM users assign to each other for the performance of processes and tasks. These ratings allow the system to evaluate how good the performance of users in specific processes and tasks are.

The SBPM engine uses the above three types of data to recommend the most suitable user (the user with the highest score) for a particular task in a ranked manner to a process owner (responsible for the enactment and management of a process). The process owner is free to follow the recommendations of the engine, or to select an entirely different user to assign to a task.

The three types of data are complimentary. For example in the case of insufficient feedback data the system can utilise the first two categories of data to perform user task assignment. Therefore the richer the data the more accurate and suitable would the user assignment function be. Ranking models [29] can be employed for this purpose. One possible scoring system as suggested in [28] uses: *frequency scores, operation scores* and *process design scores*. The algorithm for ranking

users is customisable and the criteria based on which the users are chosen can be tailored based on the process owner or the system administrator.

C. Process Recommendation

Traditional BPM suites do not provide sufficient agility to support rapidly changing and unpredictable processes [4]. This makes flexibility during the runtime of the processes almost impossible, as all the flow and sequences of the steps have been hard-wired at the design stage. In contrast, our proposed architecture employs a recommendation system, to guide the user towards accomplishing the goals set by selecting tasks from a set of predefined templates. This approach provides both flexibility as well as guidance to the users [4].

Recommender systems [17], [29] have mainly been employed for product recommendations. Although recommender systems are used extensively in entertainment, content presentation, e-commerce and services [30], they have not previously been used in the context of SBPM. According to [18], [19], the recommendations are made based on 'past experiences according to a specific process goal. This is achieved by comparing the current process instance with past execution logs and by preferring those executions that satisfy the specific goal'. This is similar to the type of recommendation employed in our SBPM approach.

The process recommendation used in our approach, employs a *hybrid approach* that combines recommendations that have been made in the past (*content–based recommendations*), with recommendations made by other users with similar tastes and preferences (*collaborative recommendations*). The recommendations are based on the data gathered as explained above to ensure, the correct processes and tasks are assigned or suggested to the right individuals [14].

Furthermore, the process recommender employs a process template which is a pattern of how a typical process in a given domain achieves its goals. This template can provide the basis for an instantiated process that can be changed on the fly, during execution [21]. This concept is explained further in the context of a real case scenario in Section V.

Overall, the proposed architecture and recommendation system enables a shift from static rigid, predefined sequential flow of steps to a dynamic collaborative social flow of goals and states which need to be accomplished socially [23]. The user can reject, customize, propose new steps or accept the recommendation as illustrated below in Fig. 2 in a dialogue with the SBPM system.

D. User Interaction during Process Enactment

Real-time interaction and accounting for unplanned participation from the user community is a core element in the social BPM model, as it is impossible to anticipate every potential scenario that the user could be in [22]. Such interaction between the recommendation engine, user and wider social community is illustrated in Fig. 2.

The purpose of such interaction is to achieve flexibility, i.e. the "the ability to adapt the process flow on demand through adding, skipping, or sequence reordering of process steps" [16]. This interaction during the enactment, changes the very nature of processes. Processes evolve during execution and the course of action is determined based on the user, social community and the system recommendations.

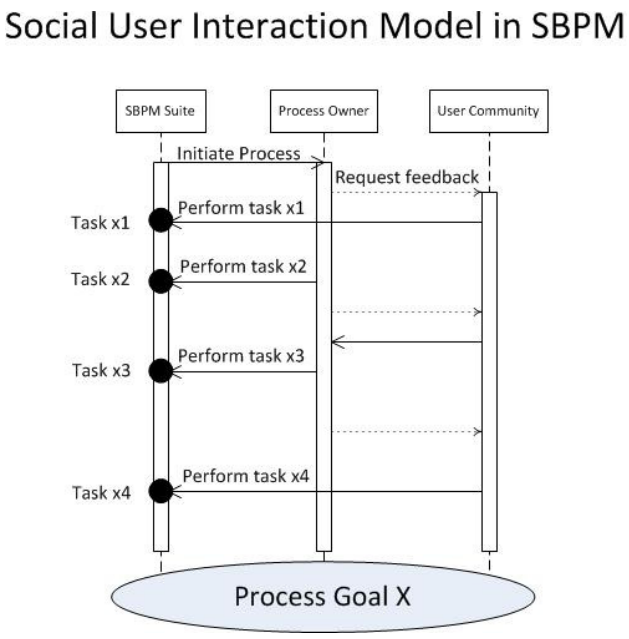

Fig. 2 Process Recommender Approach

A process is modelled as a network of goals linked to each other with dependency relationships. The SBPM manager will always recommend to the user to fulfil a goal that has no dependencies.

The user and his/her social community collaboratively decide on how to fulfil a goal (i.e. what tasks to perform), possibly by considering execution logs from past processes. The SBPM manager maintains the state of process execution and actively participates in the community dialogue by recommending users to carry out tasks, sending reminders about incomplete goals, and performing general housekeeping tasks.

Based on the architecture and the main components of the social BPM proposed in this paper, the following section proposes a preliminary metal model for social BPM systems.

IV. A Proposed Goal –Based Meta-Model for SBPM

Fig. 3 proposes a Social Business Process Management meta-model that is goal-based and driven by user social behaviour. This is based on the main components required for the proposed SBPM framework following Fig. 1. The aim is to define a common architecture for future SBPM tools and enable both BPM and social software vendors to align their efforts and interoperate. The meta-model accommodates different categories of goals, i.e. 'process goals' which are based on the business objectives of the organisation, and user-social goals. Social goals reflect the social motives and goals

of the user to engage with the system to run a specific process. Social goals fall into categories such as affiliation, approval, status, individual, responsibility and concern goals as classified in [20], [11], and are used by the system's role assignment and process recommender modules.

The aim of this proposed meta-model is that BPM vendors as well as user organisations can easily define and customise goal templates and store them in the SBPM system as process templates. Adaptors are required to import user profiles from various social networking sites using social software type of tools.

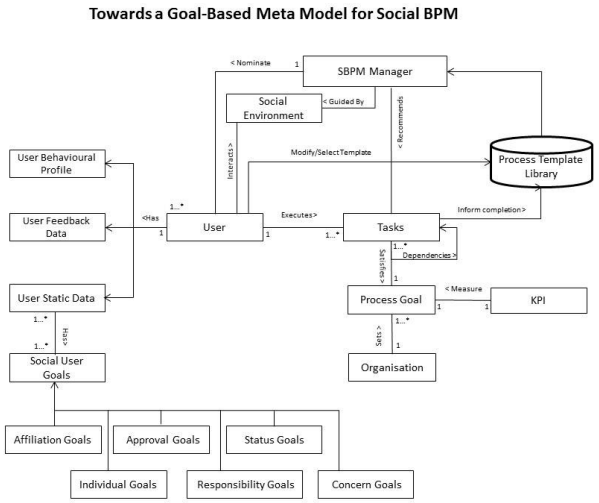

Fig. 3 Proposed goal-based socially enabled user interaction meta-model

Here some of the components in this model is briefly explained:

User Feedback Data: Information about the user which has been rated by the members of the social community after the involvement of a user in a particular activity.

User Behavioural Data: Information about the user which is gathered through the behaviour of the user in the community and the frequency of their involvement in a particular activity.

User Static Data: Information gathered about the user upon their registration and becoming a member of community.

Social User Goals: These are the motives why the user would engage and participate in fulfilling a given process goal.

Tasks: In order to complete a specific process goal, a number of tasks need to be completed.

Social Environment: This is the community of users who are registered on a specific platform and have an interest in being part of an organisation or community and work towards fulfilling the organisations overall aims and objectives.

Process Goals: The goals that the execution of the process achieves and it consists of a number of tasks.

SBPM Manager: Manages the role assignment and task recommendation mechanisms.

Process Template Library: Process templates are stored and users are able to choose from the existing templates. The tasks to be completed are also listed in the library and the SBPM uses this template to recommend the task to be completed.

KPI: Key Performance Indicators are measures which the user needs to compare the completion of the tasks against and inform the process template library.

The main components of the meta-model such as tasks, process goals, SBPM manager and user related data have been explained in their own context in the previous sections of the paper and will be further demonstrated in the context of the following example.

V.A Worked Example

A. Overview

In order to illustrate further the functionality of the proposed SBPM framework functions, an example is described below involving a charity organisation. The reason for choosing a charity organisation as the case study is because of the inherent social dimensions of such organisations, and the more ad-hoc and volunteering based nature in which processes are carried out. A process of organising a fundraising event is used for illustration purposes, and only its main goals and tasks are discussed.

B. Task Constraints and Dependencies

In Fig. 4, a goal dependency model is presented in which the dependencies of the tasks are illustrated as an example. For instance, the first goal to be achieved in a fundraising process is to decide on a date and time for the event, something that is not dependent on any of the other goals. Thereafter, the venue needs to be booked after which there is a choice between deciding on the food or booking the speaker. In order to advertise for the event, a flyer needs to be designed; this is dependent on a number of tasks that need to be satisfied first, as illustrated in Fig. 4 below:

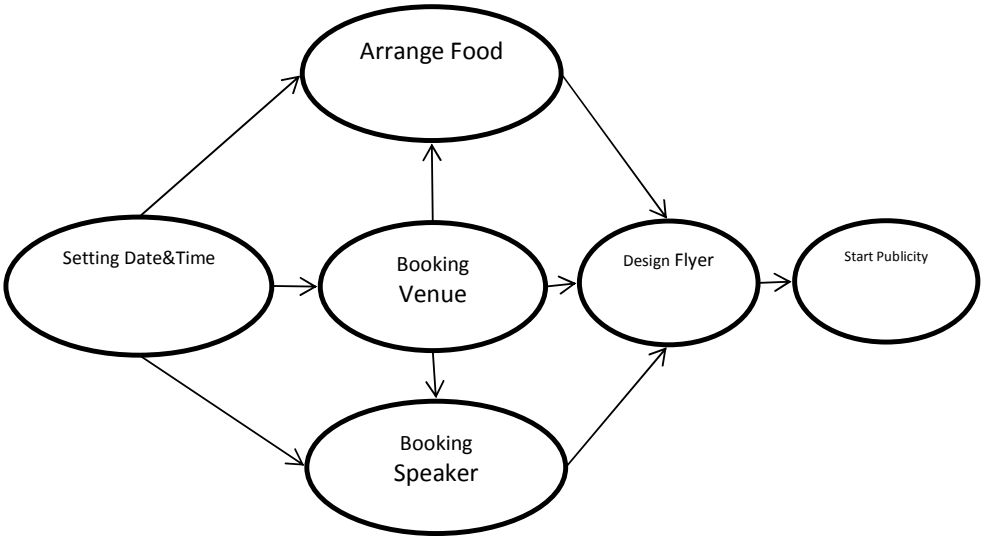

Fig. 4 Dependencies for Organising a Fundraising Dinner

These dependencies are used to manage the processes and to make it impossible to execute a goal without having its pre-requisites completed first. Often goals with no interdependencies can be pursued in parallel. For example, after the confirmation of the date & time and venue, the food and speaker goal can be accomplished in parallel as there are no dependencies between them. The system will always recommend all goals that have their dependencies met, to the user. This is particularly essential in instances where the user is not familiar with how the processes are run and in more complicated scenarios where the sequence of tasks to be achieved is not clear.

C. Role Assignment Mechanism

Following the discussion in Section III, the user task assignment can be automated based on the availability of user data from the three different categories. Before the initiation of the process, the system or the user community can suggest a process owner who is most suitable to take on the overall responsibility of managing the whole process. As an example, in our scenario, a user registers with the system and becomes part of the committee at the charity organisation. As part of the registration the user can provide details about his experiences and interests (Profile static data). For instance if the user has expressed interest in fundraising events and has rated his/her interest with a score higher than everyone else, he will be nominated upon the initiation of the process 'organise a fundraising dinner'. This is the first type of data which helps the recommendation of a specific user. After the user has completed this process, other users in the social community and the charity committee are able to rate his performance organising fundraising dinner by providing feedback data. The system refers to the ratings received from the social user community to pick the user with the highest rating.

During process execution, the system may recommend specific users to execute a specific goal. This is dependent on the availability of the recommended user. As an example, a user can be recommended as responsible for booking the speaker based on his profile and on his behaviour in the current and past processes, i.e. on how frequently this specific user has taken part in discussions about booking a speaker. This assignment recommendation can be supported by the user's received feedback for this task (booking a speaker).

D. Process Recommendation and User Interaction

As per Fig. 5, the system contains a template for fundraising events. In this, a set of activities that have to be satisfied in order for the main goal (organising a fundraising event) to be completed, is listed. Furthermore the dependencies between these tasks are also described as explained in Section V and illustrated in the table in Fig. 5 indicating what the dependency of each of the activities are.

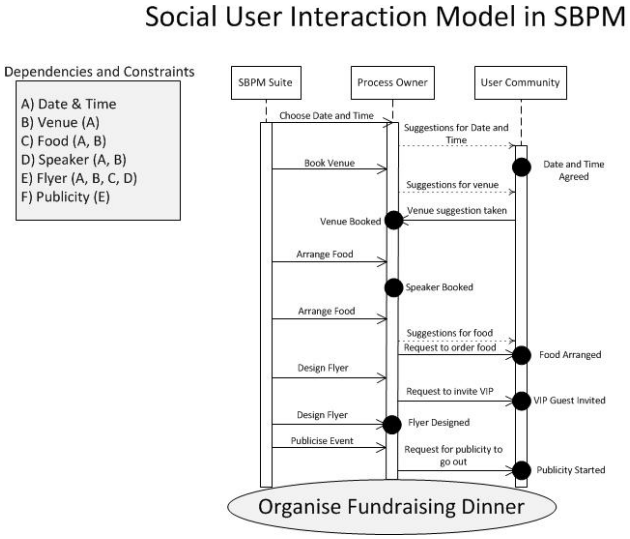

Fig. 5 Goal-Oriented Interaction towards Organising a Fundraising Dinner

As shown in Fig. 5, the system makes a recommendation to the user about how to begin the process, by proposing all possible goals that can start the fundraising process. The user can select one or more of the initial goals, such as 'set venue'. Tasks about how to realise this goal can be recommended by the SBPM manager who maintains logs of previous process executions. Such logs for the 'select venue' for example, will contain the social discussion that took place for this goal and its outcome. The users are free to reject the recommendation and try a new way to fulfil the goal. When the goal is fulfilled, the user responsible must inform the system so that it can update the process state.

In the above examples, after the completion of the first two goals, there is an option between booking the catering or the speaker as both of their pre-conditions have been fulfilled. They are both recommended to the user who is free to choose which one to follow. This style of interaction continues until all goals have been fulfilled. When the process terminates the users are free to add the modified process template to the process library.

VI. Conclusion and Future Research

In [22], business is compared with life and it is proposed that business processes need to incorporate a dynamic and interactive mechanism to cater for the various changes. Most of such dynamism can be caused by interactions in social environments between systems, users, and the wider user community. What has been proposed in this paper is a step towards formalising the concepts of social process modelling and execution. Overall, the proposed SBPM model is more geared towards 'ad-hoc processes', as opposed to structured processes where the process steps are pre-determined and remains unchanged, or even semi-structured processes [4]. According to [4] in ad-hoc processes the execution path is defined during the enactment of the processes and the user is free to choose the course of action he wishes to follow. The proposed system could therefore be suitable for ad-hoc processes that occur in dynamic and unpredictable environments such as in emergency response situations. There, not only some of the processes are ad-hoc but many participants are volunteers (i.e. lack a predefined static profile) and their suitability for carrying out a task needs to be determined dynamically based on their behaviour and group activity participations.

The paper also presented a meta-model for social BPM. The recommendation process architecture and role assignment mechanism in particular are the two main components of the system which show the human perspective in SBPM lifecycle, however this needs to be investigated further. The adapted approach towards overcoming the limitations of traditional BPM models breaks through the rigid nature of process flows and provides a flexibility to the users in designing and executing the given tasks to achieve a set goal.

More research needs to be carried out on how to cater for exceptions or unplanned participations in customising the tasks during the execution of the processes. For example, in the case of the user deciding to add a task during the interaction phase, we have to provide a mechanism for the smooth integration of the new task with the remaining ones, especially when it comes to the incorporation and assessment of its dependencies. It should be noted that the overall goal of the process will remain the same and it is only tasks which should be allowed to be customised, otherwise the control and stability of the model will be reduced. The current state of research in SBPM is in need of a standardised meta-model which is what this paper is working towards.

The first challenge associated with the proposed approach is related to setting and defining process goals such as booking a venue, speaker, etc. These need to be designed as part of the process template, by considering the business rules and dependencies, something that can be quite challenging. The second challenge is differentiating between the goals and tasks as they can get conflated with one another.

The SBPM system needs to be suitably intelligent to be able to infer the goals and tasks being pursued by the different participants, by monitoring social conversation. Towards this, our system could incorporate ideas for adapting processes on the fly, such as the automatically building of workflow from knowledge workers' activities such as emails, described in [15].

Moving forward, the presented model needs to be investigated and designed in more detail and validated through further case studies with comparisons between manual and SBPM managed versions of social processes. It is hoped that this, through an evolutionary validation process will lead to a validated SBPM meta-model.

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