Towards a Human Task Management Reference Model

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Abstract. Business process engines and workflow engines (but also web applications and emails) provide information about human tasks to people. Although many of these systems support some kind of human task management, no extensive analysis of involved components has been undertaken.
This paper discusses some of these systems exemplarily and defines a first human task reference model to stimulate debates on ways how to manage human tasks crossing system and organization boundaries.

1 Introduction

A workflow is the "computerised facilitation or automation of a business process" [8] and may contain automated and manual activities, also referred to as *human tasks*. As business processes are often considered as "enacted by a single organization" [19], the business process instances "can be controlled by a business process management system as a centralized software component" [19]. Interorganizational processes are realized as process choreographies where several process instances interact with each other via message exchanges.

The management of human tasks comprises, among others, the assignment of tasks to potential workers and personal task management. Some of these management facilities are integrated into Workflow Management Systems (WfMS) and Business Process Management Systems (BPMS) [18, 19].

Today, many process automations with different characteristics are offered, e. g., control flow-driven BPMSs and data-driven Scientific WfMSs, WS-* and REST oriented solutions, processes deployed locally or in the cloud, and engines supporting unstructured, knowledge-intensive business processes [15]. At the same time, people are working in parallel in different virtual, cross-company and interdepartmental teams [12]. Hence, different process automations may be used in parallel within departments and organizations and humans may be working with different process automations in different virtual teams. Hereby, they will be confronted with different human task management solutions, too.

To support humans better —esp. those who are engaged in virtual teams— a platform- and process-independent personal task management is required. This personal task management system needs to collect all tasks of a human spread over different process engines (and other "task-aware" applications) and provide task

management facilities. A step towards this vision is a human task management reference model that allows us to

- identify all affected components and their relations to each other,
- understand possible invocation patterns between the components, and to
- determine data that needs to be potentially exchanged.

These insights will support the independent development of components for human task management and provide the potential to use process engines optimized for their application scenarios in parallel. It may foster distributed orchestrations and reuse of process engines as organizational affiliations of humans do not restrict process execution. Since not only WfMS and BPMS are aware of tasks but (web) applications like Teambox [16], too, the discussion will take a broader look at human task management.

Section 2 introduces basic terms. Section 3 discusses some systems that contain and manage human tasks and shows their diversity, Sec. 4 introduces a first reference model for human task management. Section 5 discusses this reference model and Sec. 6 concludes this paper.

2 Human Tasks and their Management

Van der Aalst and van Hee define a task as "a logical unit of work" and differentiate between manual, automatic and semi-automatic tasks [1]. In the area of human task management, we look at manual tasks that are "entirely performed by one or more people, without any application" [1] and semi-automatic tasks that involve persons and applications.

The management of human tasks considers questions like:

- How can the execution of human tasks be supported?
- How can human tasks be assigned to (potential) workers?
- How can workers be informed about their tasks?
- How can workers manage their tasks, e. g., keep track of their tasks, schedule them or delegate them?

Thus, the management of human tasks comprises, among others, the assignment of tasks to potential workers, called staff resolution [18], claiming of tasks by potential workers, which may remove the item of other potential workers' worklists [18], and also personal task management with "reminding [. . .] of current tasks, tracking task status, and maintaining relevant information" [21].

3 Systems touching Human Task Management

Many different systems cover (at least some aspects of) the management of human tasks. Due to lack of space we will only introduce selected systems and discuss their approach to human task management briefly.

The *workflow reference model* [8] focuses on workflows and identifies interfaces to enable interoperable workflow products. It discusses, inter alia, workitem handling that allows users to fetch and filter their workitems "irrespective of the nature of actual product implementation" [8].

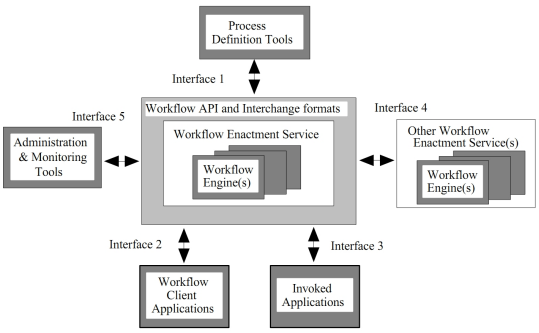

Fig. 1. Workflow Reference Model [8]

The central component of the reference model in [8] (see Fig. 1) is the workflow enactment service with its workflow engines that provide the execution environment for workflow instances. This component offers interfaces

- for process definition tools to exchange process definitions that can be analyzed and modeled with external tools,
- for workflow client applications to access worklists and workitems but also to instantiate and control processes,
- for invoked applications that can be used by the workflow for automated executions of tasks,
- for other workflow enactment services to invoke activities and sub-processes or to transfer data, and
- for administration & monitoring tools to manage users and roles, among others.

The workflow enactment service and the workflow client applications provide some human task management facilities jointly: Human tasks are controlled by the workflow engines within the workflow enactment services incl. some information about them. Workflow client applications can access workitems using the 'Interface 2' of the workflow enactment service and can mark them as completed or change their states. They can also instantiate and control workflows (and consequently initiate human task). Hence, workflow client applications allow users to fetch and work on tasks as task workers as well as to initiate them.

The business process community has developed WS-BPEL as an executable language for business processes. For human tasks, the complementary specifications *BPEL4People* [3] and *WS-HumanTask* [2] were added.

The WS-HumanTask specification defines an XML-based description of human tasks assuring portability as the task can be deployed in different environments. A lifecycle specification for tasks and a programming interface assure interoperability. The programming interface, for example, can be used by task list clients to display information about tasks to users. Requesting applications can use a callable WSDL interface to initiate human tasks and —with deeper integration— use WS-HT protocol messages to influence the lifecycle of tasks.

The BPEL4People specification is based on the WS-HumanTask specification and adds people activities to BPEL processes to use human tasks as activity implementations. Human tasks can be defined as part of the BPEL processes and thus executed by BPEL engines that implement BPEL4People. Alternatively, the processes can invoke human tasks from other environments using web services protocols.

The assignment of people to human tasks can be defined by logical people groups, literals or via expressions. The staff resolution is done by the task infrastructure which manages information about the tasks.

Teambox is one of many different collaboration tools provided as web applications that offers online project management facilities including task management [16]. Teambox allows the organization of tasks and artifacts in projects as well as the invitation of other users to these projects for collaboration. Tasks can be defined manually, added to projects, and provide a simple lifecycle that is also managed manually. Tasks can be assigned to people and commented, and files can be attached to tasks. All task management facilities are contained within the application but information about tasks can also be sent to users by email.

Many other web applications rely on *email* as a tool for notification about human tasks. Individuals and groups of individuals may use tools like EasyChair [6] or ConfTool [5] for conference management, Google Docs [7] for word processing and Moodle [11] in lifelong learning scenarios. Especially small teams collaborating over limited periods of time may benefit from these applications (regardless of whether provided by individual team members or by third parties).

Often, processes are firmly implemented in these web applications and contain human tasks. The humans concerned are informed by email, and email applications are regularly used for the management of these tasks [20, 21] incl. management facilities like the delegation of tasks to other humans by forwarding emails. In addition, emails allow the direct information and assignment of tasks to users.

Although these applications and systems have very different characteristics, there are some common but also individual components and facilities regarding human task management. Section 4 introduces a human task management reference model to create a shared understanding of important aspects.

4 Human Task Management Reference Model

A first version of a conceptual reference model for human task management is depicted in Fig. 2. In the following we explain the model's core elements and their relationships.

The central component of a human task management solution is a *personal task manager* that allows a human to overview all his current tasks, track their states, and maintain relevant information [21] (also called worklist or task list; it is provided by all systems analyzed in Sec. 3 except email; in the case of email, inboxes are used for it regularly [21]). Analogously, groups of people can use a *shared task manager* that

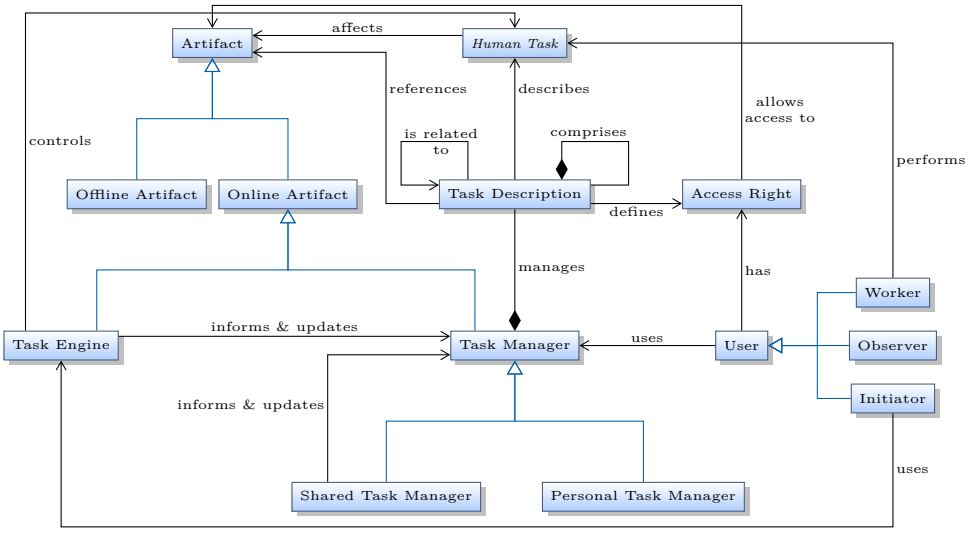

Fig. 2. Human Task Management Reference Model

- can provide direct access to personal task management facilities (the workflow reference model discusses this option briefly), but
- can also act as a simple distributor that passes on information about tasks to other *task manager*s, i. e. personal or shared task manager (Teambox may be used this way if users receive their tasks by email; mailing lists may also serve this purpose), and
- can provide staff resolution facilities and passes on information about tasks to *task manager*s of selected individuals (as done by the task infrastructure).

The execution of a task is controlled by a *task engine* that defines in which steps a task is executed (the workflow engine and the task infrastructure provide such functions). The task engine provides information about tasks as well as updates of this information to task managers (the workflow engine and the task infrastructure allow clients to fetch this information). The definition as well as the goal and scope of a human task are part of the task engines realization (defined by the deployed process or task, for example).

Task managers manage the information received from task engines and other task managers as *task description*s, which describe *human task*s and contain information about them such as name, status, description, priority, expiration, and progress. They can comprise subtasks and formulate relations to other tasks, e. g., predecessor or successor relations. If real world artifacts —*offline artifact*s such as a certain punching machine or a certain car— or *online artifacts* —e. g., an online document or a web application— are affected by a task —e. g., needed to perform it—, they could be referenced. For the latter, hyperlinks may be appropriate.

*Access Right*s to artifacts are held by users, for instance, in form of a front door key for a machine hall or credentials for a web application, but may also be contained in task descriptions, e. g., as credentials, code of a combination lock, or a description where to find the keys (the described systems focus mainly on displaying tasks but the responsible clients are not described in detail).

*User*s —especially as (potential) *worker* or *observer* of a task— use task managers (usually personal task managers) to overview and manage their tasks. *Initiator*s of tasks use task engines to initiate and, if necessary, to influence and manipulate task instances.

5 Discussion

The reference model provides terms for components and relations between them for the human task management area to allow the discussion and comparison of different solutions. The relation between task engines and task managers is, for example, implemented very differently: The workflow reference model discussed in Sec. 3 defines a *pull* model, where workflow enactment services (in the role of task engines) define an interface to retrieve and manipulate work items, whereas the email based solutions use a *push* model, where task descriptions are sent to the email applications (in the role of task managers). The *informs and updates* concept between task engines and task managers should therefore not be understood as a directed information flow but as a logical relationship. It shall promote the discussion of advantages and disadvantages of the different implementations dependent of different use cases.

Because of the different perspectives of the WfMSs and BPMSs on the one side and the human task management reference model on the other side, they have only few elements in common. Most process automation functionalities (incl. portable specifications) are subsumed in the task engine component of the human task management reference model whereas many human task management aspects are not explicitly identified in the other models and systems.

The reference model focuses on the management of human tasks. The analysis of tasks in real world processes and the design of tasks for humans are not covered. These aspects are, among other things, discussed by industrial and organizational psychology that examines the task design to improve work conditions towards health and personality-enhancing working conditions [17] and by the user interface design that uses task models to understand and develop user interfaces for interactive systems [10].

The human task reference model is inspired by the systems discussed in Sec. 3. But many other systems provide support for human task management, e. g., Outlook, Bugzilla [4] and Remember the Milk [13], which focus on specialized application areas (software development or manual managed to-do lists). Additional concepts have also been developed to improve the current state of human task management, especially for the human task management based on emails [9, 20, 21]. Therefore, further systems need to be analyzed to refine the model and get empirical evidence that the model is complete and consistent. Additionally, the

analysis of the discussed systems has to be deepened to work out their similarities and differences.

The findings of these analyses will be used to support the development of a web-scale human task management [14], which applies the insights to real world cases.

6 Conclusion

Different systems contain human task management facilities. They consist of very different components and support human task management in various ways. To develop a common understanding of human task management and stimulate debates on ways to manage human tasks crossing system and organization boundaries we introduced a first human task reference model.

Therefore, the proposed reference model pursues three targets: (1) foster the discussion of human task management, (2) provide a framework to analyze and compare existing human task management solutions and approaches, and (3) support the development of distributed and decentralized human task management solutions independent of concrete process automation systems and web applications (it shall allow humans —especially those involved in multiple projects— to overview and manage their tasks efficiently although the information about outstanding tasks may be distributed over different systems).

To improve the reference model and our understanding of human task management, additional solutions like simple to-do list tools, PIMs incl. Outlook, and CSCW workspaces will be discussed and used to refine the model in future work. In addition to components, interaction patterns as well as interfaces need to be analyzed. The usage of different process automation systems and task-aware web applications in parallel and the choice of humans to work on human tasks beyond company boundaries may be a long-term goal.

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