POLITECNICO DI MILANO
Scuola di Ingegneria dell'Informazione

Master of Science in Computer Engineering

Social resource and asset sharing: a case of social enterprise optimization

Supervisor: Prof. Marco Brambilla
Co-Supervisor: Prof. Piero Fraternali

Master Graduation Thesis by:
Eric Umuhoza
Student ID *767409*

Academic Year 2012-2013

POLITECNICO DI MILANO
Scuola di Ingegneria dell'Informazione

Corso di Laurea Specialistica in Ingegneria Informatica

La condivisione sociale delle risorse aziendali tramite social network per l'ottimizzazione dell'impresa

Relatore: Prof. Marco Brambilla
Correlatore: Prof. Piero Fraternali

Tesi di laurea di:
Eric Umuhoza
Matr. *767409*

Anno Accademico 2012-2013

Abstract

With the advent of the Web, citizens and business users perform an ever-increasing fraction of their everyday activities online and consequently, organizations from all sectors are more and more deploying their business processes on the Web, with the aim of better reaching their customers, employees and stakeholders and of reducing the total cost used resources.

The classic BPM approach aims to efficiency, accuracy and automation but doesn't allow an efficient collaboration and knowledge sharing between the different divisions and stakeholders of an organization. The tasks and their performers are fixed and can not change dynamically.

The aim of this thesis is to provide solutions to increase efficiency in organization by using ICT tools enabling a shared participation of all stakeholders in business process.

The solutions proposed integrate BPM systems with the social tools in order to improve communication, the knowledge sharing and the transparency of the decisions.

The case of enterprise resource management has been studied and validated through an application that integrates social sharing practices with other enterprise systems such as Enterprise Resource Planning. The application has been implemented in a model-driven-engineering framework which allows to quickly develop, modify and integrate an application.

Sommario

Con l'avvento del Web, gli utenti svolgono una gran parte delle loro attività quotidiane in linea e, di conseguenza, le organizzazioni di tutti i settori stanno distribuendo la gran parte dei loro processi aziendali sul Web, con lo scopo di raggiungere tutti i loro clienti, i dipendenti e le parti interessate e di ridurre il costo totale di risorse impiegate.

L'approccio tradizionale di Business Process Modeling ha lo scopo di ottimizzare l'efficienza, l'accuratezza e l'automazione dei processi ma non consente un'efficiente condivisione della conoscenza tra le diverse divisioni e stakeholder di un'organizzazione. Gli esecutori delle attività ed il workflow complessivo definito non possono variare dinamicamente a seconda delle esigenze dettate dal momento. C'è una carenza di comunicazione orizzontale e di trasparenza delle decisioni.

Lo scopo di questa tesi è quello di fornire soluzioni innovative per aumentare l'efficienza nella organizzazione utilizzando degli strumenti informatici che consentano una partecipazione condivisa di tutti i soggetti interessati nel processo di business.

Le soluzioni proposte integrano BPM con gli strumenti sociali al fine di migliorare la comunicazione, la condivisione delle conoscenze e la trasparenza delle decisioni che interessano la vita quotidiana dell'organizzazione.

E stato trattato in particolare il caso della gestione delle risorse aziendale. Nella fase di validazione delle le soluzioni proposte è stata implementata un'applicazione che integra le pratiche di condivisione sociale delle risorse con altri sistemi aziendali quali pianificazione delle risorse aziendali(Enterprise Resource Planning). L'applicazione è stata implementata in un framework con approccio di tipo model-driven engineering, il quale permette di sviluppare, modificare ed integrare velocemente una o più applicazioni.

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1. Introduction

1.1. CONTEXT

With the advent of the Web, citizens and business users perform an ever-increasing fraction of their everyday activities online and consequently, organizations from all sectors are more and more deploying their business processes on the Web, with the aim of better reaching their customers, employees and stakeholders and of reducing the total cost used resources.
The increasing use of the Web and the introduction of social platforms are making the people engaged to share their data, relations opinion on the quality of received services, etc. Organizations are facing new problems related to the rising customer expectations.
This increases the pressure on companies to lower total costs in the entire supply chain, shorten throughput times, drastically reduce inventories, expand product choice, provide more reliable delivery dates and better customer service, improve quality, and efficiently coordinate global demand, supply, and production.

The classic BPM approach aims to create an efficient and well managed organization. It is applied to the routine work, designing a sequence of processes performed by assigning actors, increasing efficiency, accuracy and automation.
Nevertheless it achieves the good results, the traditional BPM has some limitations: the model does not allow an efficient knowledge sharing between the different divisions and stakeholders of an organization; the performers of a specific task and the workflow of the activities are always fixed; it doesn't allow the employees to provide their opinions about the performed tasks. The decisions are always taken by a group of people and often the process is not transparent to the performers.

The introduction of social practices into BPM will allow the organization to gain more accurate and useful information. The process decisions become transparent to each internal actor and other affected stakeholder. Engaging a broader community

to participate in the business process allows the possibility of assigning an activity to a wider set of performers, both internal and external. This leads for instance at gathering opinions that will contribute to taking decisions, find the appropriate contacts for a determinate process enactment or to involve stakeholders during the design and the execution of the tasks.

1.2. GOAL

The aim of this thesis is an attempt to provide innovative solutions to increase efficiency in organization by using ICT tools enabling a shared participation of all stakeholders in business process.
In particular this work studies the problem of resource management and proposes solutions which integrates the Resource Management Systems with the social sharing practices that involves the use of social networking.

1.3. THESIS STRUCTURE

The thesis is organized in chapters. In **the second chapter** will be presented other works related to social business process modelling(Social BPM) and resource sharing.
The third chapter will describe different techniques proposed to integrate social practices into Enterprise Systems. This chapter ends by exploring the approaches for social application deployment.
The fourth chapter is dedicated to describe the application designed to validate the techniques proposed in third chapter. The design was performed with a model-driven engineering approach with the tool WebRatio.
The fifth chapter contains the conclusions of the work and the possible future developments.
Bibliography. Are reported in this section, all references to the texts and scientific articles consulted during the project and during the writing of this thesis.

2. Related Works and Background

This section reports some research related to the context of my work found in the literature. The chapter is divided in two parts. The first one covers the works related to Social BPM. The second part will present the works related to the concept of "Sharing" emphasizing its social aspects.

2.1. SOCIAL BPM

Social Business Process Management (Social BPM) is the integration between business process modelling and social software and platforms, to bring "more and diverse voices into process improvement activities".
Gartner Research states: "Social BPM resides at the intersection of process and collaborative activity. It is supported by BPM and social software that makes process design more visible and holistic. It supports more effective process execution through the use of social software tools that augment human actions to better mirror the way work is performed, while also providing visibility to this work "

The work on [2] defines Social BPM as the fusion of business process management practices with social networking applications, with the aim of enhancing the enterprise performance by means of a controlled participation of external stakeholders to process design and enactment.
The social extension of a business process can be seen as a process optimization phase, where the organization seeks efficiency by extending the reach of a business process to a broader class of stakeholders.
This optimization can be achieved exploiting several factors. First of all discovering and employing the informal knowledge and the relationships between the different stakeholders. The gathered knowledge is therefore accessible by all members and permits to avoid the waste of time for information distribution activities.

The information spreading enacts different advantages within the enterprise everyday life.

The process decisions are transparent to each internal actor and other affected stakeholder. Engaging a broader community to participate in the business process allows the possibility of assigning an activity to a wider set of performers, both internal and external. This leads for instance at gathering opinions that will contribute to taking decisions, find the appropriate contacts for a determinate process enactment or to involve stakeholders during the design and the execution of the tasks.

The Social BPM brings greater agility in business management systems by supporting agile methods for process discovery and implementation that allows processes to change quickly to meet business needs."[8]

The work on [14] provides a set of features to be included in the BPM implementations in order to make the BPM socially-centric.

- Capture, rank and share everything. Using the social technologies the participants into business process capture suggestions, describe policies and explain actions that they can be stored and indexed for retrieval. This set of information is enriched by the system generated information such as statistics on the first paths through processes, common rules and codified policies. This information is useful for everyone. First of all the decision makers can research questions and see the input of a crowd of knowledgeable people. The developers can see patterns for suggestions to processes improvements and finally, the management can see common questions or difficult decisions.
- Promote collaboration: Having access to networks of knowledgeable people enables participants to find the most skilled resources to form a collaborative team.
- Create social feedback loops: promoting the engagement of many participants to comment and rate information provides additional context and makes the information more valuable
- Use Social conventions for non-social applications

- Make participant the center of the universe. By focusing on empowering participants by giving them the types of tools that social applications provide a higher degree of knowledge sharing, expertise location and collaboration can occur. The integration of social technologies into BPM toolkit increases the value delivered to a participant.

The Social BPM space is defined on a continuum between closed BPM and a process where its model is absent and the constraints are implicitly defined observing the behaviour of the community.

In closed BPM, processes are defined top-down centrally by the organization and deployed for execution by internal performers. Tasks are defined rigidly, the process actors are preregistered, and allocation of actors to task follows statically defined assignment and escalation rules. The actors just perform the tasks assigned with a limited communication.

The further step is the participatory design where the process model discussion is open to different actors, including end users.
Participatory enactment is reached when a well-defined community is in charge to execute some tasks within the business process using some social tools.
When the community is instead open and so not well-defined we are talking about of social enactment.

The last step is the process mining, is the less structured approach, where activities are executed freely and the process constraints are recovered a posterior, by observing the behaviour of the actors, e.g., inspecting execution traces.

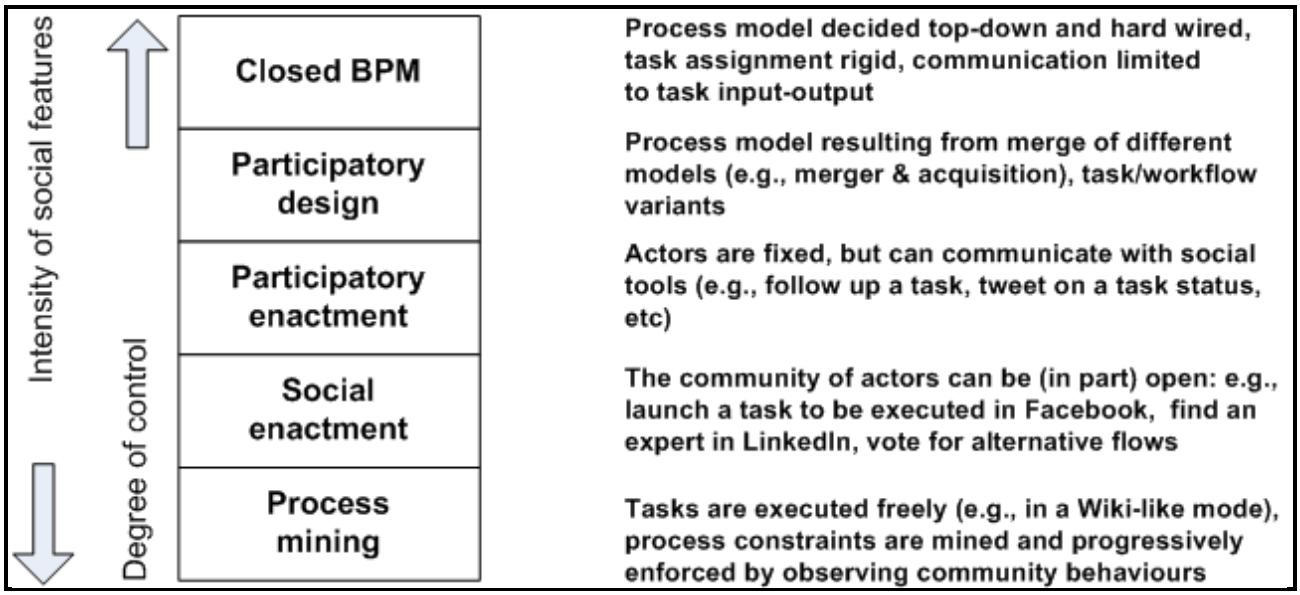

Figure 2.1 The Social BPM space

The main difficulties to cover this continuum are the lack of appropriate tools and notation, since social aspects are not considered in classical business process model descriptions.

The BPM4People[1] project proposes a Model-Driven Approach(MDA) to participatory and social enactment of business processes[4]. This project aims at designing methodologies, modelling languages, design patterns, and vertical applications for the implementation of processes collectively defined and executed by organizations and their stakeholders (that could be employees, customers and citizens).

The BPM4People approach is composed by three main processes as illustrated in figure 2.2.

[1] www.bpm4people.org

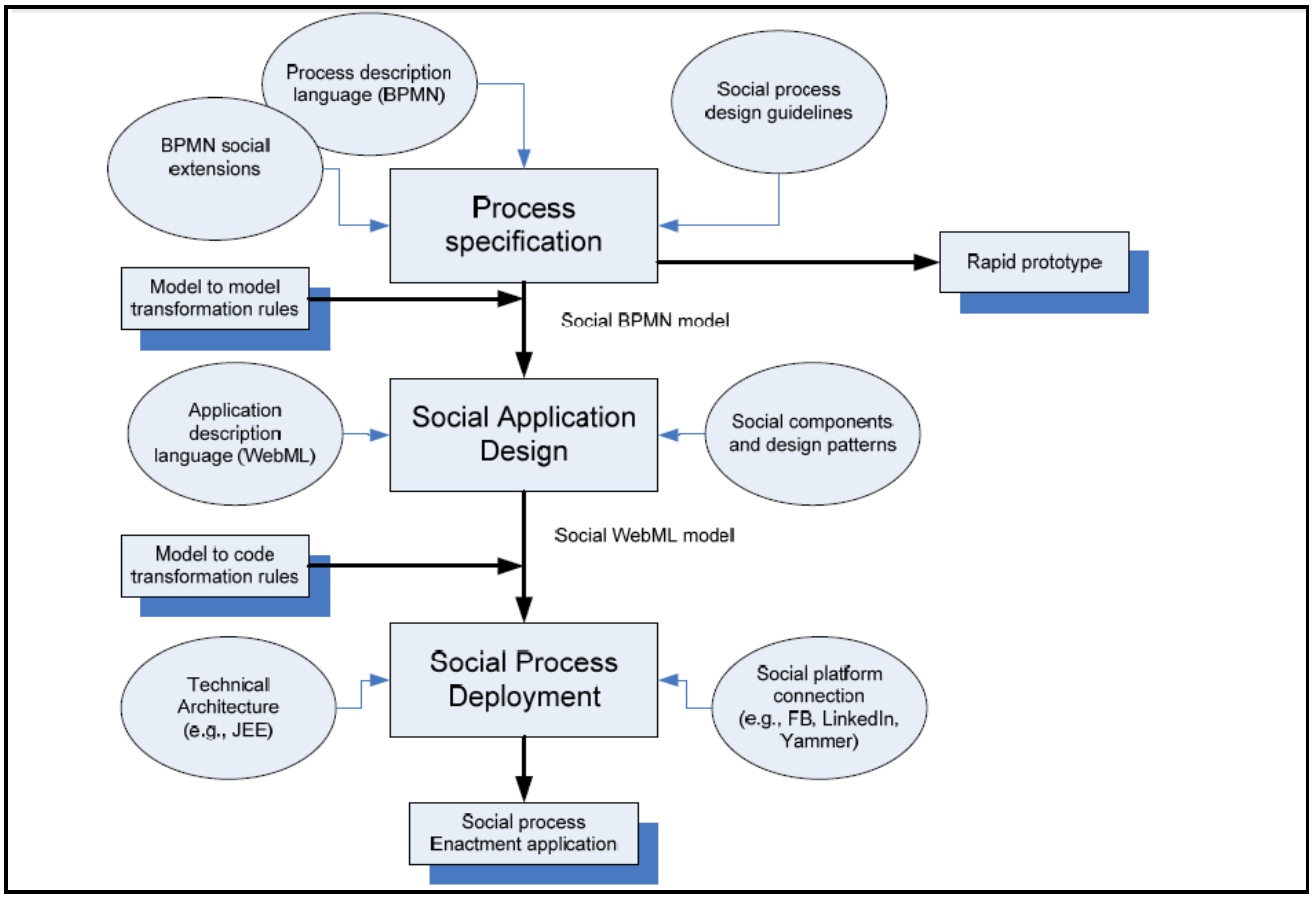

Figure 2.2 Model driven approach to Social BPM development

1. Process specification phase that takes in input the business requirements and workflow description of an organization and outputs a model of the business processes that formally describes the organization of activities necessary for satisfying the business requirements. The process model is encoded in BPMN[2], extended to support the specification of social interaction[5].

   The social process model can be used directly to produce a prototype of the enactment application, whereby a business analyst or a stakeholder can:

   - impersonate any actor of the process, at all the levels of social interaction;
   - start/suspend/resume/terminate the process activities in accordance with the process constraints;
   - create and inspect project artefacts and parameters, according to the process specification;

[2] BPMN, Business Process Model and Notation, is a standard for business processes modelling. More details are provided at www.bpmn.org

- impersonate external user roles and simulate social actions.

2. Social Application Design which takes in input the Social BPMN model and produces in output a model of the application(s) needed for enacting it. The design phase is formally driven by model-to-model transformation rules, which dictate the way in which each BPMN construct has to be turned into a construct of the social application model. The output model is encoded in the WebML[3] Domain Specific Language, extended with social components and patterns (Social WebML) [6] [7].

3. Social Process Deployment. It is the technical phase that produces the actual executable version of the social process enactment application. It is driven by model-to-code transformation rules that map each construct of the application model into appropriate artifacts of the deployment platform. In the case of WebML, existing rules, implemented in the WebRatio tool suite [WebRatio], map standard WebML projects onto the JEE platform. The extension to social BPM requires an enrichment of the existing model-to-code transformation rules to map the novel social WebML components into their respective implementation-level primitives. This code generation rules typically produce service calls to the Web APIs (Application Programming Interface) of the specified Social Networking Platform (e.g., the FaceBook API to interact with such social network).

[3] WebML (Web Modeling Language) is a visual notation and a methodology for designing complex data-intensive Web applications. It provides graphical, yet formal, specifications, embodied in a complete design process, which can be assisted by visual design tools. In 2013 WebML has been extended to cover a wider spectrum of front-end interfaces, thus resulting in the Interaction Flow Modeling Language (IFML), adopted as a standard by the Object Management Group (OMG). www.webml.org/webml

BPM4People approach exploits the native extension mechanism of BPMN 2.0 and provides its extension which enables the coverage of the social aspects.

The four main extensions are provided [5]:

1. Social monitoring: capturing activities and events from a social network;
2. Social behaviour enactment: performing social activities as inviting, commenting, voting;
3. Social content description: explicitly model social data and contents;
4. Social access: the possibility of using social user profiles and credentials for accessing the BPM platform.

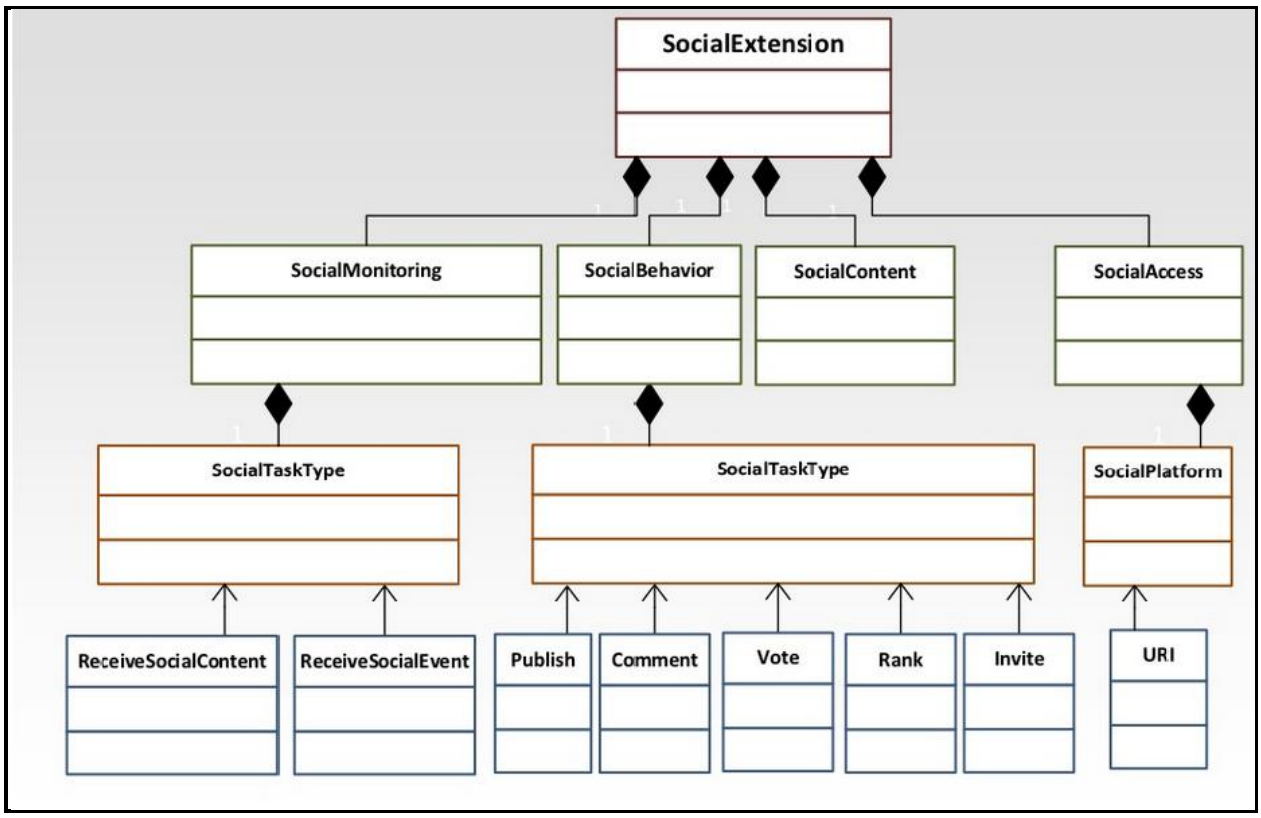

Figure 2.3 The extension of BPMN for addressing Social BPM requirements

Attribute value	Icon / Example
Comment	Comment
Vote	Vote
Invite	Invite
Rank	Rank

Figure 2.4 Social activities

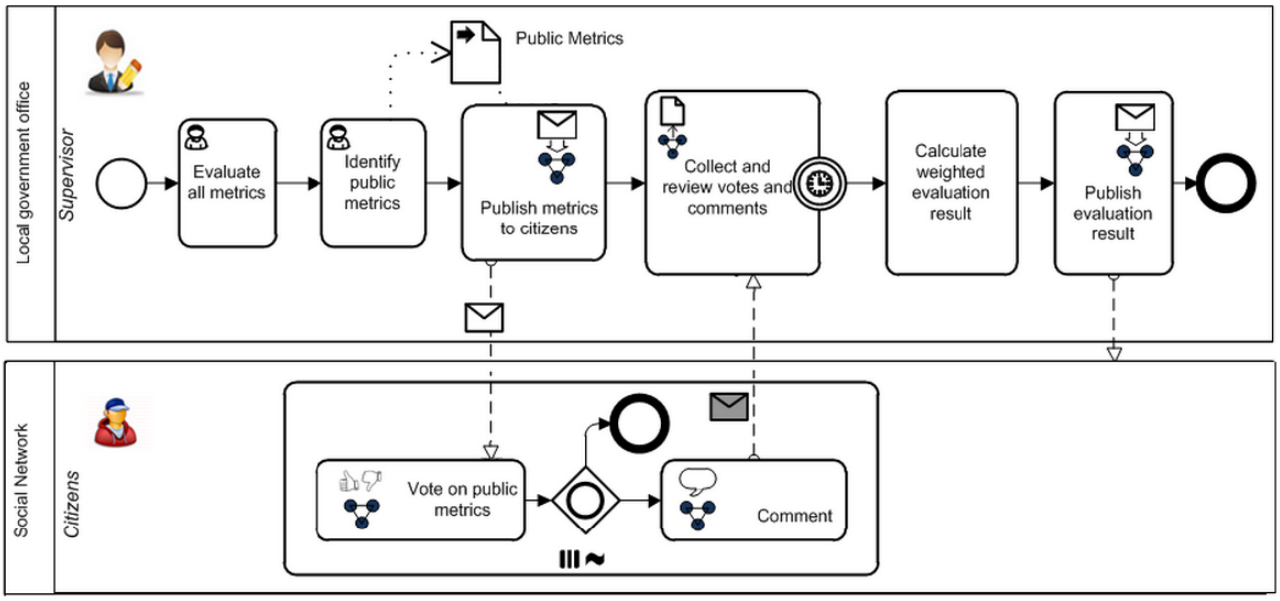

Figure 2.5 Example of extended BPMN model for addressing Social BPM requirements of a participatory public administration process where citizens are involved in the evaluation of the government performance.

The main point of the BPM4People approach is the way of how the implementation is done, from the Social BPM design until the generated web application. The framework used is WebRatio.

The engine exploits model-to-model and model-to-code transformations, according to the Model Driven Architecture of the Object Management Group (OMG)[4].

First the process is designed by the business analyst in the Social BPMN, defining the organization, the roles, the workflow and its activities and assignments. This model is then converted in the WebML one [6], so the web application is described from the presentation and business logic point of views, extended with social features too. The second transformation generates the standard JEE code and the final social web application.

The framework allows the business analyst to rapidly prototype and to develop social business processes. He can therefore interpret the roles defined to check how the information flows by the different tasks and modify the overall process. The notation is also understandable by the people who are not usually performing business analysis. The stakeholders can be therefore involved, engaged, during the designing and testing phases, anticipating the desired process outcome.

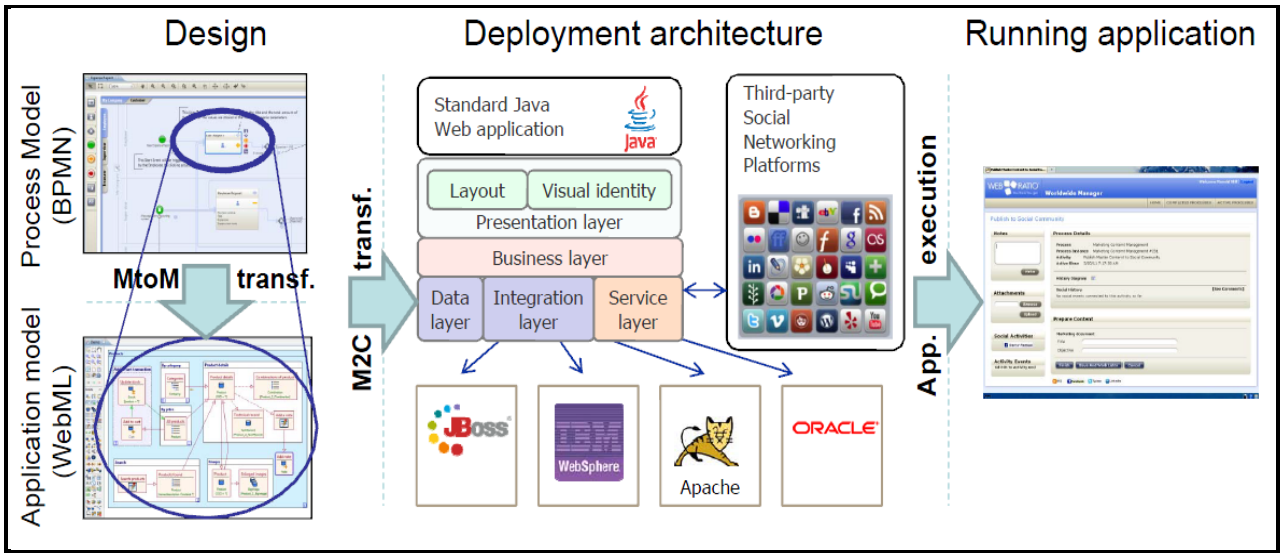

Figure 2.6 Overview of BPM4People approach to social BPM

[4] The Object Management Group (OMG) is an international, open membership, not-for-profit computer industry standards consortium. Founded in 1989, OMG standards are driven by vendors, end-users, academic institutions and government agencies. More details are provided at http://www.omg.org

In the BPMS2(Business Process Management and Social Software)[5] workshop series are discussed hot issues related to Business Process Management and Social Software. The goal of the next session (the 6th Workshop on Business Process Management and Social, 2013) is to promote the integration of business process management with social software and to enlarge the community pursuing the theme.

In the previous sessions has been explored how social software can interact with business process management, how it has to change to comply with the features of social computing: weak ties, social production, egalitarianism and mutual service, which profits may arise from these principles.

Erol et al state :"The benefits of combining business process management and social software are facilitated by the completely new approach for putting together the inputs of different people. Instead of predefining the inputs of all participants in a top-down manner, all stakeholders are encouraged to provide their inputs without the existence of an overall plan in a bottom-up manner."

The work on [12] arguments that social technologies can help to model the process with a bottom-up approach by exploiting the community knowledge and its horizontal communication. This knowledge is open to improvement, each member of the community can contribute. The reliability issue is partially solved using a system of mutual trust and reputation building by the participants.

The Social software not only considers the content but also the context as valuable. The context is defined using the tags, links or bookmarks. Objects are located with annotations and the relationships between stakeholders are displayed with links.
The traditional BPM (known as closed BPM) suffers from the "Model-Reality Divide". The model-reality divide is the gap between the abstract process models and the actual executed processes. This division represents the failure to be adopted.

[5] http://www.bpms2.org/

Another important problem of the standard BPM is the loss of innovation. Although there is knowledge in the organization about possible improvements of business processes, this knowledge is not applied and the possible optimizations are omitted. The proposers are concerned about the transparency of their suggestions and are afraid about the failure of their ideas.

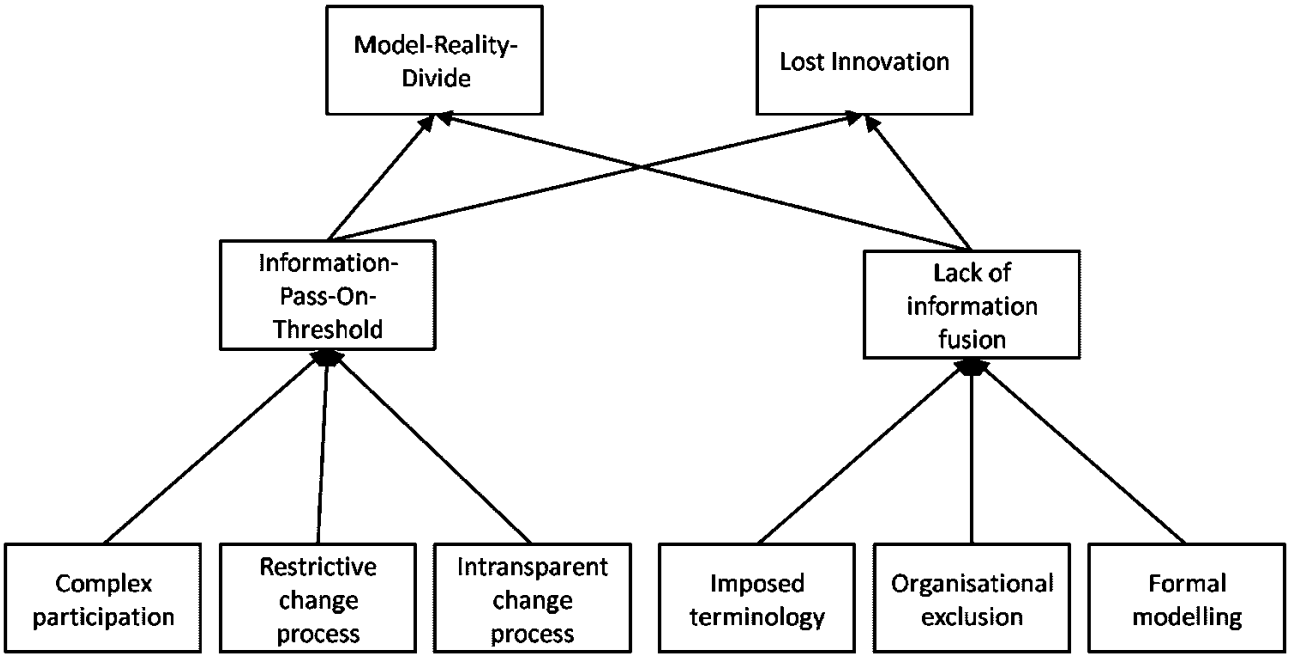

Figure 2.7 Roots of the model-reality-divide and lost innovation

The social software are by their nature, an ideal complementary solution space to the model-reality-divide and could capture the lost innovation to business processes. The information-pass-on-threshold is lowered, because using social software it is easy to participate in the process design.

All changes are transparent. The integration of social software into business process addresses also the issue of the lack of information fusion. Social software allows the group construction of a common terminology. Owing to the egalitarian nature of such software, organizational exclusion may be avoided.
The social software features provide several tools that should be considered when designing business processes:

- Self identification. Any actor who would like to contribute to an activity may do so and thus identifies themselves as competent to carry out such activity;

- Transparency. The results are open to anyone;
- Signing. The performing actor signs all work activities upon completion;
- Open modification. Anyone can modify the knowledge inserted by other stakeholders;
- Logging. Activities are historically tracked;
- Discussion. The contents can be commented and discussed;
- Banning. Actors exhibiting inappropriate behaviour may be banned.

Erol et al advocate to use control flow mechanisms only for controlling management activities. It's important to give to the users the access to a wider context of the processes including information about other people who may contribute to the processes as well as histories of previous process executions. Work activities should be designed so that they require only minimum effort to complete, encouraging users' participation in the processes. Making use of rewards for the activities carried out will improve the user participation.

When using social software the organization must be aware that information/data quality tends to be lower while data quantity increases and should find a way to engage the stakeholders to participate in the processes.
This work considers a wiki-enabled workflow system as an ideal framework satisfying the needs of flexibility and adaptability. A workflow definition as a wiki object with a very low degree of completeness exposed to a community, which with responsiveness will go along with detecting and repair exceptions.
The work on [12] provides a strategic view to evaluate possible usages of social software within enterprises representing which fields of the enterprises are changing thanks to the adoption of social software.

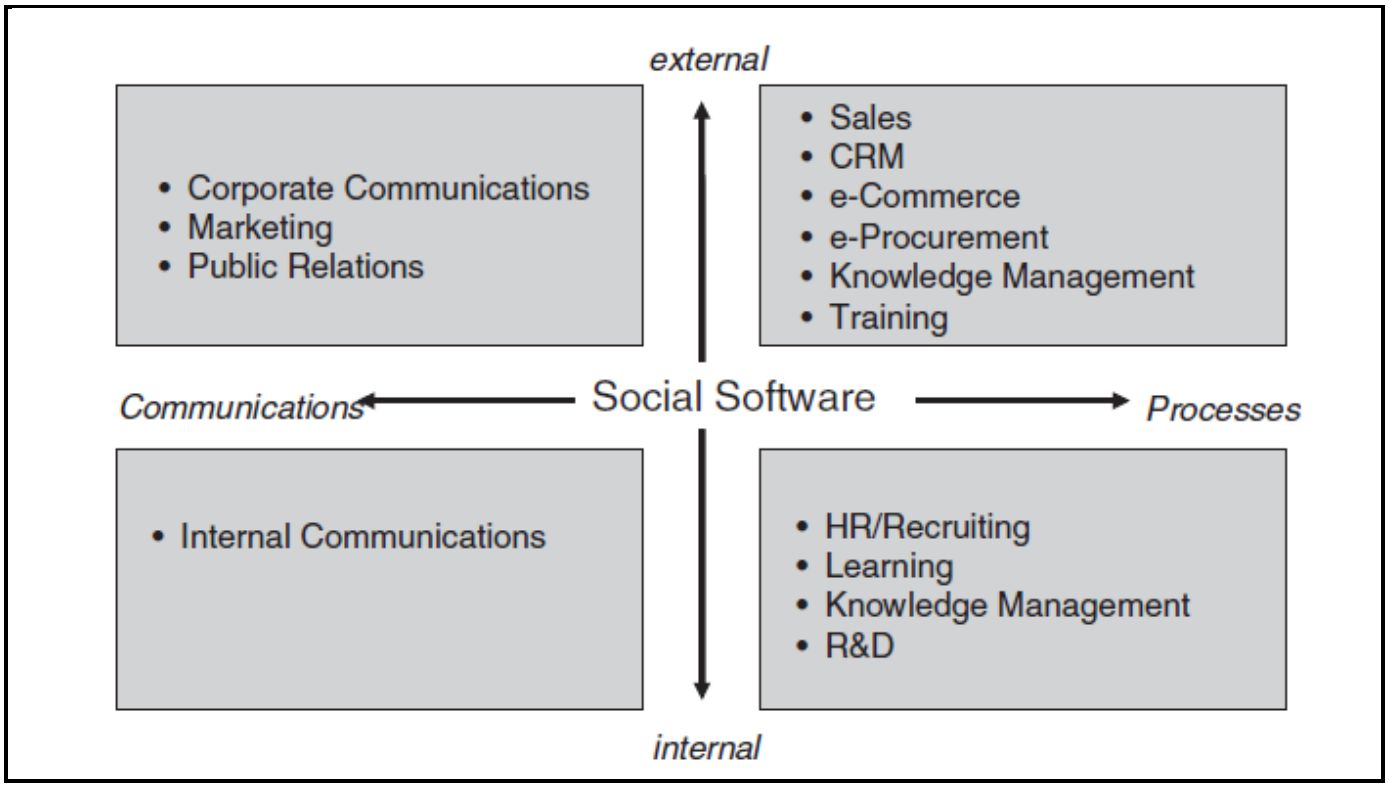

Figure 2.8 Social software influence in an enterprise

Although is not at the same level, all organizational departments within the enterprise are influenced by social software, internal as well as external operating units, management processes as well as production and support processes.

A dimensional view is valuable to clarify the benefits from combining social software and business process management. More precisely, the dimensional view helps to determine the business processes that are likely to benefit from utilising social software and gives some guidelines on what kind of social software solution would be suitable to support a particular business process.

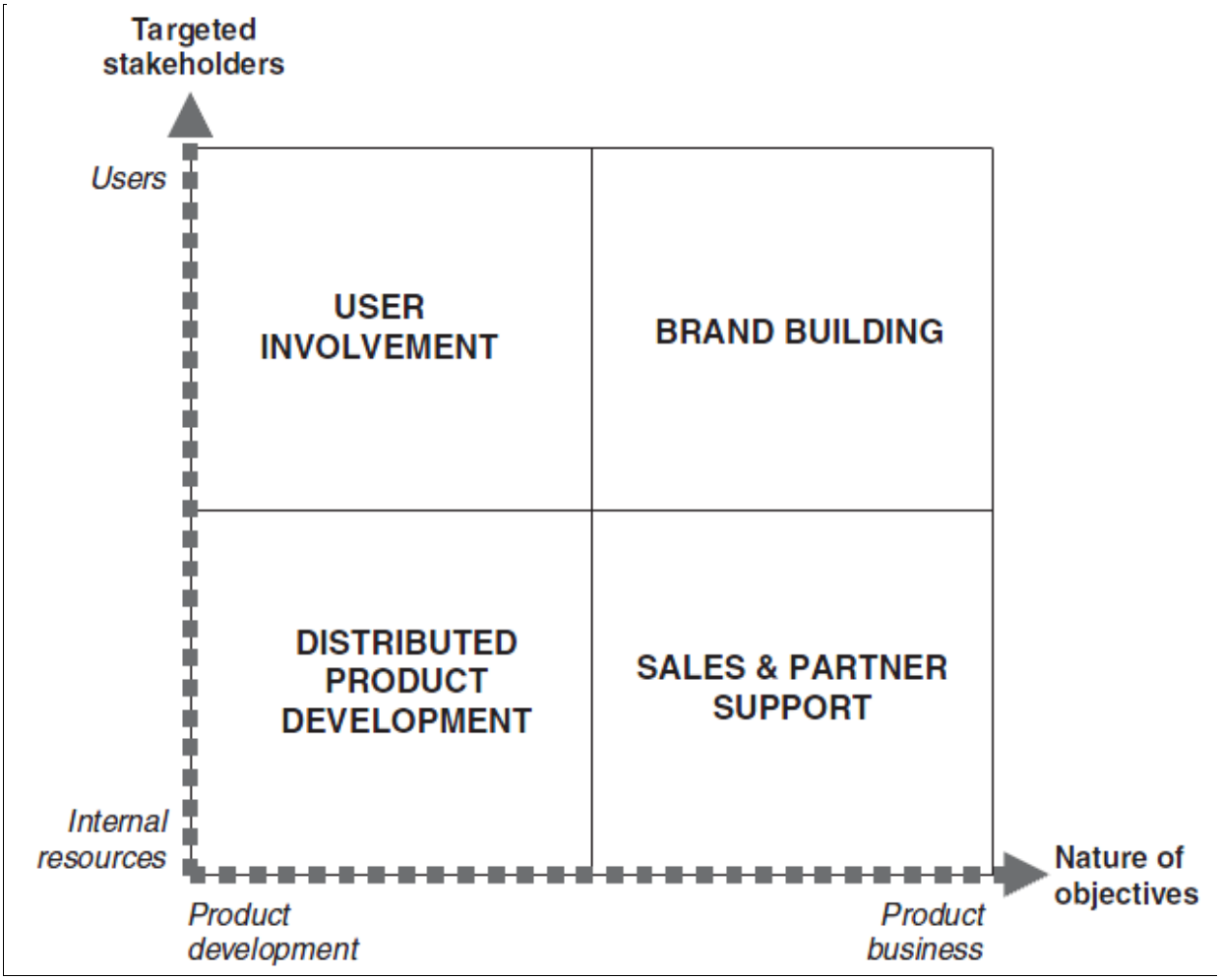

Figure 2.9 Dimensional view illustrating different utilizations of social software and their relationships to business processes.

When integrating social software into business processes, there is a creation of links between the users and the content that are managing. These links give a deeper understanding of the individual within the enterprise. This goes under the name of digital identity. The problem about this is that a user can generate more and more data, leading to information overload. It is therefore important to provide a way to distinguish and identify the good contents from the bad ones in order to provide to the other stakeholders the right amount of useful information

In the context of social software the users may not know each other, so trust and reputation needed in order to bring significant value to the enterprise become a complex issue to be managed, and they have to be coordinated from an authoritative voice.

Trust and reputation are both based entirely upon personal feelings and the interpretation of ambiguous signals, rather than the objective representation of fact. Without a clear sense of identity across data artefact sets, there can be no foundation for trust or reputation, so an automated mechanism must be implemented to describe them according to the users' contributions.

Erol et al concluded that the benefits of combining business process management and social software are facilitated by a bottom-up approach in which all stakeholders are encouraged to provide their inputs without the existence of an overall plan and task assignment. In this approach each user may add context to the content in different ways(for instance tagging, evaluating, commenting or even reading) and the sum of all the contributions is new content itself and part of the collective intelligence.

The work on [18] studies the aspects related to Agile Business Process Management. The authors state that: "Business Process Management is called agile when it is able to react quickly and adequately to internal and external events in order to implement the vision of an agile enterprise that is capable to rapidly adapt to changing business challenges and opportunities". The Social software permits us to satisfy the principles for enabling agile Business Process Management. To enable an agile BPM life-cycle is mainly required the organizational and semantic integration of modelling, execution and management activities, considering their grade of responsiveness.

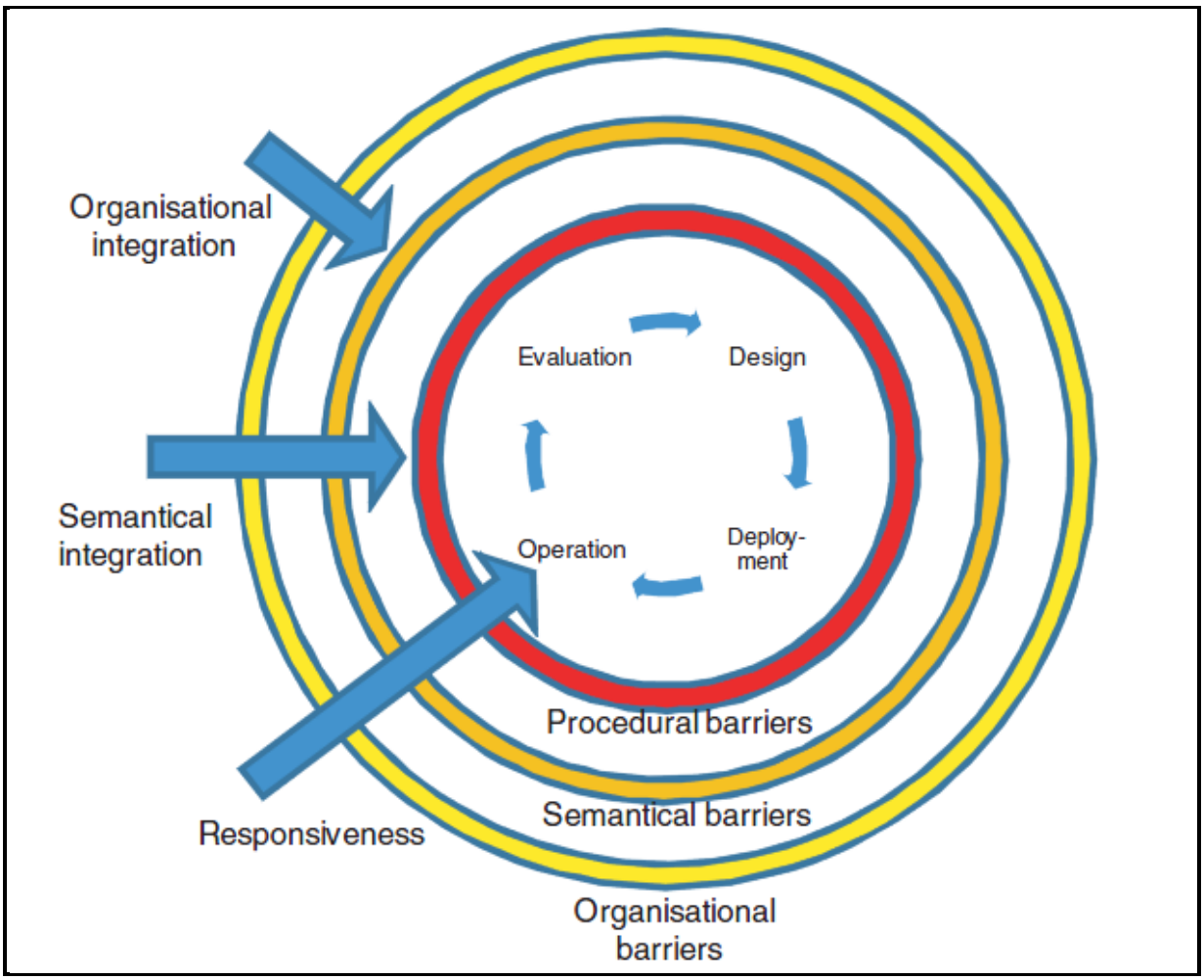

Figure 2.10 Prerequisites for agile BPM life cycles

The organizational integration is reached including all the stakeholders into the requirement gathering phase.

The perspective of stakeholders helps to get knowledge and contribute to make a complete and rich requirements specification.

The diversity of stakeholders' goals, values, languages and motivations are integrated from a semantic point of view, giving a common understanding of terms and context. Responsiveness is supported by the weak ties exploitation, bypassing organizational hierarchies. The three requirements result in a "bottom-up flow of information in real-time".

In traditional workflow systems the controlled activities are affected by the decisions taken by the controllers. There is not a common identity and thus there is not a positive attitude towards the business process.
The controllers and controlled would perceive each other as part of the same group sharing goals, intentions and also rules. In order to facilitate this, controlled opinions should be taken into account contributing to define the regulations of their activities. By doing this their motivation and commitment into business process will for sure increase.

The Knowledge Sharing within an organization and among user would break down the organizational barriers. To do this, it's mandatory to make business process models available to all relevant stakeholders. Social software can support this task for instance by tagging and posting mechanisms to describe business process models. Doing so people will be able to perceive the generated content and will be encouraged to express more easily their opinion. The content is therefore available to be searched by the community, accessing the knowledge management system. If several tags are assigned to a particular model it will be read by different perspectives and the content description will transcend the organization hierarchies. The research of a particular tag can result in retrieving different process models to serve the same purpose.

The development of tools which gives a not complete comprehensible views of the business processes is necessary in order to foster stakeholders' collaboration. It is time-consuming and increases the possibilities that the implemented business process is not any more satisfying the organizational needs. End users should be able to create and execute non-specified activities and combine them with specified activities, adding explanations of their deviations. The unexpected behaviors should be able to be promoted as business process implementations in business process reengineering to improve the efficiency of the organization.

Stakeholders need to be empowered. The terminology and the models used in processes are defined without their participation so due to their background they

could not speak the same language as the analysts. To avoid the effects of this problem in BPM Lifecycle it is suggested to integrate semantic web technologies with the MediaWiki software, enabling large-scale and interdepartmental collaboration on knowledge. The stakeholders can use natural language and formalizes it by adding concepts and semantic properties within the text. This changes the user's behavior from the passive participant forced to accept others terminologies to an actor who contribute actively.

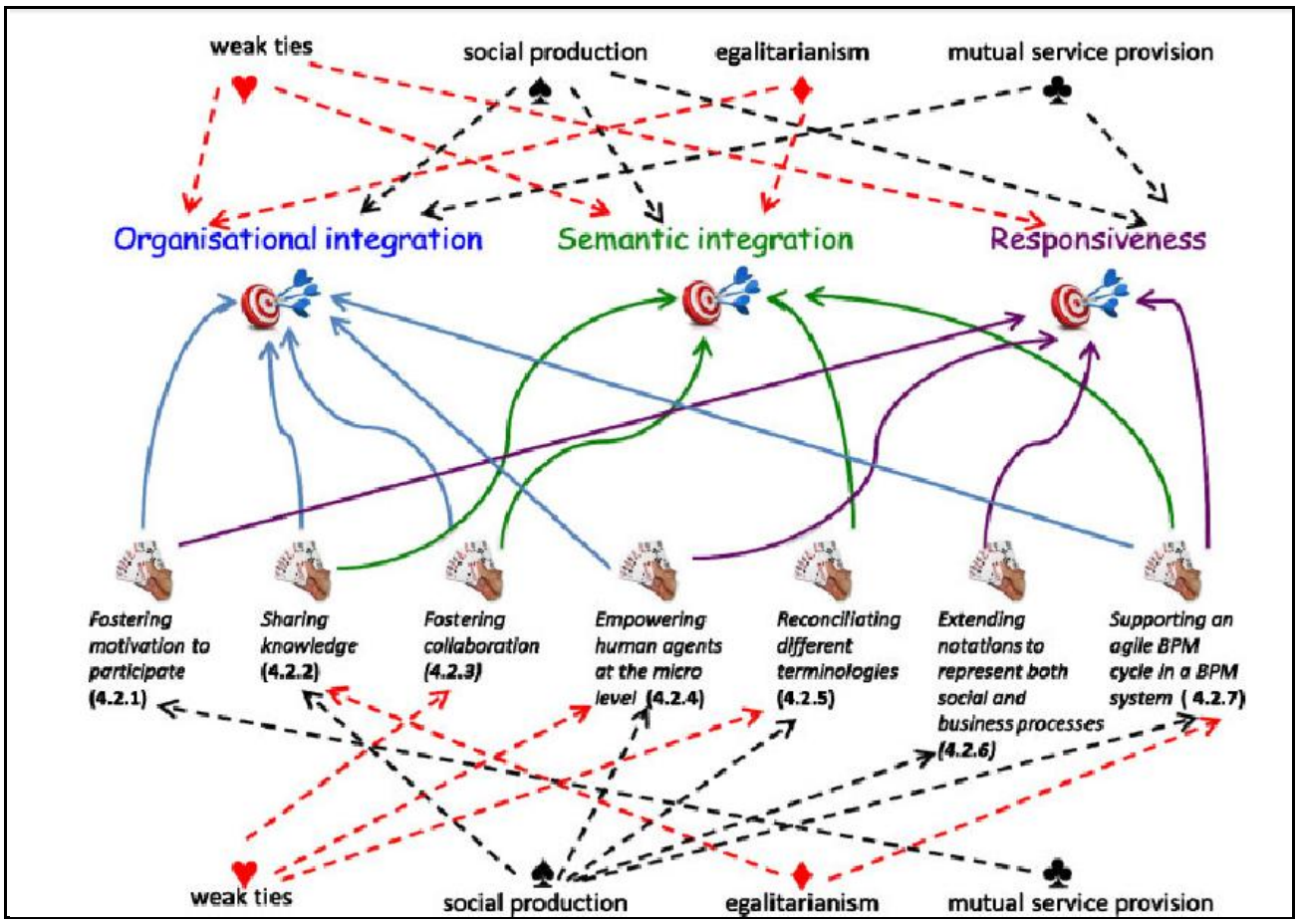

Figure 2.11 Mapping social software features and the approaches to agile BPM requirements.

The Social BPM problem has also been tackled by the book "Work, Planning, and Collaboration under the Impact of Social Technology" published in association

with the Workflow Management Coalition(WfMC)[6]. The book gathers several contributions by BPM practitioners from the field.

The work[8] explores the drivers behind social BPM, provides insights into main manifestations of Social BPM and discusses the network effects that increase the expansion of social BPM.

Kemsley states: ”The applications that support social production can also be problematic unless they are integrated into the main business processes that workers are tasked with completing: otherwise, they are just one more thing that someone needs to do during their busy work day without adding significant value to their work.” The integration of the social business functionality into traditional BPM is one solution for this problem.
The adoption of social BPM will allow workers to configure their own environments to suit their working style, to collaborate with others and to use the information coming from multiple sources in order to accomplish their tasks within business process. The involvement of several workers at all levels in the process discovery and definition leads to the process models that more accurately capture the actual processes.
Supporting agile methods for processes discovery and implementation allows processes to change quickly to meet the business needs.
This work provides the main ways in which the socialization is manifested in BPM systems:

- collaborative process discovery. People from a variety of perspectives (including end users, business analysts and IT) are involved in modelling processes;
- runtime collaboration. During the execution, the processes are modified dynamically to include unplanned participants in order to complete the work more effectively;

[6] Founded in 1993, the Workflow Management Coalition (WfMC) is a global organization of adopters, developers, consultants, analysts, as well as university and research groups engaged in workflow and BPM. More details are provided at http://www.wfmc.org/

- process event streams. Publishing event streams for both process models and runtime process instances enables visibility and participation across a broader range of participants and devices;
- internal and external BPM communities for sharing best practices

The barriers to collaboration can be broken down using the tools that provide the models visualizations which take into consideration the worker's role and skills. For example, the workers unfamiliar with processes modelling notations such as BPMN may view a simplified perspective of the model and add their feedback using typed comments rather than having to use less familiar graphical tools.
Kemsley concludes providing the best practices to be considered when using the social BPM into enterprise transformation. Those guidelines suggest to shift from top down organizational management in order to give to the appropriate levels of control to everyone so that they can control their environment and make it most effective for completing their tasks at hand.

2.2. SOCIAL SHARING

Sharing is a basic component of human interaction, and is responsible for strengthening social ties and ensuring a person's well-being. It refers to joint or alternating use of an inherently finite good, such as a common pasture or a shared residence. Sharing is also seen as the process of dividing and distributing.
Free software development , distributed computing, and other forms of peer production offer clear examples sharing practices.

The work on [15] illustrates some successful examples of social sharing practices based on peer production[7]. One of the most success case of peer production and sharing practices is the development of free software[8].

[7] Peer production is a system that depends on individual action that is self-selected and decentralized, rather than hierarchically assigned.

[8]The story of free software begins in 1984, when Richard Stallman started working on a project of building a

Free software is an approach to software development that is based on shared effort on a non-proprietary model. In such approach many individuals with different motivation and knowledge contribute to a common project. Every participant shares with others his contribution without any single person or entity asserting rights to exclude either from the contributed components or from the project as a whole. A model of licensing a software produced collaboratively is used in order to avoid its appropriation by a single contributor or a third part. The GNU General Public License, or GPL is an example of such model.

Free or open source software are widely used in their different forms from operating systems like GNU/Linux to Web servers.

The work on [15] estimates that about 70 percent of Web server software runs on the Apache Web server[9]. Free software program are also largely used in back-office and e-mail functions.

The work [15] observes that the increasing adoption of business and service strategies that rely and extend free software is not only motivated by the fact that they are free. Organization are in general concerned by delivering reliable services to their clients /stakeholders. They cannot risk a higher rate of failure in their core business activities in order to save on licensing fees. This leads to conclude by absurd that the adoption of those software by big commercial companies like Google, Amazon as well as military and other mission-critical government agencies justify the reliability of open source software.

Another collaborative enterprise presented in the work [15] is the case of the famous online free encyclopaedia, Wikipedia. In particular, this work discussed the

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nonproprietary operating system he called GNU. He wanted a world in which software enabled people to use information freely, where no one would have to ask permission to change the software they use to fit their needs or to share it with a friend for whom it would be helpful.

[9] The Apache HTTP Server Project is a collaborative software development effort aimed at creating a robust, commercial-grade, featureful, and freely-available source code implementation of an HTTP (Web) server. The project is jointly managed by a group of volunteers located around the world, using the Internet and the Web to communicate, plan, and develop the server and its related documentation. This project is part of the Apache Software Foundation. In addition, hundreds of users have contributed ideas, code, and documentation to the project. http://www.apache.org/

three core characteristics that have allowed the success of Wikipedia. 1) The use of wiki[10] as content management system.
This platform enables anyone to edit almost any page in the entire project. All versions are stored allowing to everyone to revert a document to any prior version as well as to add changes. The contributions and changes are transparent. 2) It is a self-conscious effort to create an encyclopedia governed by a collective informal undertaking to endeavor for a neutral point of view, within the limits of substantial self-awareness as to the difficulties of such an enterprise. An effort to represent sympathetically all views on a subject, rather than to achieve objectivity, is the core operative characteristic of this effort. 3) The content generated through this collaboration is released under the GNU Free Documentation License[11].

The democratic and social nature of Web 2.0 have changed the usage of internet from just a passive content consumption to actively involve the user to create information and share it for a different kind of communities.
Although the motivations to share (purely social reason or economical reason) remain the same as in pre digital age, the use of information technologies tools and social networks allows to expand the concept of sharing to a broad community of connected users.

The users of social networks are continuously creating and sharing contents such as photos, feelings, advices and views with their friends. Those practices that exploit the features (commenting, tagging, liking/disliking, etc) offered by social networks as Facebook are providing alternatives solutions for information sharing and searching systems. The work on [16] provides an example of how the sharing of

[10] According to Wikipedia, A wiki is usually a web application which allows people to add, modify, or delete content in a collaboration with others. In such content management systems the content is created without any defined owner or leader. Wikis have little implicit structure, allowing structure to emerge according to the needs of the users.

[11] The GNU Free Documentation License (GNU FDL or simply GFDL) is a copyleft license for free documentation, designed by the Free Software Foundation (FSF) for the GNU Project. It is similar to the GNU General Public License, giving readers the rights to copy, redistribute, and modify a work and requires all copies and derivatives to be available under the same license. [http://en.wikipedia.org/wiki/GNU_Free_Documentation_License]

opinions and recommendations can enhance the quality of searching systems. The work [16]defines a new search system, CrowdSearcher, that integrates human interactions with traditional search systems. This approach of information seeking exploits the power of human suggestions and insights for improving the quality of search results. The quality of a such search depends on the quantity and quality of responses(recommendations /suggestions). To achieve this goal, CrowdSearcher uses social platforms such as Facebook, LinkedIn and Twitter to reach user's community across the world and to collect many as possible opinions, suggestions and recommendations from responders.

The work on [17] classifies as shareable those goods having systematically excess capacity that may better be harnessed through sharing relations than through secondary markets[12]. According to this work, shareable goods are goods that are technically lumpy and of mid-grained granularity. In this context the term "Lumpy" means that they provision functionality in discrete packages rather than in a smooth flow.

For example a personal computer is "lumpy" in that you cannot buy less than some threshold computation capacity, but once you have provisioned it, you have at a minimum a certain amount of computation, whether you need all of it or not. By "granularity" the author seeks to capture:

- technical characteristics of the functionality-producing goods;
- the shape of demand for the functionality in a given society;
- and the amount and distribution of wealth in that society.

These characteristics define conditions under which, when goods with these characteristics are prevalent in the physical-capital base of an economy, it becomes feasible for social sharing and exchange to become more salient in the overall mix of relations of production in that economy.

[12] Secondary market in this context refers to the market for any used goods or assets, or an alternative use for an existing product or asset where the customer base is the second market.

3. Resource management and social capacity sharing.

In this section are described innovative solutions to **resource management problem** focusing the attention on **social capacity sharing** practices. The proposed solutions are grouped in three main areas :

1) **Social BPM and Capacity sharing**. This part is dedicated to the integration of social capacity sharing process with other enterprise systems such as Enterprise Resource Planning (ERP) System. That integration allows: (1) an automatic identification of the resource's extra capacities that, by its characteristics, are suitable for the sharing practices rather than other policies for extra capacities management. The identified extra capacities are then automatically published on dedicated sharing platforms; (2) to meet the lack of resources by acquiring the needed capacities from social sharing platform instead of using traditional enterprise resource acquisition procedures.

2) **Social capacity sharing and Mobile**. In this part are proposed solutions which exploits the convenience offered by mobile devices and the numerous mobile applications present on market. The integration of social capacity sharing module with other mobile applications(for example geo-localization applications such as Google Maps, GPS, online calling and instantaneous messaging systems such as Skype, FaceBook, GooglePlus,etc.) will permit to enrich the information about the resource provided by its owner and an easy get in touch among users. In Enterprise, this integration will simplify informative process. For example when the identified resource's extra capacity is published on sharing platform, the responsible of the process which triggered that publication is directly informed(by SMS for instance) in order to follow the capacity sharing process or to take another appropriate decision (for example to inform or delegate other responsible).

   A simplified version of this application in particular will allow the users to serve time in contacting the resource owner, to geo-localize the resource, to

search and rent resource everywhere there are. To the resource owner, the mobile version of social capacity sharing application will permit the execution of repeated tasks such as resource publication, grant available resource to a user, etc.

3) **Application deployment**.

3.1. CAPACITY SHARING AND SOCIAL BPM

Companies today face the challenge of increasing competition, expanding markets, and rising customer expectations. This increases the pressure on companies to lower total costs in the entire supply chain, shorten throughput times, drastically reduce inventories, expand product choice, provide more reliable delivery dates and better customer service, improve quality, and efficiently coordinate global demand, supply, and production.

To remain competitive, organizations must improve their own business practices and procedures. Many organizations have found the enterprise resource planning (ERP) systems as a solution to accomplish these objectives. The benefits resulting from the use of these systems can be improved through their integration with the practices of social sharing.

The techniques suggested for that integration are reported in the next paragraphs.

The core idea of these techniques is to use the functionalities(or any combination of them) offered by other enterprise systems in order to automatically identify the resources which are defined to be better for sharing. The identified resources are then shared via resource sharing platform.

The sharing process could involve only the organizations participating on that platform or the global community by exploiting the confirmed power of social networks.

The proposed solutions differ one from other mainly on the way the identification of those resources is done.

3.1.1. Automated resource sharing based on accessed data object.

This technique uses relatively simple methods to identify sharable resources:

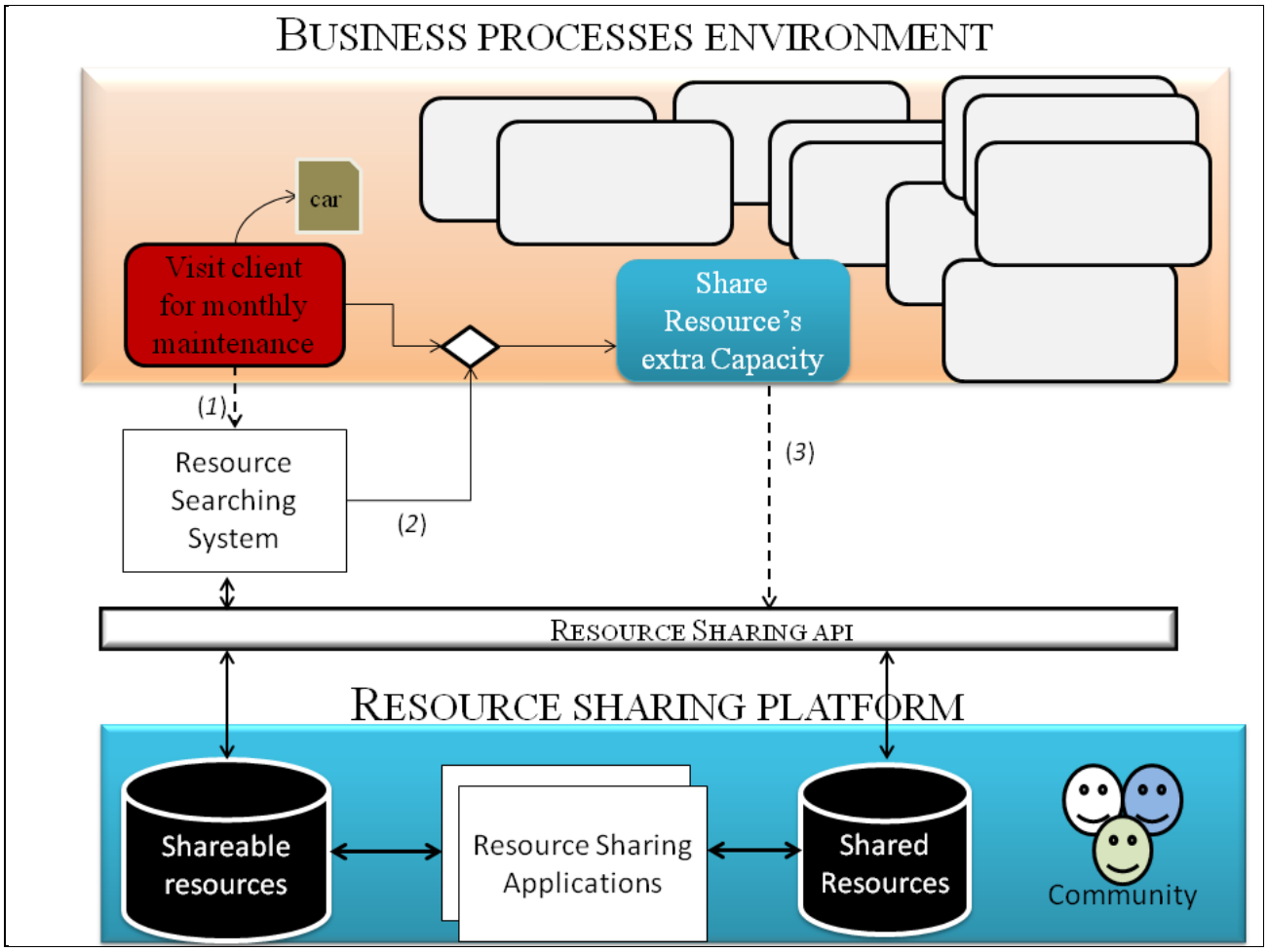
- resource monitoring mechanisms are used to track the usage of all resources involved in the business process. The abnormal usage of the resource (over solicitation or underused capacity) are detected by comparing the current resource usage with a prefixed threshold. This functionality can be implemented on the Enterprise Resource Planning systems;
- identification of the data objects accessed by the process which leads the resource in an abnormal state. The business process management systems allow the identification of all data objects accessed by a given process;
- a searching system that takes in input a data object and checks its shareability.

This technique requires:

1) at process design time a dedicated platform containing the types of resources classified as suitable for sharing has to be designed and made accessible for all processes running on the same business process management environment.

   There exist in literature economical criteria which allow to classify resource as suitable for sharing or not. For instance the work[17] provides a set of economic criterions for shareability.
2) during business process execution, when a process is highlighted as in over capacity for instance, the integrated system checks automatically whether the accessed data object is among those present on sharing platform. If the outcome of such check is positive, meaning the resource is suitable for sharing practices, the identified resource's extra capacity is automatically published on the dedicated canal of resource sharing. The published resource's extra capacity is then visible to other organizations which could need the same resource in their business.

   The figure 3.1 exemplifies the logical sequence of operations during the automatic resource's extra capacity sharing.



3.1Routine resource's extra capacity sharing based on accessed data object.

(1) *When a process leads a resource it uses on an abnormal state(over capacity or under capacity), the integrated system checks whether the* ***data object*** *accessed is on the list of shareable resources. In this example is treated the case of resource extra capacity. The management of resource under capacity works in an opposite way.*

(2) *If the outcome of that search which involves the access to* ***Resource Sharing Platform*** *is positive(meaning that the resource is better for sharing practices more than other resource management policies), "****Share Resource's extra Capacity process****" is executed.*

(3) *The "Share resource extra capacity" process uses Resource Sharing API to publish the identified resource's extra capacity on Resource Sharing Platform. As the result of this operation, the resource's extra capacity is added to the list of shared resources of that Organization.*

3.1.2. Automated resource sharing based on patterns recognition

This technique uses patterns[13] recognition mechanisms to identify the resource to be managed through sharing practices. During the process execution phase, the sharing tasks associated to each sharable resource of a recognized pattern are automatically executed.

At design time this technique requires:

- the definition of patterns providing for each pattern the resources involved in sharing processes. The pattern definition phase includes also the specification of the sharing action(resource acquisition or resource's extra capacity sharing) to be executed when a given pattern is recognized.
- Patterns recognizer system. A system able to recognize a given sequence of tasks during process design phase. There are different ways to recognize a pattern such as the recognition based on a structural analysis of the activities involved in that pattern plus their labels.
- Construction of sharing map. At the end of the recognition phase, the pattern recognizer system constructs a map of identified resources to be shared and the relative sharing activities to be invoked during process execution phase.

During process execution the proposed technique requires an integrated system able to access the produced map of resource sharing and execute the designed sharing activities.

In this technique a pattern recognizer proposed operates during design phase but this does not exclude the implementation of this technique using a system which recognizes patterns during the execution phase. The preference made here is based on the fact that "design phase pattern recognizer" allows the earlier construction of sharing map.

The figures 3.2 and 3.3 illustrate this technique using an example of patterns which represent the starting of design phase and ending development phase of a software product.

[13] A pattern in this context represents a determinate sequence of tasks which compose a business process.

The design phase is preceded by software requirements acceptance. In this specific software life cycle (there are other software life cycles different from the one presented in this example) the design phase can start only when the customer has signed the document of requirements specification.

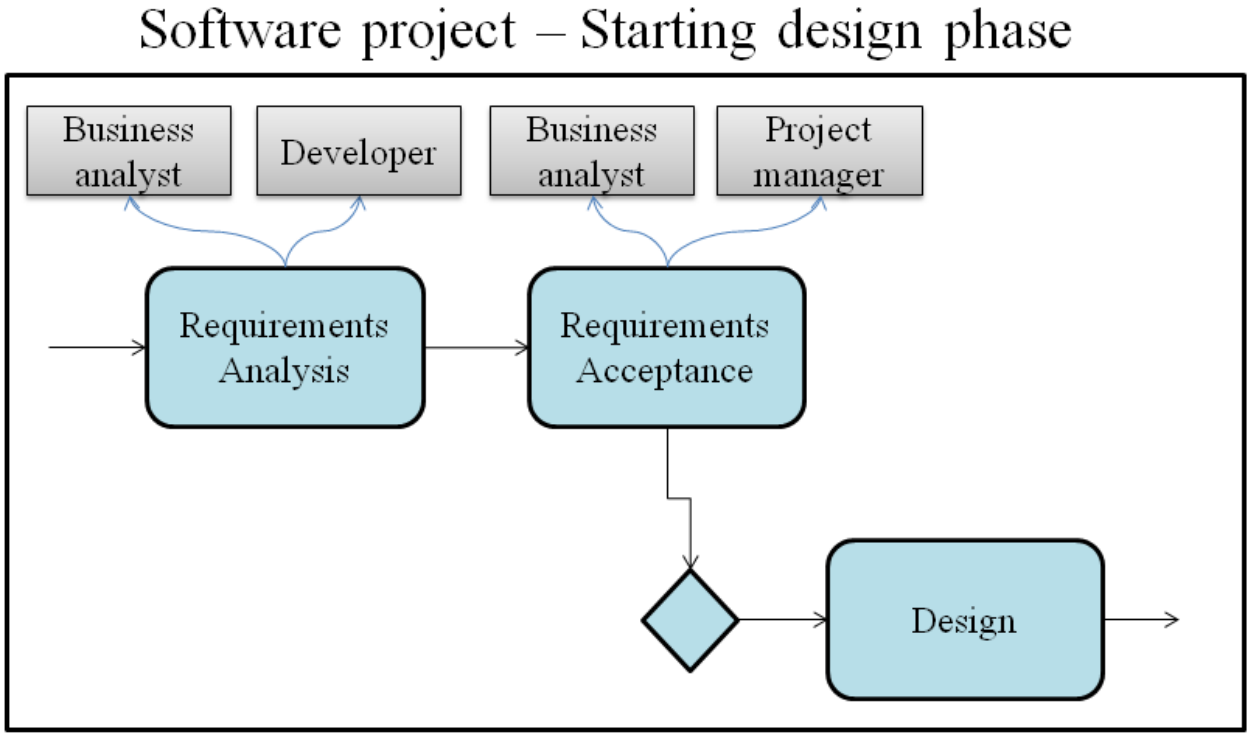


Figure 3.2 Automated resource sharing based on pattern recognition. Starting design phase in a software project.

This phase involves in general three main activities: testing of the integrated software product; the training of system users and the deployment of the developed software.

To each activity are associated resources which are needed to complete it (for readability of the figure are shown only the resources necessary to illustrate the proposed technique.)

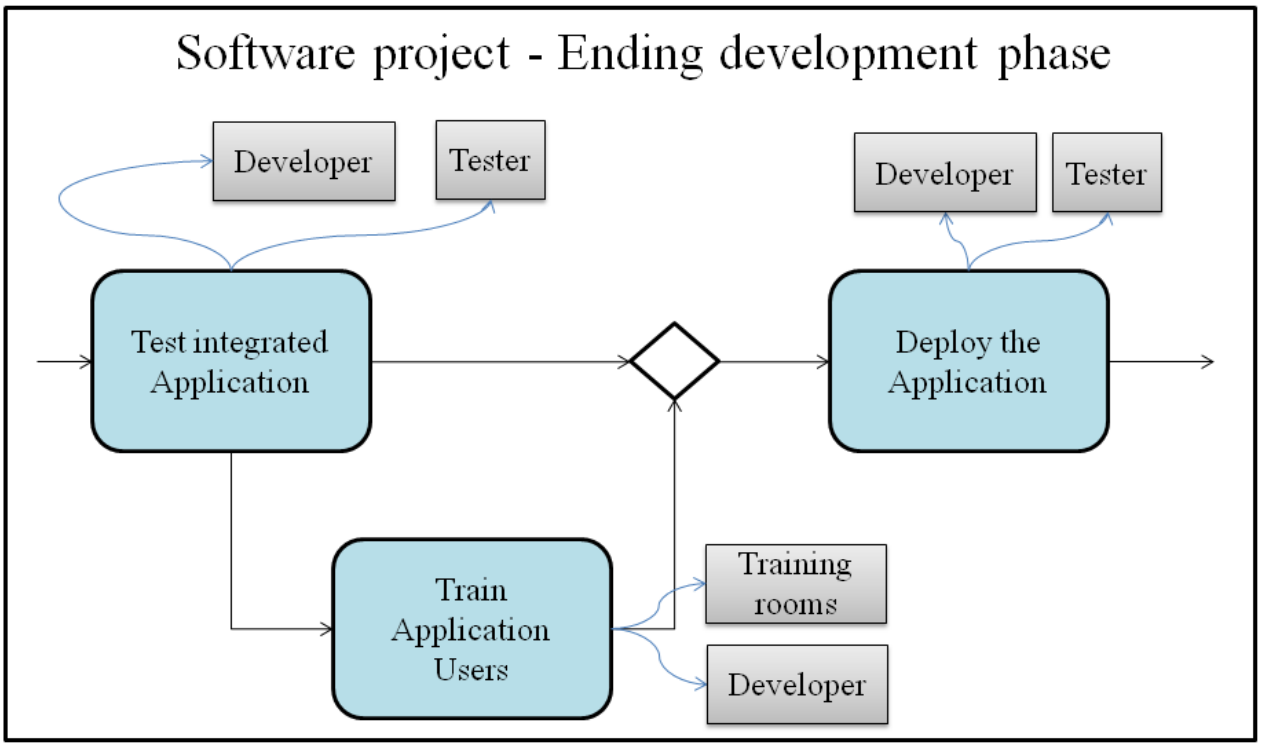


Figure 3.3 Automated resource sharing based on pattern recognition. Ending development phase in a software project.

When a pattern is recognized, the resources involved are marked as to be shared. During the process execution phase, the actions related to those resources to be shared as exemplified on the table 3.1 are executed.

Table 3.1 The patterns for resource sharing process.

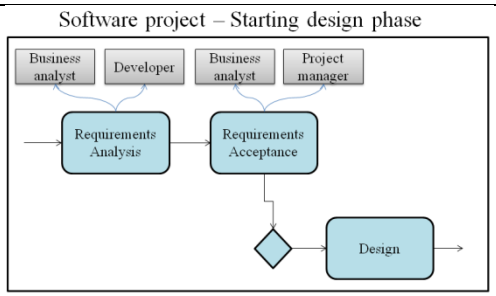
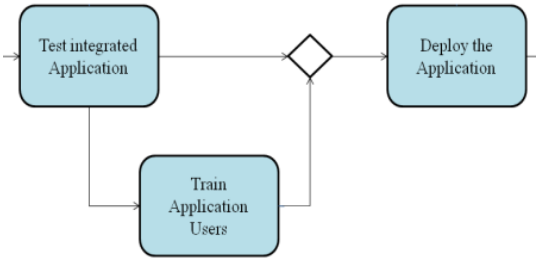
Pattern name	**pattern**	**resource involved**	**sharing activity**
Starting software design phase		expertise(Business Analyst)	share extra capacity
		Expertise(Designer)	Request resources
Ending software development phase		expertise(testers)	share extra capacity
...	…	...	...

Table 3.1Mapping of the sharing activities to patterns

3.1.3. Automated social resource sharing based on activity labels

This technique suggests to use the labels on the activities composing the process and to infer from them (name plus meaning) whether the resources involved in that activities can be managed through the techniques of resource sharing.

The idea behind this technique is the following:

1. the relevant concepts about the shareable resources are extracted from the platform of resource sharing. This task can be done easily by accessing the resource sharing platform and reading the types of supported resources;
2. those concepts constitute a set of flags;
3. during the process execution, when the integrated system encounters a label with the same name/meaning of the one of those flags, the resource is classified as better for sharing practices and the related sharing activities are executed.

This technique requires:

- The construction of a dictionary of relevant concepts of the shareable resources;
- The design of a subsystem able to compare dynamically the labels of activities with a given flag;
- The use of resource's usage tracking mechanisms in order to identify the resource's sharing action to be invoked when a resource is marked as suitable for sharing.

The figure on 3.4 illustrates this technique by an example.

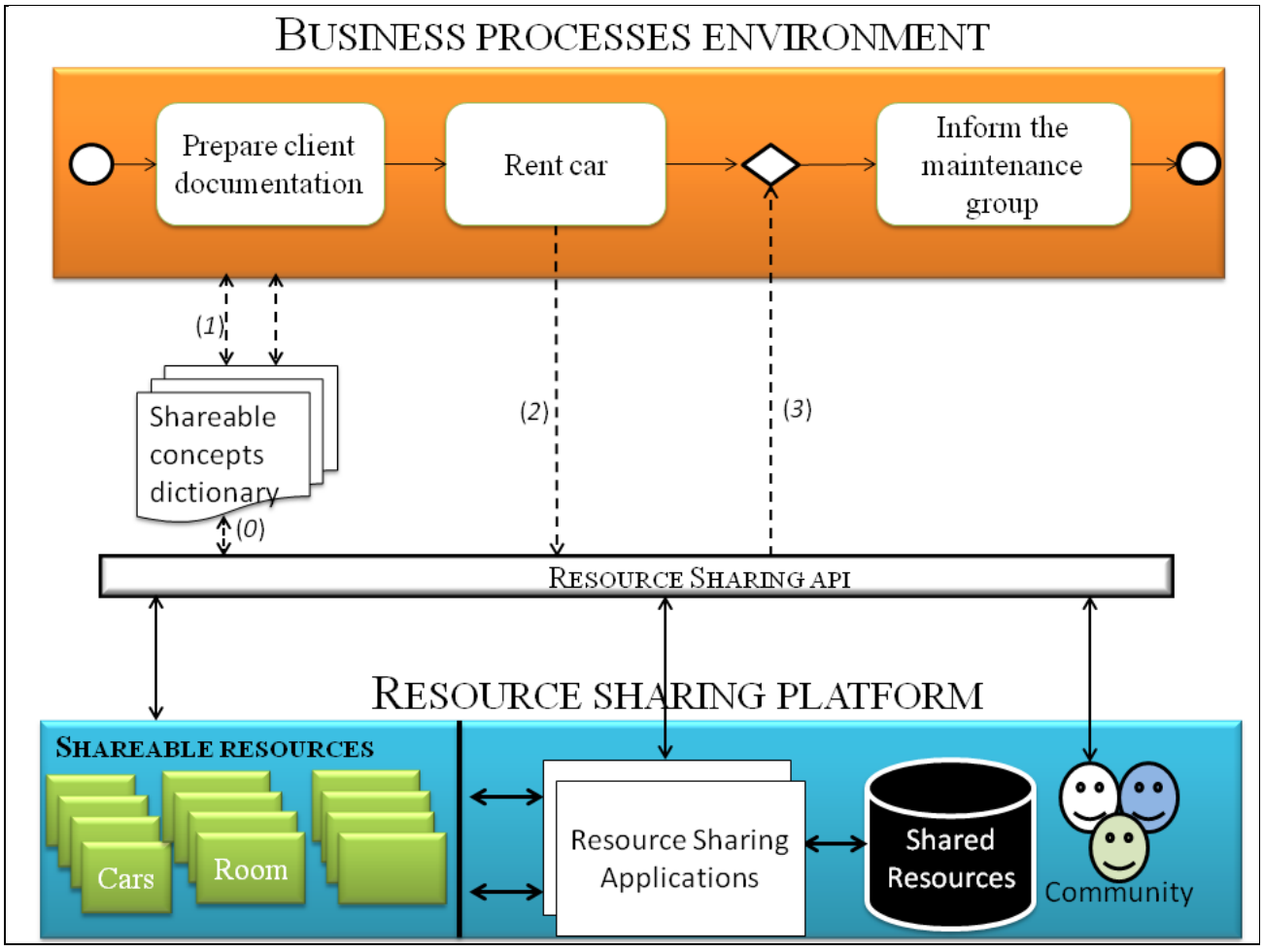


Figure 3.4 Automatic resource sharing based on activities' label

(0) Main concepts extraction. A list of main concepts about shareable resources is produced by accessing the resource sharing platform.

(1) During process execution the list of those relevant concepts is compared with activities' labels.

*(2) When the label has its correspondent on the list of shareable concepts, the correspondent resources are managed through resource sharing platform. In the reported scenario the task "**Rent car**" invokes **Resource sharing practices** and the process waits the acquisition of car from sharing platform.*

(3) Once the resources are managed (in this case, a car has been acquired)the process continue its normal execution(in the described case, the task "inform maintenance group" is performed and the process ends).

3.1.4. Automated resource sharing based on the properties of shared resource

This technique considers the fact that the resource sharing activities may depend on the properties of shared resources. Those properties can be: 1) attributes of shareable resources, the properties which characterize directly the resource like its name; 2) the properties derived from other enterprise resource management systems such as the number of processes in which that resource is involved; the net book value of the resource etc.

The proposed technique identifies the resource to be shared simply by reading its properties. During the process execution the identified resources are shared socially by executing the relative sharing tasks. The proposed technique requires:

- at design time the mapping of resources' properties and relatives sharing actions;
- during the execution phase the integrated system must be able to read the produced mapping and to execute specified sharing actions.

This technique which combines social sharing practices with the use of simple mechanisms of analyzing the properties of the resources provides an alternative solution to resource management systems especially for those resources that by their financial nature have to be evacuated because otherwise they constitute an extra cost for the organization. Consider for instance the resources that have reached the end of their lives according to internal criteria of the company. Using

social sharing techniques the organization enhance the chance to reach potential customers which could need those resources for an alternative use.
In conclusion, the techniques proposed in this section are the real alternatives to the traditional resources management systems.
The integration of the social sharing practices with traditional resource management systems increases the chance:

- to acquire the needed resources in a reasonable time and may reduce the total cost of the resource acquisition process.
- to choose a reliable supplier by exploiting the knowledge of the community through its suggestions and recommendations.
- to reach a large number of users and then enhance the probability to find a client for an unused resource.

3.2. SOCIAL CAPACITY SHARING ON MOBILE

This section explores the needs of a mobile version of the social capacity sharing application. It will provide a set of best practices to be considered during the design of mobile applications in order to better exploit the conveniences offered by mobile devices taking into account the confirmed power of social networks.

The use of mobile devices in our daily life is increasing day by day. There are different reasons justifying that increasing. The most relevant are:

- users want to reach everything they need without having to use a personal computer;
- mobile devices offer comfort and permits the user to save time;
- the advanced features offered by mobile devices themselves;
- the large number of mobile applications and mobile users;
- **Accessibility**. In some cases the mobile devices result more accessible than desktops, and are actually used for assistive technologies. The applications of

Apple for people with vision impairments which focus their attention on interfaces based on voice command are good examples in this field;

- **Socialization**. The social networking are providing mobile applications which let the user update his profiles at any time and feel connected anytime, anywhere with his network of friends;
- A mobile device can be used in free time or to exploit the dead time. For instance, using a mobile device on the way to or from home, one can search for information he doesn't have time to search during his busy working day; and etc.

Even though the mobile devices provide useful functionalities they have some limitations. The most constrained limitations are related to the smallness of their screens. The design of the applications which exploit the rich features offered by those devices must take into account those limitations. The followings are best practices to overcome that issue:

1. the quantity of delivered information have to be reduced. This suggests to focus more attention on the quality of the information presented to the user.
2. a mobile application must have a clear orientation. That can be a "reduced version" of the full application or a "goal oriented" mobile application.

In **reduced version** of the application all features implemented on a web version are also present in mobile application but with simplified patterns. The details provided to the user are limited to the minimum necessary. For example in "**social capacity sharing"** application, the functionality of renting an available resource which involves:

- searching of all available resources in slot of time defined by the user;
- choosing the payment method; and
- finally contacting the resource owner as reported in the figure 3.5.

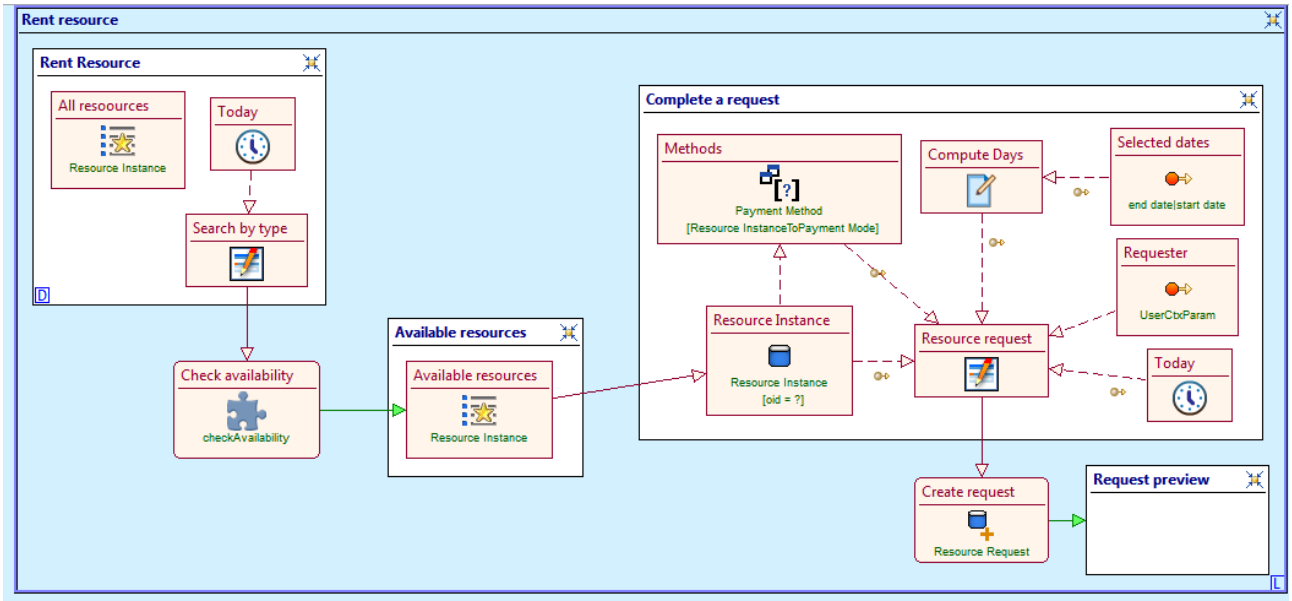


Figure 3.5 Rent resource pattern

can be simplified in its mobile version as follows:

a) a user is allowed to rent:

- a resource he usually rents. This avoids the searching task and a long list visualization. The payment method used by the user may remain the same and he will chose other method only when necessary.
- known resource or resource owner. For a known resource the search is done by name. The searching time is reduced and only one result is displayed(The name identifies univocally the resource).
- Nearby resources. This will reduces the set of retrieved resources. In real life, if there are no other particular reason suitably the user will need to use the resource close to him.

b) the resource owner is directly contacted by calling his number or sending to him an instant message.

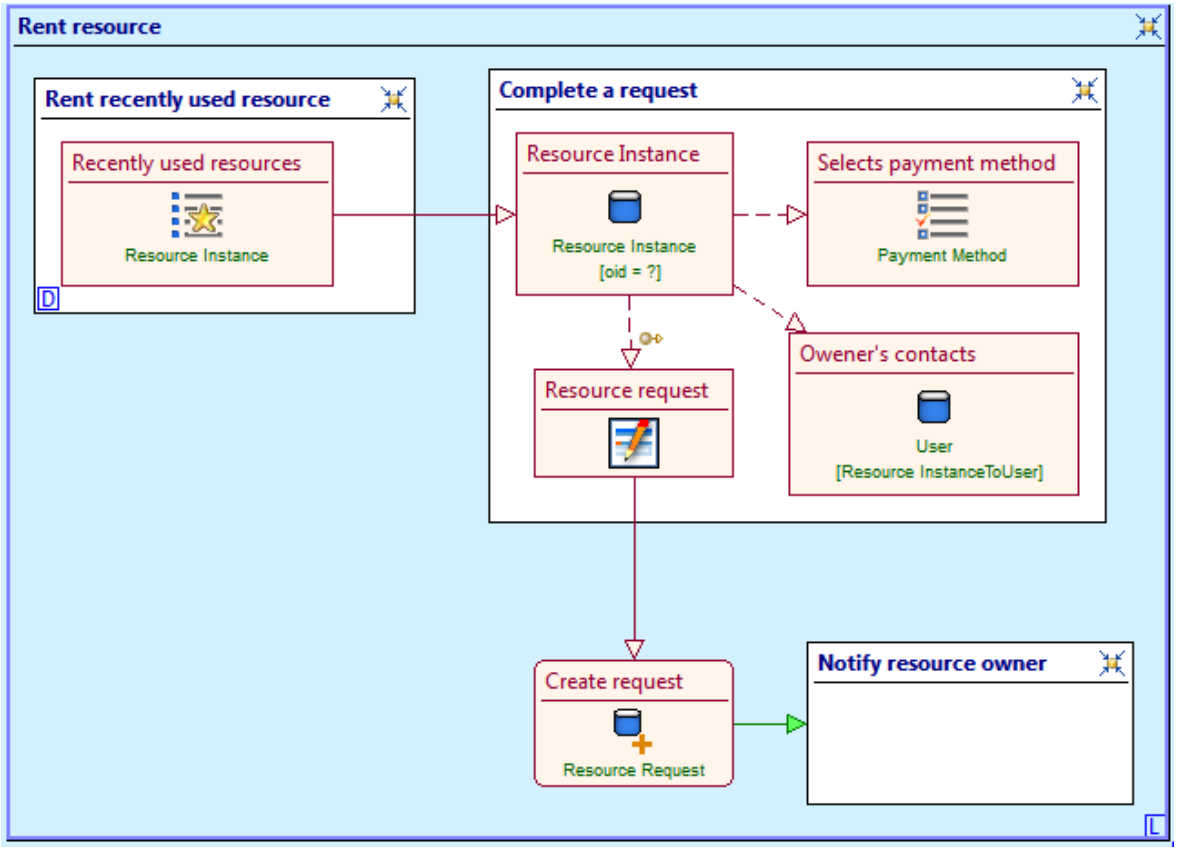


Figure 3.6 Rent resource- simplified version for mobile devices

In this example of a pattern representing the functionality of "**renting a resource**" is simplified in its mobile version taking in consideration a repetitive task(a user is allowed to rent a resource he usually rents) and the pattern is enriched by the integration of social capacity sharing application with other mobile features like GPS to locate the nearby resources and the mobile calling function to contact the resource owner.

This simple example shows how a well designed mobile application should allow the user to save time for repeated tasks. The combination of different mobile applications permits to enrich to information provided to user by integrating the original information with those derived from the use of other mobile applications.

Goal oriented mobile application.

Due to a specific necessity, a mobile application may implement only some functionalities of the full application to achieve a predefined goal. In this case only the features related to that goal are implemented and to perform other tasks the user is redirected to the full version of the application.

For example on social capacity sharing application, it can be provided a mobile application with "a **pure informative goal**". That application shall implement only the functionalities having as finality to inform the user about what is happening(highlights). For example in social capacity sharing application the user can be informed about:

- a new shareable type. At the end of the definition of a new type of supported resource, the system could send a notification to the users (for instance all resource owners) simply by sending a short message(SMS) or by posting that fact on social networks;
- availability of recently requested resources. The application could allow to the resource owner to inform the user when the resource he was waiting for becomes free;
- top resources and top users ;etc.

3. The information must be well organized. On mobile devices the navigation crucial. The users want to perform their tasks quickly and need to be guided during their navigation. The designer must provide the layout that directs the user how to proceed visually on the page.

4. The interface must be most intuitive as possible both in terms of visual appearance (the look) that the mode of interaction (the feel). The effort is concentrated on the first impression the user will have the first time he use the application.

3.3. DEPLOYMENT

This section treats application deployment process. The section starts describing the different approaches for deployment. It ends providing recommendations to the deployment of social sharing applications.

Many organizations have a structured process followed during the acquisition of new software products. In general the first phase of this process consists on deciding whether it is better for the organization to develop the software in house or to buy the needed software product(Make-or-Buy Decision).

The main advantage of adopting in house strategy relays on: 1) the full control of the software development process; 2) the quality of developed software; and 3) Its integration with other enterprise systems. This solution requires specific knowledge and extra resources for software development and maintenance.

Usually organization prefers to acquire software products from the software companies specialized on software development. There are many reasons leading to this choice.

- Search of Software Quality. The software houses have a large know how and the required resources to produce and maintain a software product. Software company must guarantee the quality of produced software;
- Efficiency. Instead of investing resources such as personal and time on the development of a software, the organization concentrates these resources on the implementation of its main goals;
- The organization can always get the required software within time. The company defines its deadline and it is for the software house to meet this requirement. The organization can buy a software already available on market.
- Organization doesn't have necessary resources to develop the software in house; and etc.

3.3.1. Buy and install

The term "Buy and install" refers to the modality of software product acquisition from software houses. It consists on buying a software and its deployment on the enterprise's infrastructures.

This technique provides in a wide sense the same advantages as the software developed in house. It allows to the enterprise to integrate the new acquired module with other enterprise systems. By adopting this solution the organization takes the control of the software and its management into the organization. There are different forms of this modality and they differ mainly on the level of control(expressed in terms of software licence) the organization has on that software product.

Buy and install increases the cost of technological infrastructures, the resources to maintain the software and licensing fees.

To overcome the limitations and high costs of "buy install", enterprises exploit the functionalities and facilities provided by cloud computing systems.

3.3.2. Install on Cloud

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications ,and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

The deployment on cloud can be under one of the following models: enterprise owned or leased cloud. Private cloud; shared infrastructure for specific community. Community cloud; public cloud; or any composition of two or more clouds. Hybrid clouds.

The adoption of cloud solution offers the following main advantages:

- It can provide an almost immediate access to hardware resources, with no upfront capital investments for users, leading to a faster time to market in many businesses. The cloud becomes an adaptive infrastructure that can be shared by different end users, each of whom might use it in very different ways. The users are completely separated from each other, and the flexibility

of the infrastructure allows for computing loads to be balanced on the fly as more users join the system.

- Improve accessibility. Clouds are accessible anywhere, anytime using any device provided that is connected.
- Cloud computing makes it easier for enterprises to scale their services which are increasingly reliant on accurate information according to client demand. Since the computing resources are managed through software, they can be deployed very fast as new requirements arise. In fact, the goal of cloud computing is to scale resources up or down dynamically through software APIs depending on client load with minimal service provider interaction.
- It lowers the cost of entry for smaller firms trying to benefit from compute-intensive business analytics that were hitherto available only to the largest of corporations. These computational exercises typically involve large amounts of computing power for relatively short amounts of time, and cloud computing makes such dynamic provisioning of resources possible. Cloud computing also represents a huge opportunity to many third-world countries that have been so far left behind in the IT revolution. Some cloud computing providers are using the advantages of a cloud platform to enable IT services in countries that would have traditionally lacked the resources for widespread deployment of IT services.
- Cloud computing can lower IT barriers to innovation. The online applications such as Facebook and YouTube are concrete examples.
- Cloud computing also makes possible new classes of applications and delivers services that were not possible before. Examples include 1) mobile interactive applications that are location, environment and context aware and that respond in real time to information provided by human users, nonhuman sensors or even from independent information services (e.g. worldwide weather data); 2) business analytics that can use the vast amount of computer resources to understand customers, buying habits, supply chains and so on from voluminous amounts of data.

There is no good solution for all. The applications for social sharing practices can be deployed following one or other deployment approach depending on the needs and policies of each organization.

In buy and install approach, the integration of sharing practices has to be well studied. The aspects related to social software and platforms have to be considered.

By adopting cloud solution the organization must be aware of some critical issues such security and privacy, services level agreements and etc.

4. Social capacity sharing application

This chapter describes the general idea of the social capacity sharing application and the functionalities that can be developed to implement it.
The chapter is dived into three main parts: a general introduction about the social capacity sharing application, a users' overview and the description of the high level features. The second part is dedicated to the description of the intended users of the application and their functions. In the third section is provided the presentation of the features of the application grouped by main area.

4.1. INTRODUCTION

The social capacity sharing application allows enterprises to exploit their extra capacity by sharing, renting or leasing assets that would otherwise remain unused for a certain amount of time. The social side of the application is that the company's extra capacity is offered on both a dedicated portal and on public social networks, with resources of different types automatically extracted from the enterprise systems based on their scheduled availability.

Posting on social networks is used to improve the visibility of rentable resources, by encouraging people outside the company to spread the word to their acquaintances. The adoption of Social BPM supports the integration in the same process of enterprise and social activities (e.g., by allowing automatic sharing of resources when these appear as free in the enterprise ERP system).

The application supports a workflow for the definition of resource types (e.g., cars, office space, houses), the publication of available resources of those types, and the reception of resources requests from customers.
Resource availability can be advertised on multiple social networks, so as to spread the word and to collect feedback and declarations of interest.

Three roles can participate to the process:

1. administrators;
2. resource owners; and
3. resource consumers.

An administrator can define the types of resources that can be shared; approve/reject new resource types proposed by other users; and manage the users subscriptions.

A resource owner can publish his resources on the social networks of choice; disseminate such a publication to his friends/followers on enterprise or public social networks; monitor how the community reacts to his offers through a social activity monitor; and approve or reject bids from social network users.

A consumer can search available resources; evaluate resources and owners from their community ranking, produced from people's votes; make a bid for a resource; post a comment on the application or on a connected social network about resources or providers; and propose new resource types.

A usage scenario may consists in the following steps:

1. a resource owner identifies the resource extra capacity(for instance unused car in a given slot of time) and publishes the resource on social networks of his choice to get bids from the community. Resource extra capacity identification may be done based on a prefixed threshold monitored automatically by the Enterprise Resource Planning system;

2. resource consumers make their requests for that resource. The users can be helped in their choices by the community for example by reading previous comments made on that resource and its owner or by asking opinions and recommendations from friends/followers ;

3. based on collected bids and internal resource management policy the resource owner decides to whom grant the resource and inform the requesters about the exits of the process.

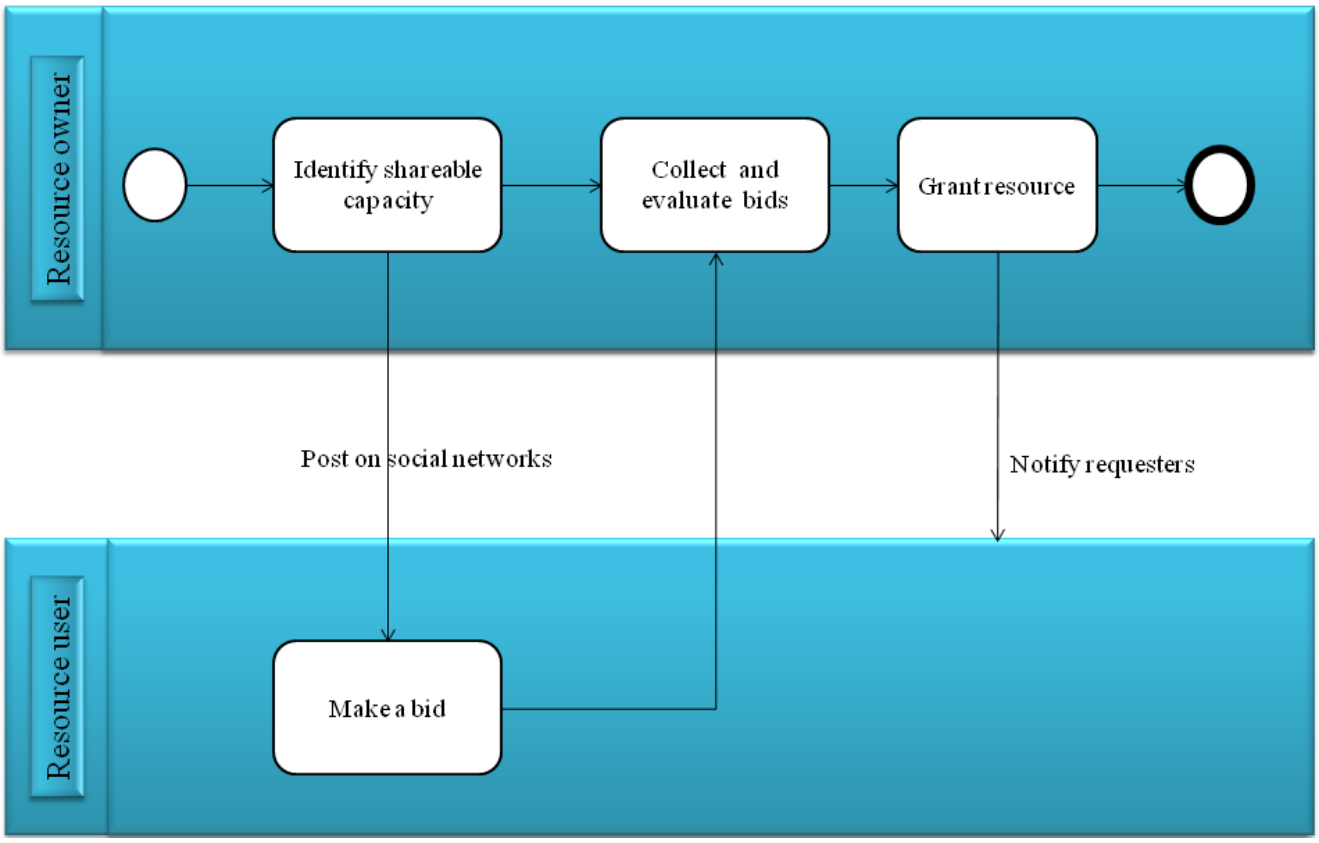


Figure 4.1 Usage scenario

The Social Capacity Sharing Application produces the ranking of resources and owners according to criteria such as number of comments (likes or dislikes), etc. This ranking is made available to all users and may help resource owners improve the quality of their service, as in traditional marketplaces.

4.2. USERS OVERVIEW

For this demonstration application three types of users have been identified: administrators, resources owners and resource users(consumers). For each category of user a description and the related functionalities are provided.

4.2.1. Administrator

The administrator is a particular user who doesn't use the application to create content but instead manages some of its settings:

- users, groups of users and which modules they can access depending on the group which they belong;
- the type of shareable resources: it can create, delete and edit types and approve/reject new resource types proposed by other users

4.2.2. Resource consumer

The resource consumer(equivalently resource user) is any user registered to the application. He can access to the limited set of functionalities of the application. Once logged into the application the consumer can :

- search available resources;
- evaluate resources and owners from their community ranking, produced from people's votes;
- make a bid for a resource;
- post a comment on the application or on a connected social network about resources or providers;
- and propose new resource types.

The resource user is characterized by his profile's data, his friendship connections, the credentials for access to the various social platforms.

4.2.3. Resource owner

The resource owner is a user who owned resources published or those which can be shared on the application. He can get access to all functionalities of the application but the administration tools. The resource owner in particular can:

- publish his resources on the social networks of choice;
- disseminate such a publication to his friends/followers on enterprise or public social networks;
- monitor how the community reacts to his offers through a social activity monitor; and approve or reject bids from social network users.

The resource owner is characterized by his profile's data, his friendship connections, his relevance index, his position in resource owners ranking and the credentials for access to the various social platforms.

4.3. HIGH LEVEL FEATURES

This section is dedicated to the description of the high level features of the application. The Social Capacity Sharing application is designed following the design methodology described on work [6], "Designing data-intensive web applications". The application is composed mainly of three site views, each of them related to a specific set of features grouped with respect to the identified roles:

- Administration view which regroups all functionalities related to application user management, resource type management;
- Application user view, contains in particular a reserved area for resource owner;
- Public view (Home), the access point to the application.

4.3.1. Home

The home view represents the main entry for the application. It contains three sub-views. The first one, called "Login", allows users to access their reserved area by inserting their credentials. The login sub-view contains also the social login which allows the users to log into the application by using the social networks accounts associated to their profiles.

The second one shows the rank of the 10 top resources, based on the comments received from the community. The first on the rank is one having a greater score.

Score = (# like + # positive comment) – (#dislike + # negative comment);
where # like designs the number of like.

This ranking list may help the resource consumers to get an idea of the most reliable resources. Each resource on the list is described by its thumbnail and contains a link which allows the user to see the details of the resource.

The third sub-view shows the rank of the top five users, based on their relevance index. The relevance index is calculated basing on the assessment made by the users by commenting liking/disliking the owner and/or the resources he owns. Each user is described by his name and his relevance index.

The following table shows the main functionalities to be included on the home page and their relative importance on the page(priority) according to design methodology presented on work [6].

Table 4.1 Map Of home site View

Area Name	Description Of Area	Accessible Objects	Priority
Login	Contains the form with two fields: username and password used to log into the application	Application User	High
Highlights	Contains the ranked list of top resources and owners. In the highlights will be inserted useful information such as new resources inserted, organizational changes, etc.	Owners, Resources, comments, like, dislike	High
Recovery password	Contains the form to recovery the pass word. The user fills the form with his username, email and the date of birth(registration date for company)	Application User	Medium
Register	Area where unregistered user by providing required information they register to the application	Application User	Medium

Table 4.2 The main functionalities to be included on the home page

4.3.2. Application User site view

It is the central view of the application. It includes the pages through which a registered user can access to the core functionalities of the application such resource publication, resource request, comment resource and owner, manage received requests, etc.
It contains two main area: a reserved area called “resource owner area” and the second one which regroups the actions that can be also performed by the resource consumer.
The resource owner area contains four main pages: “Resource publication”, “Manage request”, “My resource” and “Resource modification”.

Resource publication page

The resource publication page allows the resource owner to configure the resource step by step following the schema predefined for that type of resources. Once all required information are correctly provided, this pages allows to the resource owner to publish his resource on the social networks of his choice.
The first step related to the resource configuration is to choose the resource’s type(category), the name of the resource and its short description. If the desired type is not present, the application allows the user to propose a new one by invoking “resource category proposal page”.
The user will then provide the availability range(from and until when the resource presents an extra capacity to be managed via sharing systems) of the resource.
The user will be then asked to provide the further details to describe better his resource and to choose the payment modes and their correspondent base of pricing. To do so a list of attributes of each resource type is provided during the resource type definition. The application allows the user to propose other characteristics(attributes) if needed.

Finally, by clicking on publish button , the user is led to publication preview page which allows him to publish the resource on social networks of his choice(

Facebook , Twitter, etc.) The preview page allows the user also to make quick modifications if needed before he spreads the word on social networks.
The following figure shows how will look like the resource publication page.

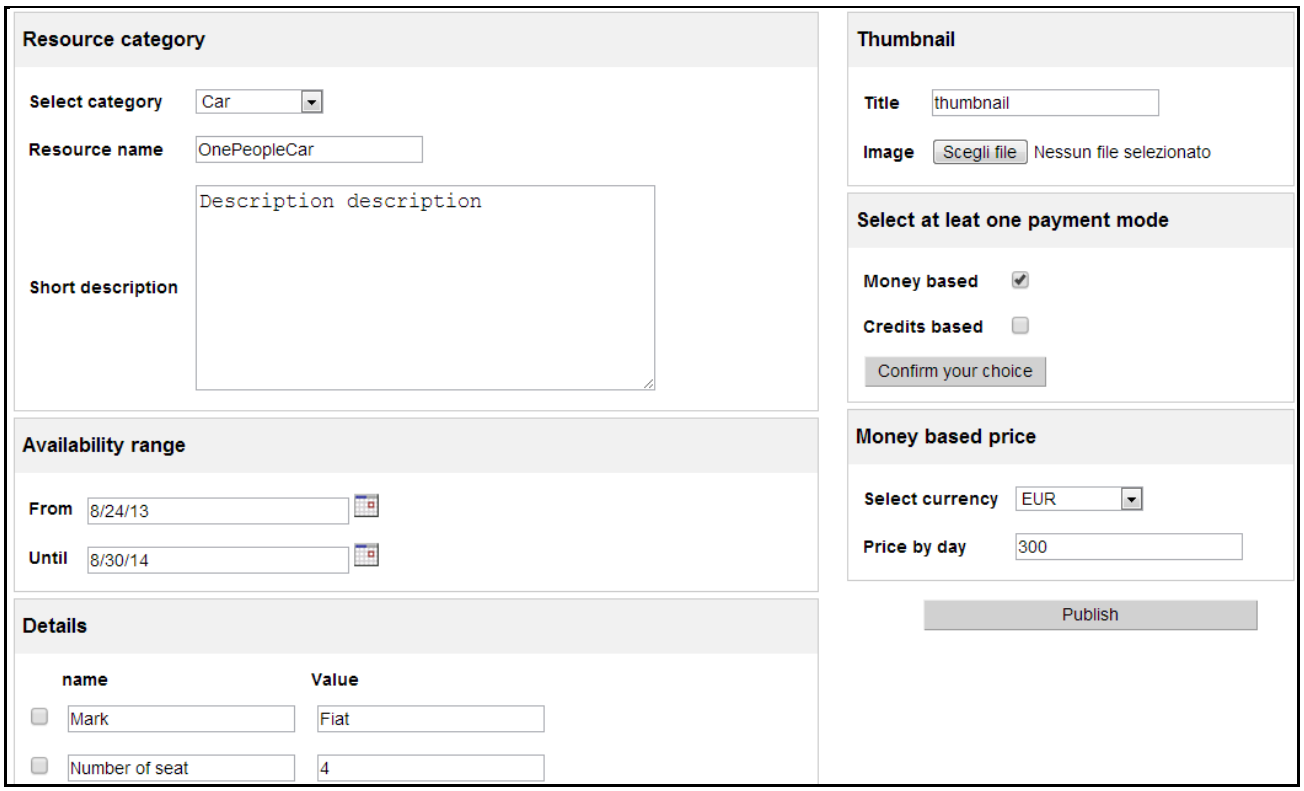


Figure 4.2 Resource configuration page

Manage request

The manage request page allows to the resource owner to check up the bids from customers and to decide to whom grant the resource. This page contains three main area :
One showing the details of the request . Each request is characterized by :

- issue date , this specifies when the request has been created;
- start date: from when the user intends to use the resource;
- end date: the expected date of release of the resource;
- approved : a flag which shows the status of the request approval.

The second area contains useful information about the requester.

The third area is for the details about the requested resource. The information provided in this area are as a reminder for the resource owner to help him to make decision.

The resource owner grant or reject the request by clicking on the button "Approve request" or "Reject request" accordingly. The link back to requests allows the owner to return to the list of pending requests.

The following figure shows the look of "manage request" page

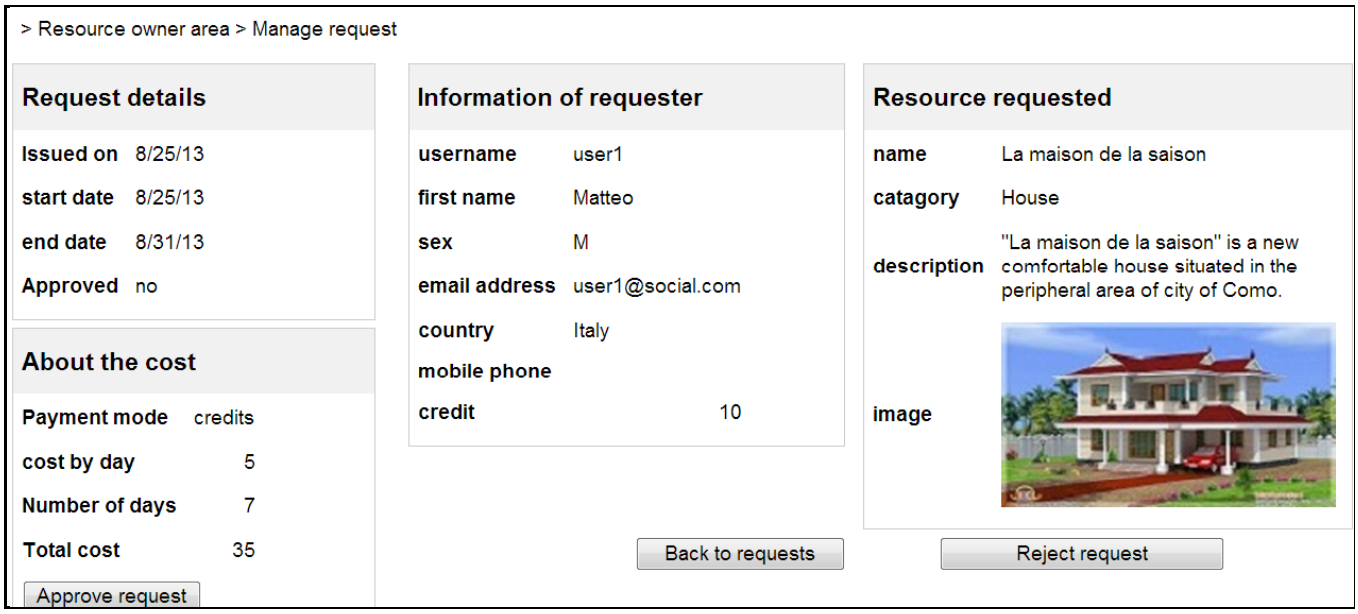


Figure 4.3 Manage request page

My resource

My resource page is the main page of the resource owner sub-area. It contains the list of all resources owned by the logged user. From this page, the resource owner can see the details of his resources, make some modification on resources. In addition, for free resources, the application allows the owner to delete the resources from the list of his shareable resources. Each resource on the list is characterized by

- resource name;
- resource category: the category referred also as type in this thesis;
- start date and end date: the slot of time in which the resource is available for sharing purpose.

The resource are grouped by their category and sorted by name.
Resource user area contains all pages related to general tasks that can be performed by every registered user. This area contains five main pages: ” Rent resource page”, ”Resource requests page”, “Comment used resource page ”, “Comment the owner page” and “Resource category proposal page” are described in the following paragraphs.

Rent resource page

Rent resource page is the entry page of resource user area. It allows the user to search among available resources and formulate the request for a selected resource. Searching is done by resource’s name or by the category of the resource if the user doesn’t know the name of the resource a priori. The resources’ usage calendar is used in the process of availability searching. This calendar is updated every time the resource is granted.

Rent resource page contains two main area: the first one shows the list of all resources. Each resource in that list is characterized by its name, thumbnail and the availability range. The second one is advanced searching area which contains two searching forms.

The first step on renting a resource is the identification of the resource and a slot of time the user intends to use the resource. On this phase the user chooses the resource category or the name of the resource if known and specifies the expected starting and ending date.

The user will then choose the resource he want to use among those which are free on the specified period. The application allows user to see details of the resource including recessions from the community.
Finally when the user confirms he intent to rent the resource, he is led to “make request page”. This page is considered as a confirmation step. It contains the details of the request and the general information of the resource owner. Make request

page allows the user to provide additional information like the payment mode he prefers.

The request is concluded by clicking on dedicated button ”Send request”. At this point the user waits for the response from the resource owner.

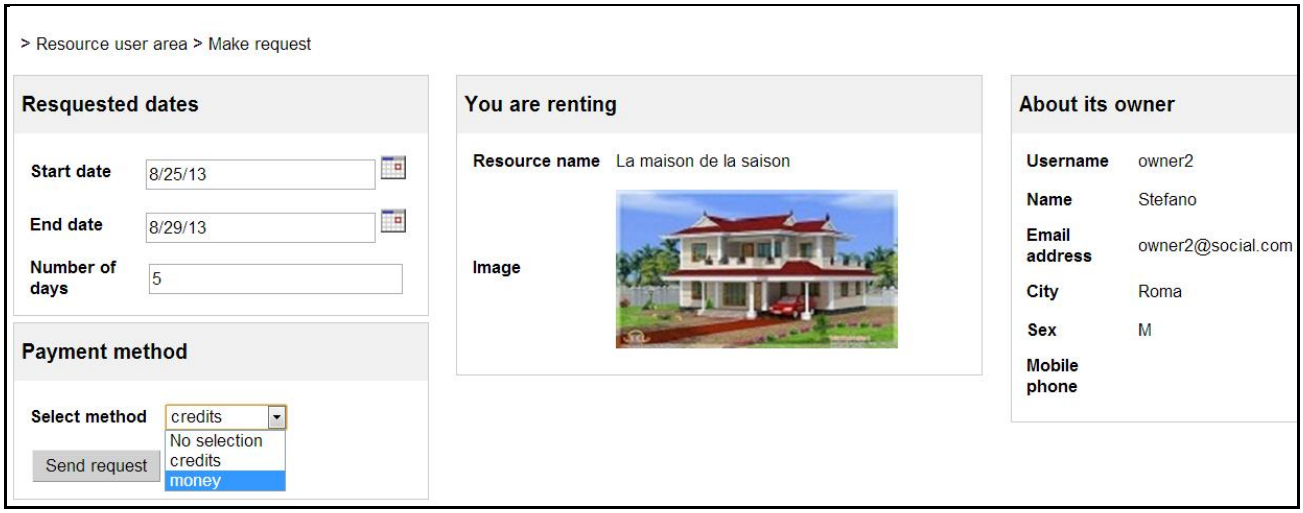


Figure 4.4 Make request page

Resource requests page

Resource request page allows the user to monitor his requests. It contains two area. The first one contains the list of all requests of the logged user.

Each request is characterized by:

- the name of the requested resource;
- date of last modification(It coincides with the issue date if the resource has not been modified);
- start date: the date on which the user intends to start using the resource
- end date: the date of resource realise
- approved : if a flag showing if the resource has been granted(used) or not;
- and the link “details” which leads the user to the details of the selected request.

The second side of resource request page contains a list of pending requests(requests for which the user has not yet received the exit from the owner).

Following the link "modify" of a resource the user can update the request by changing some details.

Resource request page allows also the user to delete the requests not yet managed.

Comment resource page

Comment resource page is the page which allows the user to express his judgement on the used resource. It contains three main parts. The first one is an history of past comments. This list allows the user to see what other users said about the same resource he is commenting on.

Each comment is characterized by :

- issue date: showing when the comment was written
- a flag "positive". It is a mandatory field which will help to track quickly the purpose of the comment. The "yes" value of this field means that the user have somehow liked the resource;
- title of the comment;
- text : the body of the comment.
- Author of the comment.

The second part contains a form to make a new comment on the resource.

The last part of resource comment page provides the details of the selected resource to remind the user the resource is commenting.

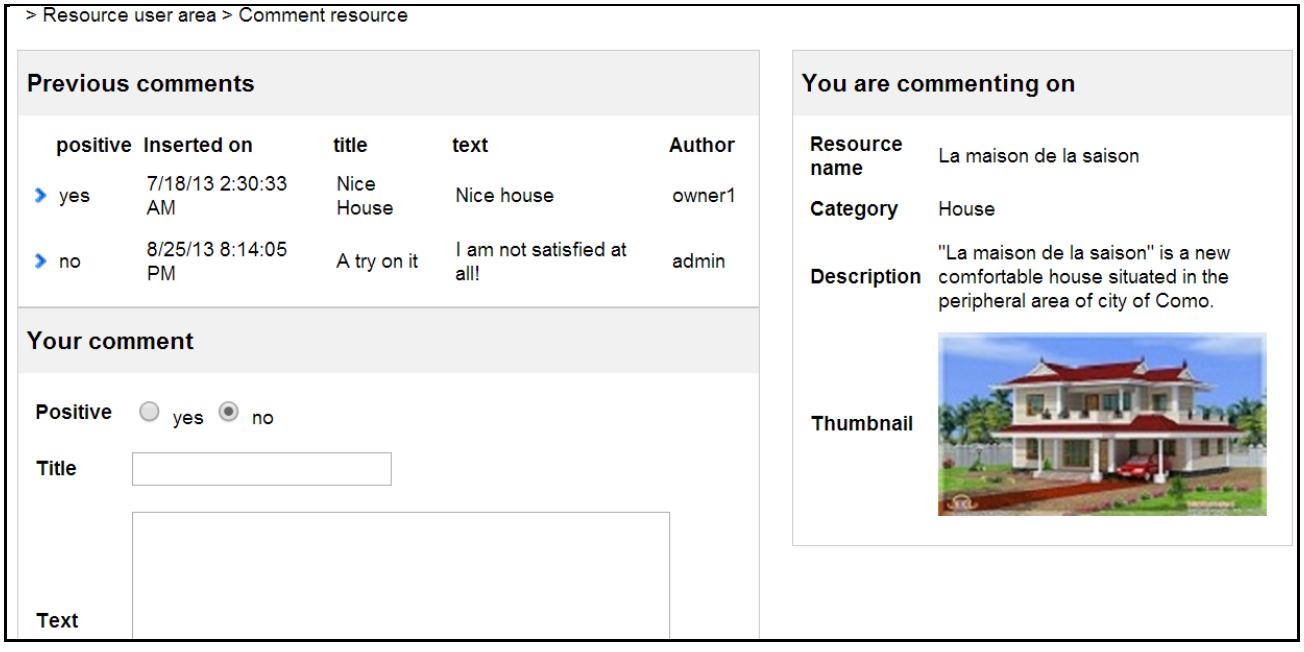


Figure 4.5 Comment resource page

Comment owner page

Comment resource owner page is the page which allows the user to express his opinion on the owner of the resources he used. It contains three main parts. The first one is an input form which allows the user to write down his comment. The second part of this page contains the list the comments related to that owner. This list allows the user to see what other users said about the owner he is commenting on. The last part is a reminder for the user. It contains information about that owner.

Resource category proposal page

Resource category proposal page allows the user to participate in resource type(category) definition process. The proposed category is managed by the Administrator. The application administrator can ask opinions of other users about the proposed resource type by using for instance the voting procedures which involves the social networks like(Facebook , Twitter, etc). If the outcome of the voting is positive the proposed resource type is added to the list of sharable resources supported by the platform and it becomes visible to other users.

To enhance the visibility of that new supported category, the administrator can notifies the community by posting that fact on the social networks of his choice.

The resource type proposal is done in 2 steps. The user chooses the name of the type(for instance computer). The second step is related to the definition of the main characteristics of the proposed type. This step consists on choosing the appropriate name of the characteristic(attribute) and assigning the proper data type to that attribute. For instance the attribute called “name” should be of type “string”.

The following figure shows the details of a proposed resource category. From this page the user can modify his proposal, add new characteristics or delete it if needed.

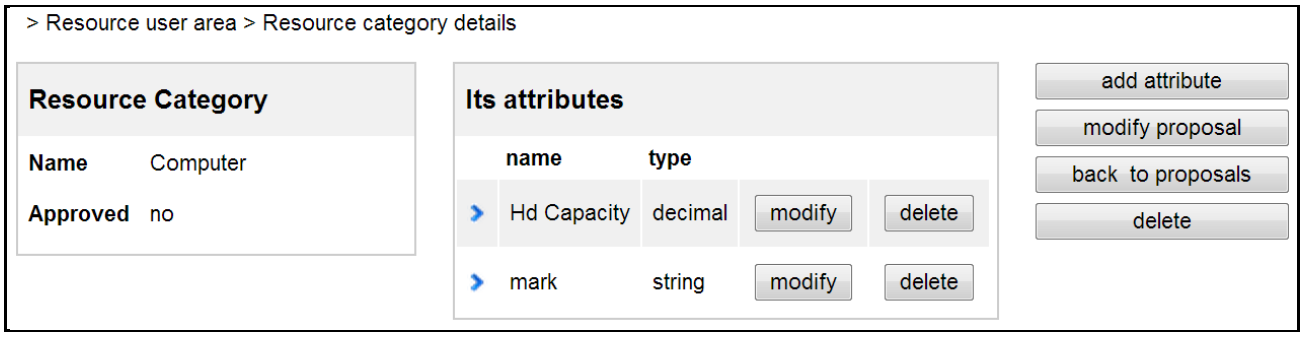


Figure 4.6 Page of details of the new proposed category.

4.3.3. Administration view

The administration view is a reserved space in which an administrator of the application sets the functional policies for different categories of users. This view contains also the pages through which the administrator defines the types of resources that can be shared on the application; approves/rejects new resource types proposed by other users; and manages the users subscriptions.
The main pages of this view are ”Manage users page”, “permission assignment page” and ”manage resource category”.

Permission assignment page

Permission assignment page allows an administrator to assign to the groups of users the permission to access the reserved area of the application. In this application three groups of users have been identified: resources consumers; resources owners and administrators of the application.
The administrator selects firstly the group and then chooses the modules he wants to assign to that group. This page allows also to un assign permissions to a group if needed.

The next figure shows the permission assignment process.

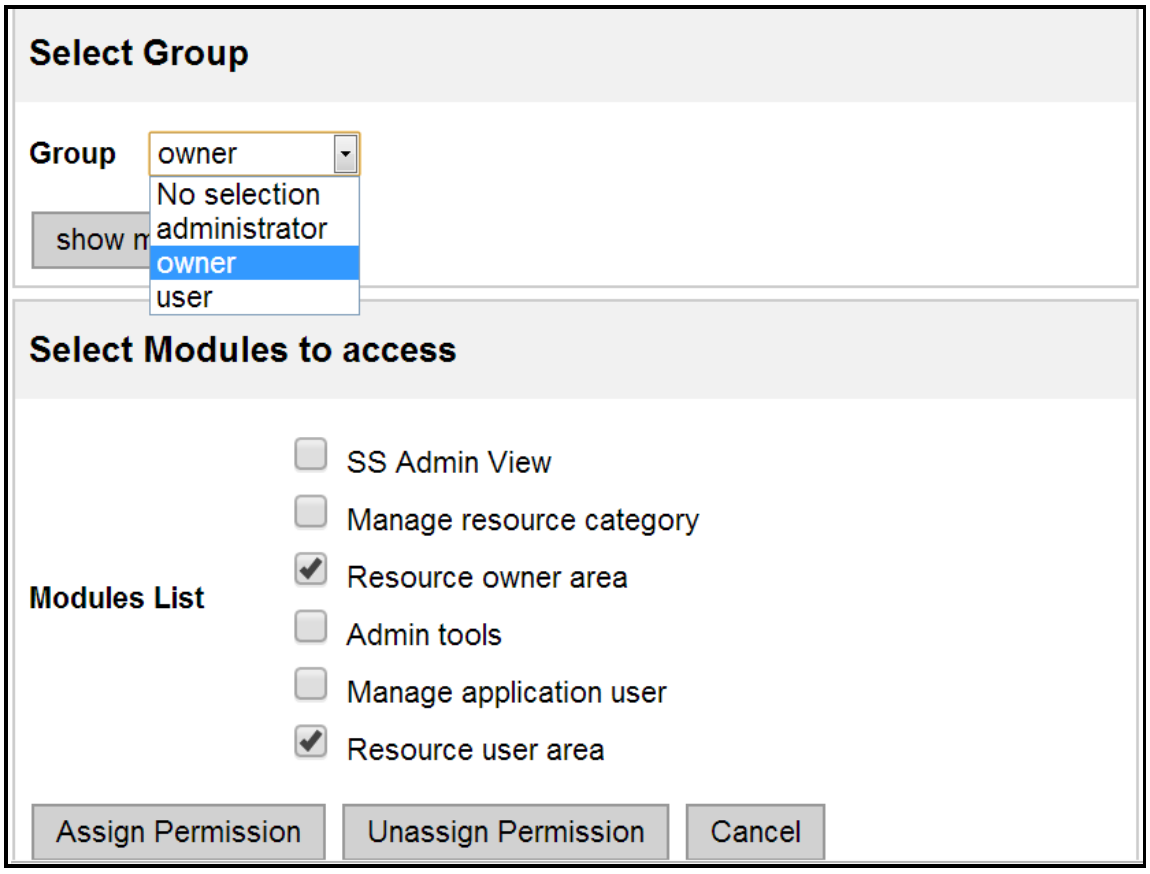


Figure 4.7 Permission assignment page

Manage resource category

Manage resource category page regroups all functionalities which allows an administrator to manage the resource type proposals made by other users. This page is divided in three main parts. The list of proposals to be managed. Each of them is characterized by :

- name: the name of proposed resource type/category;
- approved : a flag containing the status of the proposal. The value "false/no" means that the decision(acceptation or rejection of the proposal) must be taken by the administrator ;
- author : this field contains the name of the user who proposed the type. For each proposal, the application keeps trace of its author. In the social context every useful participation could contribute to enhance the sociability level of the user.4

To express his decision, the user clicks on proper link. By clicking the link approve, the administrator is led the page "category approval" which allows him to approve the proposal as it is proposed or to approve it with modifications. The modifications could come from the opinions of other users gathered through social networks.

The second part contains the list of supported resource types (categories of sharable resources). This list helps the administrator to not approve the proposal having the same characteristic to an already supported type. Each type is characterized by its name and contains the link that leads to its details.

The last part of the page "manage resource category" contains a form which allows the administrator to create an resource type. The types created by an administrator are by default approved.

The following figure shows the main functionalities "manage resource category" page.

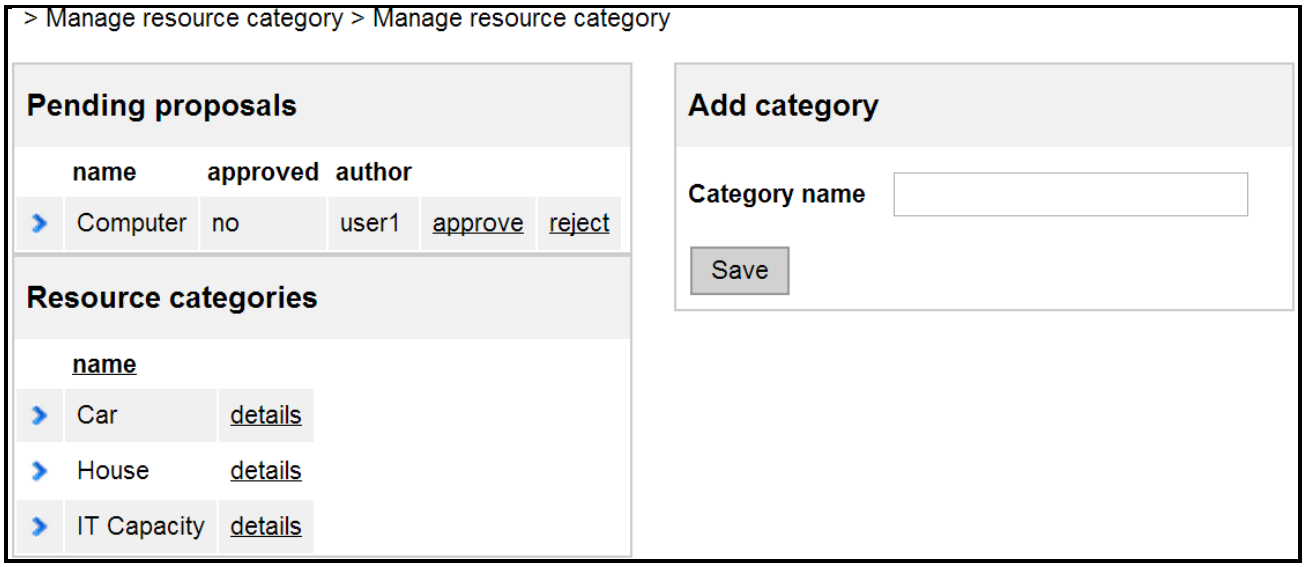


Figure 4.8 Manage resource category page

5. Conclusions and Future Developments

5.1. DISCUSSION

The goals of the presented work were to provide techniques that integrate social practices with enterprise systems with the aim of improving the efficiency in organization.
The integration techniques proposed in this work require the use of systems which allow the integration of several tools in order : 1) to improve the communication within the enterprise and towards the stakeholders; 2) to track the main changes in resource management; 3) to improve the knowledge sharing and the transparency of the decisions. In particular those techniques require the implementation of a system which encourage the users to participate in the organization in order to make right decisions (based on the user's knowledge and experiences).

Specific integration techniques related to the resource management systems have been provided. By integrating the social sharing practices with enterprise resource management systems, those techniques could provide good results reducing time between the identification of the need of a specific resource and its acquirement.
Automated resource sharing based on accessed data object using: resource monitoring mechanisms (to track the state used resources) ; lookup the object accessed by a specific process and a share-ability checking system (to decide whether a resource is better for sharing practices) allows the organization to automatically share or acquire resources which may result in an abnormal state.
Sharing based on pattern recognition. By reading the sharing map(association of sharing activities to patterns) produced at process design time, the integrated system is able to execute the sharing tasks associated to each sharable resource of a recognized pattern.

This work has discussed also the needs to have the social practices on mobile devices and provided a set of best practices to be considered during the design of mobile applications in order to better exploit the conveniences offered by those devices taking into account the confirmed power of social networks.
Due to the smallness of their screens the design of mobile application must have a clear orientation which can be "a reduced version" of the full application or "a goal oriented" application. This will lead the designer to focus his attention on the quality and the organization of information provided to the user.

The social capacity sharing application which combines together to the practices of social sharing with resource management system had been implemented to validate the proposed techniques. The implementation is done in WebRatio model-driven-engineering framework which permits to design a web application modelling its data and the different site views. The Java code is automatically generated, letting the user develop and quickly modify an application.

5.2. FUTURE DEVELOPMENTS

This work proposes techniques that could increase the efficiency in organization if well implemented into Enterprise Systems. One of possible future development is to start from these techniques and try to implement them for a real organization.

The proposed techniques do not cover all the possible area that could be considered in order to enhance efficiency in organizations.

Another future development could be the optimization of the techniques proposed in this work. These optimizations can be related for instance to the choice of data structures to use in real implementation of the proposed techniques.

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