# Designing and Implementing a Web Platform to Support SMEs in Collaborative Product Development

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Marco Formentini, Michela Lolli, Alberto Felice De Toni

Department of Electrical, Managerial and Mechanical Engineering
University of Udine
Via delle Scienze, 208, 33100 Udine, Italy
{marco.formentini, michela.lolli, detoni}@uniud.it

**Abstract.** Research on the product development process lacks of investigation on the aspects related to its potential integration in a web-based collaborative environment, especially when considering the practical needs of Small Medium Enterprises (SMEs).Our study aims at investigating how is it possible to design and develop a web-based platform aimed at supporting SMEs in the product development process. On the basis of a thorough literature review and a mapping of the existing platform and tools available in the design domain, this paper describes in detail the development of a ICT platform, called iCommunity, which constitutes the backbone and the foundation upon which to build an ecosystem of innovation, that helps SMEs to: (1) manage the distributed collective intelligence in the new product development; (2) design and develop modular products in a collaborative way. The action research methodology has been chosen for its appropriateness to the characteristic of this study.

**Keywords:** Product development, Collaboration, Web platform, SMEs.

## 1 Research context

Since the rise of the "open innovation" concept [1], much has been said about the benefits that companies may gain by opening up their innovation process. According to the open innovation paradigm, firms have the possibility to explore new sources for innovation, through an "inbound openness", with the aim of capturing technologies and ideas originated outside the organization's R&D facilities, and transfer them into the company. The underpinning concepts of the open innovation paradigm, which can be summarized in the exchange of ideas, interaction with external partners and new forms of collaboration among the actors involved, may be contextualized in another paradigm, that emerged in the digital domain in the same years of the spreading of the open innovation: the rise of Web 2.0.

With the "new" web applications able to facilitate collaboration, knowledge sharing and engagement among the users, the Web 2.0 has immediately represented an improvement in respect to the Web 1.0, characterized by a static use by the users

without the possibility of interaction, and an opportunity "to harness collective intelligence" [2].

It appears clear how the web has straightway signified for firms a valid enabler to the open innovation practices. In the literature, we can find relevant contributions that depict the prominent role of the web as an intermediary for innovation: Sawhney et al. illustrate the communities of creation [3], and in particular the role of Internet as a platform for a valuable collaborative co-creation with customers. Pisano and Verganti propose four way to collaborate in the context of open innovation [4], two of which are made possible by the presence the web. Boudreau and Lakhani propose two ways to organize external innovators [5]: *collaborative communities* vs. *competitive markets*, putting in evidence how the former are driven by cooperative relationships, while the latter tend to have competitive relationships among one other.

In this context, virtually no company should innovate in an individualistic and independent way: "the new leaders in innovation will be those who figure out the best way to leverage a network of outsiders" [4].

## 2 Criticalities for SMEs in the collaborative innovation environment

Specifically, the present research is focused on a significant gap that regards the context of Small and Medium Enterprises (SMEs): while Internet technologies are applied more widely by the large organizations to facilitate collaboration in the trading activities, in the learning, studying and managing of business processes, or in the services providing, there are significant barriers to the diffusion of e-business and advanced web applications in the context of SMEs. Companies, especially SMEs, that want to adopt a collaborative approach have not yet developed innovative application tools and well-established methodologies. More specifically, some of the SMEs key needs in the field of collaborative innovation may be summarized as follows:

- have a closer proximity and accessibility to cognitive diversity, and have the ability to connect directly with other industries or with the final users, in order to collaborate on innovation practices;
- be guided to realize the possibilities to access knowledge, for learning how to build an own innovation and social capital: "the collective capacity of a firm to innovate";
- be helped to identify future emerging trends and technological-economic discontinuities, structuring a network approach with others, that permits to capture the "weak signals";
- be supported in the managing of technical and creative approaches during the developing of ideas for new products and services;
- be helped to reduce market risks associated with investments in innovation and R&D, through the development of outside networks of intelligence which result in feedback from users and from the market;
- be driven to improve the design and product development process, in order to receive suggestions and co-develop a product or a service.

In particular, focusing on the latter aspect, there is limited research on how web communities can positively impact the product development process of SMEs. One interesting study in such context is offered by Pritchard et al. [6], who describe the effort of a group of Singapore SMEs to cooperate and set up a partnership to carry out product development in a design chain, through a set of tools which assists SMEs to quickly and profitably bid for and carry out early development of a major sub-section of a new product. This project is focused on collaboration during the early phases of product development, and people augmentation, not replacement, by enhancing natural communication and creativity.

Therefore, our research is directly linked to these recent areas of study, and aims to deal with them through an operative and functional approach in order to match the needs of SMEs.

## 3 The product development process in the context of collaborative innovation

The product development process lacks of investigation in the aspects related to its integration in a web-based collaborative environment [7] especially when considering the context of SMEs. Thanks to a literature review and a mapping of the existing solutions, we were able to shape a comprehensive "state of the art" of portals and tools, as described in Table 1.

*Portals* allow communities to interact through basic design environments. They provide different services, often in a crowdsourcing modality. Existing examples are several and heterogeneous, that we grouped into three main categories:

- *Innovation marketplaces* support companies in their R&D problems through innovation challenges. Even though the innovation seekers may be any type of companies, these challenges are mostly powered by large organizations, in spite of SMEs. The support given by these portals is limited to the initial phase of the R&D and innovation process, when seekers need to find proper solvers, but platforms usually do not sustain companies in the product development process.
- *Creativity hubs*, as the innovation marketplaces, use contests to match seeker and solvers, but in this case to support creativity instead of innovation. Their aim is to create ad-hoc and spot collaboration between organizations and creative designers. As before, they do not to sustain the entire product development, but the focus is instead on the resolution of specific design problems.
- *Distributed factories* are the place were advanced manufacturing technologies, such as 3D printers, match with the Web 2.0; they offer a world-wide prototyping and manufacturing service integrated with on-line CAD-CAM tools.

More than 50 standalone *design tools* were identified and analyzed. These tools range from simple open source web-based tools to commercially available desktop-based tools. The most popular tools regard established design and product development techniques such as QFD, FMEA and TRIZ methodologies. These tools help firms to manage specific issues throughout the phases of the product development project.

**Table 1.** Mapping of portals and tools

| Typology | Category | Examples | Gaps |
|---|---|---|---|
| Portals | "Innovation marketplaces" | ▪ Innocentive<br>▪ Hypios<br>▪ NineSigma<br>▪ Idea Connection<br>▪ Innovation Exchange | ▪ Challenges are mostly powered by large organizations, in spite of SMEs.<br>▪ Support limited to the initial phase of the R&D and innovation process. |
| | "Creativity hubs" | ▪ Crowdspring<br>▪ Idea Bounty<br>▪ 99Design<br>▪ Choosa<br>▪ Zooppa<br>▪ BootB<br>▪ Threadless<br>▪ Quirky<br>▪ Logo Design Team<br>▪ wooshii | ▪ Ad-hoc and spot collaboration between organizations and creative designers.<br>▪ The product development process is not entirely supported, since the focus is on specific design problems. |
| | "Distributed factories" | ▪ Ponoko<br>▪ eMachine Shop<br>▪ Shapeways | ▪ Focus on the last part of the product development process (i.e. prototyping and manufacturing phases). |
| Standalone tools | "Online tools" | ▪ QFD Builder<br>▪ Gliffy's SWOT Analysis<br>▪ Sunglass.io | ▪ Lack of connection with other tools or portals<br>▪ Need of tutorials to support new users (especially SMEs) in the methodology implementation |
| | "Desktop-based tools" | ▪ FMEA Facilitator<br>▪ Autodesk Design Review<br>▪ Acclaro DFSS | ▪ Lack of connection with other tools or portals<br>▪ Risk of creating "isolated" documents<br>▪ Limited interaction |

Considering the main gaps of the analyzed tools, they are mainly developed with an internal focus to the firm, in other words they typically allow only the interaction between designers of the same company, which are located in different production sites, through a web-based client-server.

Moreover, the main solutions integrate tools, such as Computer Aided Design and Manufacturing (CAD/CAM) and Virtual Reality, or key elements of a single stage of the product development process, focusing mainly on the prototyping phases, which are generally located at the end of the product development process [8]: the

development of tools that facilitate collaborative interaction of various technical, planning and managerial skills and competences in product development must also take into account the upstream stages of the process, namely the concept generation, the functional analysis and the product improvement, allowing to analyze aspects related to cost reduction, functionalities improvement, thus enhancing the overall quality, safety and sustainability of the product.

Furthermore, a comprehensive tool requires an "external" perspective, in which not only internal designers, but also other skills may be involved in the process, embracing the paradigm of "open innovation" and following the evolution of the traditional web towards the perspective of Web 2.0.

In this context, companies should leverage on some key elements such as trust users as co-developers intended to link the various sources to connect [2].

Therefore, the evolution of the product development process in a web-based application for the development of Collective Intelligence must take account of the opportunity to integrate seamlessly some established methodologies used in the traditional product development process, although they have not been explored for possible implementation within a web platform.

## 4 Research design

In order to address these research gaps, our research aims at investigating how is it possible to design and develop a web-based platform aimed at supporting SMEs in the product development process. The objectives of our study are twofold: to select the tools and methodologies that can effectively contribute to product development in a web-based environment for collective innovation on the basis of practical user needs within SMEs, and to adapt them seamlessly within a ICT platform.

The action research methodology [9] has been chosen for its appropriateness to the characteristic of this study, since the main research objective is investigating the development and the implementation of a collaborative web platform aimed at supporting SMEs in the product development process. The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7-SME 2008-2) under grant agreement no. 243593, project COLLECTIVE – "Emerging communities for collective innovation: ICT operational tool and supporting methodologies for SME Associations".

Action research may be defined as an emergent inquiry process to solve real organizational problems, simultaneously bringing about change in organizations and adding to scientific knowledge [10]. In fact, this methodology entails the active participation of researchers in a change process [9]. For this reason action research is appropriate when studying the development of a collaborative web platform, as actually happened in our study.

As usually happens in action research, the platform we developed emerged from iterative cycles of data gathering, feedback, analysis, action planning, implementation and evaluation in close interaction with SMEs and other research institutions involved in the research project.

## 5 Platform development

The developed ICT platform, called iCommunity, which constitutes the backbone and the foundation upon which to build an ecosystem of innovation, especially tailored to fit SMEs needs, allows to:

- manage the distributed collective intelligence and creativity in the new product development process in order to find new product ideas and its business model;
- design and develop modular products in a collaborative way, reducing the market risk from the time when significant input and feedback from customers and users become an integrated component with the overall process design.

The focus of the research was also to include selected design methodologies (e.g. FMEA, FAST diagrams, Value Analysis, QFD, etc.) on the basis of practical SMEs user needs, and to adapt them seamlessly within the iCommunity platform. Based on the needed functionalities within each of the product development phases, supporting design methodologies were selected and included in the form of desktop or web-based tools to enable complex design performance. This was done by adding methodologies related tools to a specific functionality within selected design phase. The aim was to assist future users of the platform and propose a specific methodology when dealing with specific design domain functionalities in the platform. In this manner, the platform supports the users during the whole design process, thanks to the integration of methodologies and tools, thus filling the gaps detected in our mapping (Table 1).

Design methodologies may add complexity to the design process, especially when considering SMEs that could not have developed structured design and product development competences: in fact, during the action research process, less than five per cent of the SMEs involved in the research project answered to our questionnaires that they are familiar with any of the design methodologies. Therefore, it was crucial to include less complex tools or partial tools that do not support a specific methodology as a whole but only answer problems related to specific functionality of the design domain.

Moreover, tutorials for implementing methodologies and tools are available within the platform: users can choose interactive video based lectures (e.g. PPT slides) and PDF descriptions. To support SMEs users, an overall guidance is also provided to explain the navigation across the whole design workflow.

Users can choose the methodologies, tools and related tutorials as “blocks”, in order to structure the workflow across the whole design process, modeled on Cooper’s Stage-Gate model [8], as represented in Figure 1: among the main platform functionalities, when entering a new product development/product improvement project, users can configure the workflow on the basis of their needs.

The project initiator can also choose collaborators from the platform users’ network to involve them in the project and review activities after each design stage. Thanks to a semantic engine, the platform also suggests to the users potential workflows, collaborators and resources, on the basis of the information given at the beginning of the design process in the inception phase.

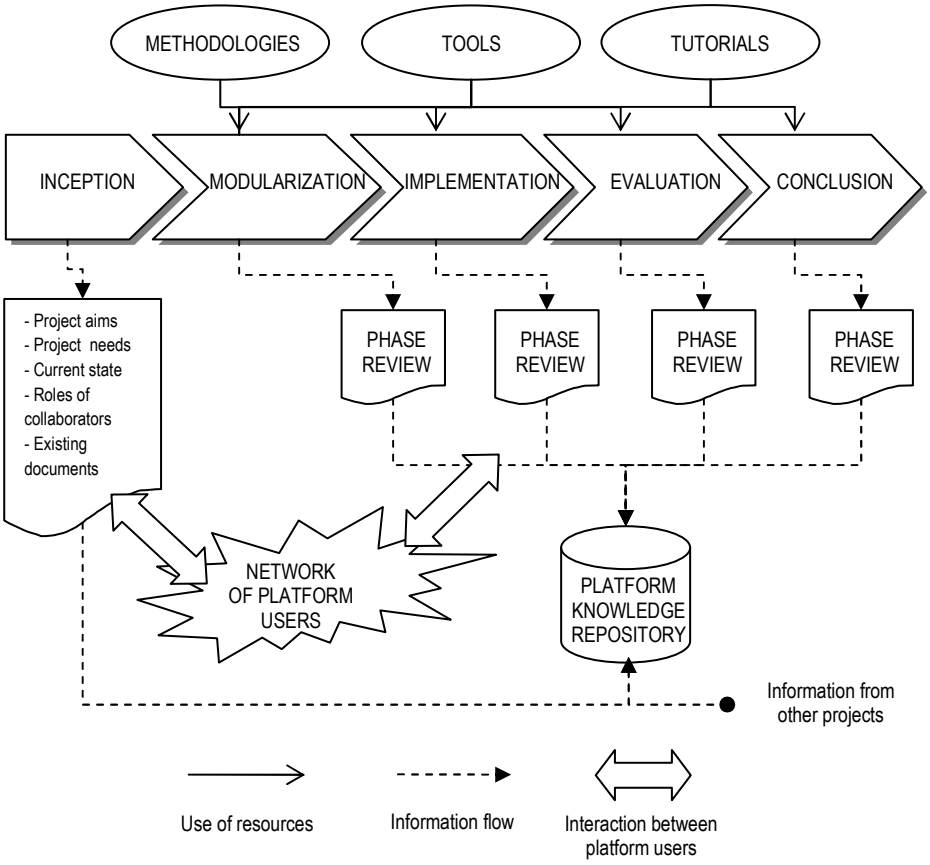


**Fig. 1.** Design process workflow

Moreover, data and information created in the whole design process can be stored and retrieved in the platform knowledge repository for future projects to allow knowledge transfer and reuse across different projects, which has been highlighted as a common pitfall in product development research [11].

## 6 Conclusions

From an academic perspective, our research contributes to the product development research stream with innovative insights in the context of collaborative innovation and web-based platforms, by offering:

- A classification of the "state of the art" of portals and tools that can support the product development process;

- A critical analysis of the methodologies and tools identified on the basis of SMEs target-users practical needs and of the identified trade-offs (i.e. usability, cost, time) for their subsequent introduction into the collective innovation platform iCommunity;
- The modeling and adaptation of the tools chosen for their inclusion in the design workflow within the iCommunity platform, in order to fill the previously described research gaps.

Focusing on managerial implications, the development of the iCommunity platform represents an important opportunity for SMEs to effectively support their product development process.

Future developments of the study will be focused on the complete validation of the platform in order to measure performance improvements in the product development process of the involved SMEs with a longitudinal perspective: the vision for the future is that the iCommunity platform will become a forum of research and development for innovation. The citizens of this *agorà*, fueled in particular by universities, software developers, experts, consultants, are associations and SMEs and their staff, but also visitors to the web, the "external" world.

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