Chapter 2
Socially Embedded Technology: The Pathway to Sustainable Product Development

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2.1 Introduction

The design of IT artifacts has been focused for the past 50 years on delivering products that serve the needs of a particular set of end users. User-centered design methods relating to the design of IT artifacts have evolved in both the academic context, in fields such as HCI, and in the commercial context. Both share a common commitment to the analysis and understanding of stakeholder requirements. The underlying rationale of such methods was that there exists a "perfect" design solution for supporting a given set of use cases and that the shipped design should reflect this as much as possible to guarantee product success.

However, with the emergence of mobile technology, Web 2.0 networked solutions, and semantic technology, this simple design equation has been problematized. Today's consumer applications actively connect users and their knowledge in order to seed highly engaged user communities and leverage the wisdom of the crowd. Such social applications are not stable by definition and require continuous adjustments and improvements to stay in sync with their respective communities. The design focus of these next-generation products goes well beyond designing for a single user interacting with a single system.

This paradigm shift also penetrates into large enterprises in terms of new demands for running their business. Besides high productivity and efficiency, enterprises must also pay attention to their agility to implement change and to respond to novel market opportunities or disruptive technologies by adapting

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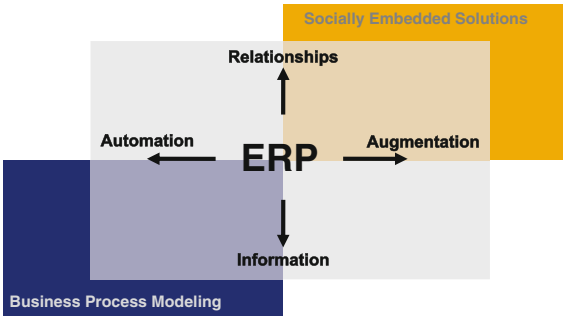

Fig. 2.1 Business process modeling vs socially embedded solutions (inspired by Schrage 2005)

business processes or changing entire business models. While service-oriented software architecture is an important enabler for quickly reorganizing the technical support of business processes (Dörner et al. 2009), the most dramatic change happens on the side of the end user. IT departments, previously specializing in automating business processes with the help of standard ERP software, are now aiming to provision knowledge workers with modern consumer-grade productivity tools which are conducive to decision making in the concrete contexts of particular business situations. Fundamentally, this extends the charter of IT departments in large enterprises from enabling and automating business processes to also augmenting people's work (Schrage 2005) (Fig. 2.1).

The ERP market is drifting from a monolithic process enablement approach to a hybrid approach which involves empowering a network of users to accomplish collaborative business tasks. This shift from a mechanical-object ethos to an organic-system ethos (Dubberly 2008) forces ERP vendors to enable new consumption patterns and channels in order to allow users to contextually access relevant business information and share outcomes with other colleagues. This in turn forces IT departments to adopt a more user-centric approach to adapting standard software since the system design must be tailored to the situational needs of the end user and not just the functional requirements of a user-agnostic business process model. This is a fundamental change and in line what Dubberly describes as the shift from an expert-driven approach to a more user-centric approach, which in case of generative tools becomes a participatory design approach aiming at enabling users rather than canonically imposing a standard solution (Sanders 2008).

This notion of social embeddedness implies a bidirectional interaction model forming a symbiosis between the IT artifact and its context of use. To reach this level of immersiveness and adaptivity, the design of the IT artifact cannot anymore be considered to remain static after deployment; rather, it needs to be conceived as elastic and flexible to evolve over time during its use. This notion of sociotechnical information systems (Taylor 1998) and design for appropriation and continuous change (Fischer and Giaccardi 2006) has been—of course—the focus of many academic publications and involves various research streams, design theories, and case studies. However, this eclecticism of method and theory makes it difficult to apply to industrial product design (Wulf and Rohde 1995).

The mission of the newly founded European Society for Socially Embedded Technologies (EUSSET) is to bring together research streams that inform the design of such sociotechnical systems and help to understand the dynamics of adopting and using IT artifacts beyond the simple interaction with a static user interface. As such, EUSSET is a catalyst for existing research results, but also aims to drive new research topics focusing explicitly on the design of socially embedded technology (Wulf et al. 2011).

2.2 Products That Transform Life

In the end, all products are socially embedded since they are used by one or several people. The analysis of social context is already the "best practice" of most user-centered design methods. Spearheaded by Contextual Design, the modeling of stakeholder networks (the role model) and socially defined motivational factors (the cultural model) became industry standard for understanding task domains (Beyer and Holtzblatt 1998). So, what is EUSSET adding to the equation?

EUSSET is the response to the extended and systematic demand in the IT industry to understand thoroughly the context of use of its products. There are a number of industry trends that all demand a deeper understanding of the interaction of IT software solutions with larger social systems and they are as follows:

Extended reach: With new cloud technology and the extended functionalities of mobile devices, virtually all users in all contexts can be reached at all times. Software vendors can inject IT artifacts into private life at home, at work, and in public. Software vendors try to invent products that quickly become part of daily practices in an increasingly ubiquitous way. The pressure to innovate and penetrate into those contexts requires the industry to think about how to address IT artifacts that support existing practices or even seed new practices. Many times, those practices are interwoven with social networks. In private life, these networks normally implicate family members, friends, and partners. At work, in contrast, solutions have to address social processes within formal and informal team structures and the dynamics of communities. Designing for one user alone feels outdated.

Ubiquitous computing: With more processing capabilities and the ability to seamlessly adjust to environmental conditions, IT artifacts can be fully integrated into everyday environments and activities. This level of integration is only possible if the functionality is coherent with the situation of use. Often such IT artifacts are equipped with sensors and machine learning algorithms to learn over time and automatically adjust to idiosyncratic preferences and patterns of use.

Viral spreading: Since Web 2.0 demonstrated how products can seed and serve large social networks, the identification of principles that facilitate the viral spreading of applications has been the focus of a number of case studies. As viral spreading takes place within the social context of the product use, the analysis of this

context and the instrumentation of social relationships becomes an important accelerator for product adoption. Optimizing the "coolness factor" turns out to be a profitable design goal to improve product attractiveness and user acceptance (Holtzblatt 2011). As coolness is a subjective quality that is primarily defined by the social value system of users, it becomes obvious that the design focus extends from the user interface to the overall product performance within a larger social context.

Mass adoption: Taking successful Web 2.0 solutions as the reference, many software vendors aim for mass adoption of their product with high degree of "stickiness" and significant network effect. The product must resonate quickly with users and create a demand pull due to coolness and/or relevance. As such, the product experience and go-to-market approach must be optimized to resonate with users and allow for quick and risk-free adoption in various contexts.

Social entrepreneurship: With the trend to social responsibility and sustainability, the success of products is not only measured by their profit and market performance but by social and environmental goals. The recognition of a social problem and the achievement of social change are the ultimate goals. The IT artifact is only a tool to achieve this overarching goal and as such becomes a technical design component within a larger sociotechnical environment.

Behavioral change: While traditionally information systems are designed to support a given number of use cases relevant to an application domain or user persona, a new breed of applications emerges which attempt to change the behavior of a user for the purpose of education (how to save money), compliance (drug prescription), social responsibility (saving energy), or becoming a better sales person. This product aspiration inverts the design rationale of the system from passively supporting a fixed number of use cases to iteratively influencing the user's behavior by capturing knowledge about the user context, including social network information.

From those examples, it becomes obvious that the understanding of the interaction between IT artifact and the user and the larger social context is more relevant than ever. Understanding how a software solution fits into the social context of the target persona is essential, and the impact on the user's social environment is now often the primary design objective. This extends the design focus both in scope and in time since the adoption of the product and the appropriation to its context of use become important aspects of product performance (Fig. 2.2).

With the design focus being the interaction between context of use and the embedded IT artifact, understanding of the interplay between the two becomes important. Yet, information and knowledge about social systems is surprisingly fragmented across many academic communities like CSCW, intelligent user interfaces, MobileHCI, social computing, ubiquitous computing, and Web 2.0 conferences. This makes it difficult to gain understanding of how to design for social acceptance, ubiquitous use, and a mutual learning relationship between user and the IT artifact.

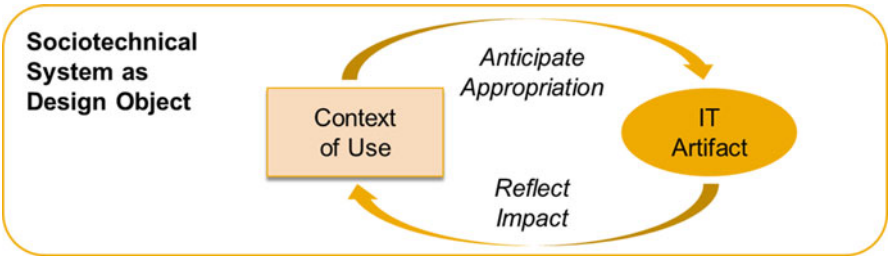

Fig. 2.2 Extending design focus in scope and time

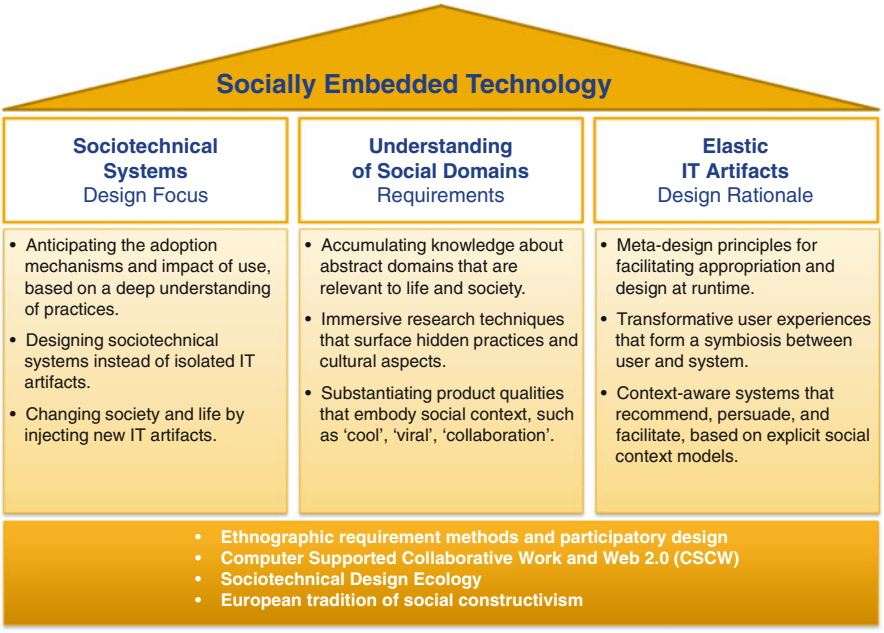

Fig. 2.3 Pillars of European Society for Socially Embedded Technologies

2.3 Pillars of Innovation

We believe that innovation socially embedded on technology and products is centered around three pillars (cf., Fig. 2.3).

2.3.1 Explicit Design Focus on Sociotechnical System

Built on the European tradition of social constructivism and participatory design, the policy focuses on designing for sociotechnical systems instead of conceiving of

information systems as isolated IT artifacts. A sociotechnical design approach goes beyond user-centered design by shifting the entire design focus from the IT artifact toward the entire sociotechnical system looking at how to design hybrid systems consisting of people and information systems. In many cases, the primary design objective might even not be the IT artifact at all, but the social system. Persuasive design and "gamification" are two examples where the behavioral change of users are the primary design focus.

The boundaries between goal-oriented application design and marketing-like tools that propagate certain behaviors are blurring. Healthcare applications helping users to be compliant to prescriptions or diets and sustainability solutions helping users to preserve energy and lower carbon footprint are two examples of products which aim to influence and seed human behavior. Whether for commercial purpose or for injecting desirable attitudes and behavioral patterns, persuasive designs assume a bidirectional force between the user and system.

2.3.2 Understanding Social Domains and Qualities

Designing for larger sociotechnical systems requires us, of course, to understand the social system itself. Domains such as healthcare, sustainability, aging, and communities of practice are becoming increasingly prominent target markets to design for. Such domains are rather abstract and difficult to understand since in many cases the design context is not just a concrete situation or use case, but rather an intangible concept like energy saving, diabetes, or economic wealth. There is a huge body of field studies and research about social systems that are written up as academic papers in a language optimized to serve an academic community and guidelines of scientific journals. By extracting key findings and summarizing key insights, they can become a reusable set of foundational insights about target domains. One task we need to set ourselves is to accumulate and synthesize knowledge from existing case studies to be able to anticipate the use and behavioral impact of new designs for a given social domain.

Designing for large social systems and working with abstract concepts that are difficult to observe and to operationalize mean that the suitability of research methods themselves become an interesting research topic in its own. Methods like participatory design and ethnographic field research seem to be essential for studying large sociotechnical systems. But their applicability and feasibility must be critically reviewed. For socially embedded technology, the monitoring of actual adoption and *use beyond the moment of first design* are important additional information resources for understanding the sociotechnical system. IT artifacts must be recalibrated if necessary to reach the right level of adoption or for the intended impact on the user or society. From community research we know that it is unrealistic to assume that a sociotechnical system can be designed and shipped. It rather has to be seeded and continuously adjusted in order to grow and become pervasive.

When designing for social embeddedness, the optimization of product qualities that relate to social adoption and use within social networks becomes a key design goal. Designing for coolness (Holtzblatt 2011) or viral adoption (Michael Weiksner et al. 2008) is an example of product characteristics which go beyond the traditional understanding of usability or user experience. A systematic approach can help us to better understand such social product qualities and to identify repeatable design principles. For example, the "gamification" of products to motivate users to engage and participate to user communities is such a product characteristic which can be potentially applied to any domain.

2.3.3 New Design Rationale

The ability of an IT artifact of continuously adapting to its own context of use as an intrinsic product capability is one of the most important innovation aspects of socially embedded technology. While traditional HCI assumes that design takes place upfront before shipping a product, newer constructivist design approaches such as meta-design and end user development suggest a distribution of power in the design process between design time and use time to support a continuous adaptation of the IT artifact to its actual context of use (Lieberman et al. 2006). The IT artifact is able to recalibrate itself to adjust to context of use.

While the empowerment of the end user to customize IT artifacts is one step toward this flexibility (Fischer et al. 2004), the challenging question is: how can we design IT artifacts that are intrinsically elastic with respect to their user interface and functionality? One of these examples is the transformational user experience paradigm which enables user interfaces to reflect situational user needs by allowing users to establish context and content at runtime in a fluid way (Latzina and Beringer 2012).

The process of continuous adaptation can be further supported by intelligent IT artifacts that are aware of the social aspect of their context of use and are able to learn from previous use. This requires the translation of sociotechnical systems into machine-executable models and the definition of external sensor information that helps the IT artifact to adjust to situational needs.

All three pillars of innovation are on top of existing foundational disciplines, but our aim is to bring together those various principles and enablers to converge to a product design approach that aims for elasticity and social impact in addition to task-centric feature coherence.

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