Community Based Innovation and Cross Industry Technology Acceptance

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Is Community Based Innovation a Tool for Cross Industry Technology Acceptance?

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Abstract:
Economic crisis impact on innovation strategy and on investment behavior causes reluctant innovative behavior and increasing innovation resistance. Decreasing technology acceptance and increasing assimilation gaps challenge marketing communication in B2B and B2C markets. Cross industry experience for smart grids, energy storage, wearable computing and smart textiles are discussed.

Keywords:
Open innovation, community based innovation, technology acceptance, assimilation gap, lead user, social percolation, innovation resistance, cross industry.

1. Introduction

Open innovation [21, pp.43] has an increasing effect on the firm's innovation behavior. Open innovation helps to reduce the risk of technology rejection as well as the risk of enlarged assimilation gap.
A special manifestation of open innovation is community based innovation (CBI), sometimes also called community driven innovation with the latter wording emphasizing the innovation dynamics and being used synonymously. The community of CBI is formed by most advanced and demanding customers, who are invited to take a part as innovators and co-producers [21, pp.56].
The author is actively engaged as a researcher / advisor and also as a shareholder in various high technology business fields. Based on this experience the author observes in B2B markets during the current world wide financial and economical crisis:

(a) loss of confidence in technological innovation which results in unexpectedly longer time to market for the innovators and increasing innovation resistance,
(b) decrease in technology acceptance caused by scrutinizing early users,
(c) enlarging of the assimilation gap of technological innovations caused by sharp budgetary cuts and poor implementing of user requirements by product developers.
(d) subtle signals of increasing innovation resistance.

This paper focuses on the development of a test bed for CBI with the goal of generating a data base which is useful to identify the causation of the effects (a) to (d).
A test bed is an environment created for testing purposes. The scope of a test bed depends on the test content, the test objective and the test conditions. The test bed content is based on assumptions and hypotheses about the behavior of a CBI system.

Overall objective of this project is the design and operation of a CBI test bed for selected high technology business fields e.g. smart textiles, wearable computing, smart grids and mobile augmented reality.

2. Definitions

2.1 Community Based Innovation (CBI)

CBI is a manifestation of Open Innovation [1, pp.3], [2, pp.13], [21]. CBI is based on communities of prospective or real customers who are willing to discuss and rate their experiences with products or services [1, pp.4], [2, pp.5]. The most important feature of CBI is the participation of customers or prospective customers in the innovation process and its outcome is taken seriously by the innovating companies involved. It seems that CBI is bridging the „gap of understanding“ from the customer language to the supplier / developer language [2, pp.10].
A subset of these community members are so called „lead users“[12, pp.39] [3, pp.6] or prospective lead users, who show a deeper understanding of the innovative technology and the characteristics of the future market demand. CBI is not restricted to the B2B market, but on the contrary it is also used in B2C markets, although the identification of lead users in B2C markets is more challenging. The open innovation approach for B2B products shows the early integration of suppliers as well as lead users and prospective early customers / launching customers for the innovating company. [3, pp. 7]
CBI is efficiently enabled by community building tools of the web 2.0 [28], which support interactively the dialogs between community members and the innovating company. [3, pp.4] One has to discern the starting point of the community: inside or outside the innovating company. Some companies operate their own community websites with more or less success, other companies react to opinions and recommendations coming from outside the innovating company. This seems to be a more effective way however with the risk to miss important information.
CBI is an informal platform to make “the voice of the customer” [31] audible.
The elements of CBI can be visualized by the following schematic graph:

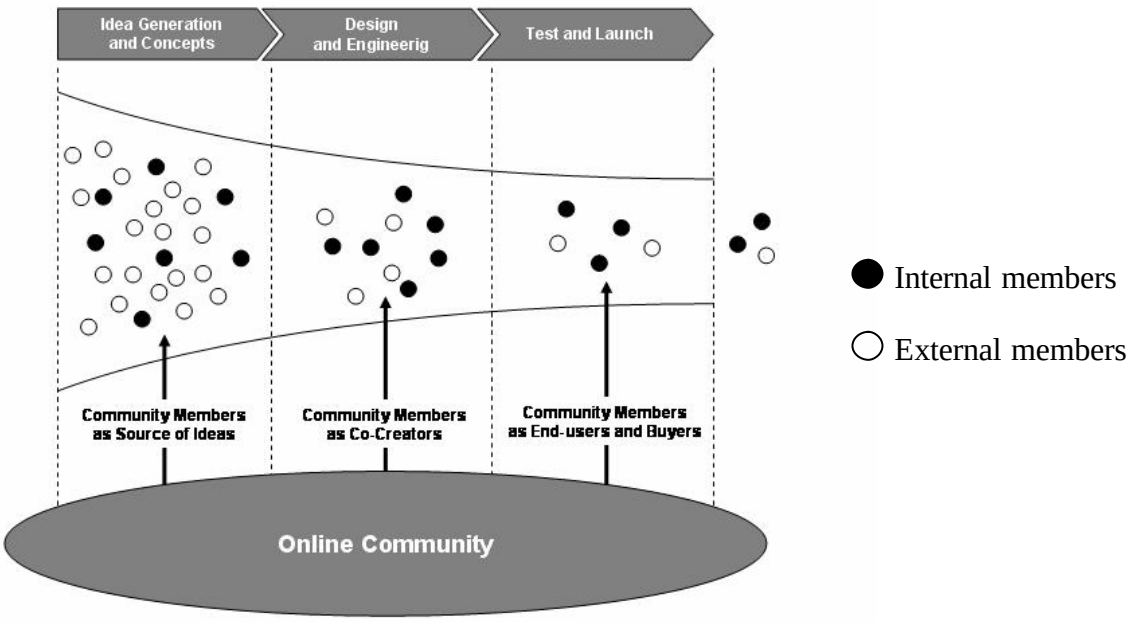


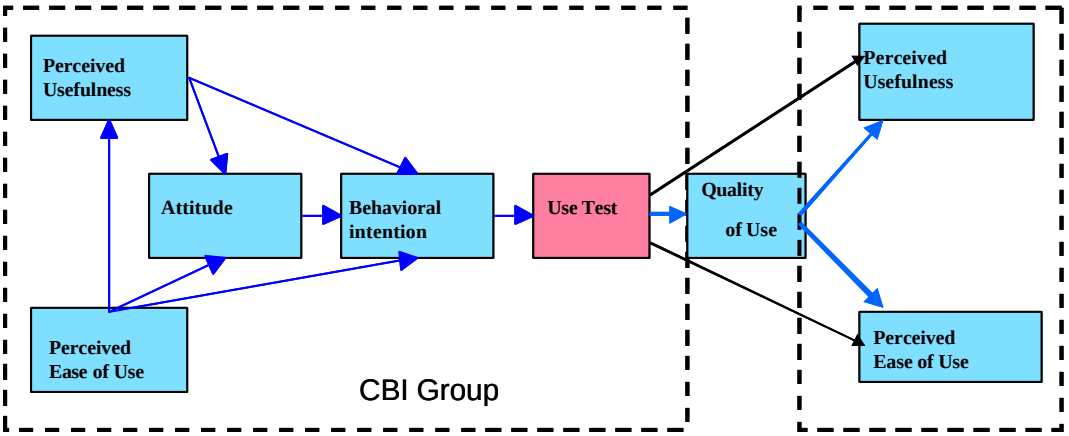
Fig. 1: [10, p.4] Multistage CBI Process with Online Community

2.2 The Spread of Innovation

CBI as self organized process is embedded in social networks.
Social networks are communication networks of social entities. Markets can be considered as a special form of social networks, formed by the communicative behavior of the social entities like suppliers, customers, lobbyists, experts, etc.: „Markets are conversations“[13, Thesis 1].
The spread of an innovation in markets is described by diffusion models. [14].
The strengths and weaknesses of diffusion models are widely discussed in the scientific community. Summarizing briefly the theoretical discussions of the adequacy of diffusion models to explain the spreading behavior of information about product- / service- / technology- innovation we can say that the higher the degree of demand fragmentation the lower the degree of adequacy of diffusion models and the higher the degree of adequacy of social percolation models. [14, pp. 2]. It is important to note that social percolation (positive word of mouth PWOM) as well as social anti-percolation (negative word of mouth NWOM) offer tools to analyze opinion dynamics [23, pp. 348] of customer communities in the early stage of innovation and market entry of products. [4]
Early stage product innovations are mostly focused on special (lead-) user groups. They address different market niches. These groups show non-homogenous behavior in collecting information about product innovation.
The speed of innovation spread is heavily influenced by the structure of the communication network in the market niche, knowledge about best practices in technology searching [5, pp.11] and the readiness of the social entities to exchange information, experiences, judgment and ratings about the perceived usefulness (PU) and perceived ease of use (PEOU) regarding the innovation.

2.3 Technology Acceptance and Assimilation Gap

This is exactly the point where the Technology Acceptance Monitor (TAM) [29, 30] has an important intersection with models of innovation spread. Two basic explanatory variables, the perceived ease of use (PEOU) and the perceived usefulness (PU) explain the technology acceptance. Technology acceptance is defined as the degree to which individual users will use a given system when usage is voluntary or discretionary. Key element for technology acceptance is quality of use and the amount of system usage.



The construct of TAM is widely discussed and researched. However „TAM is incomplete in one important respect: it doesn't account for social influence in the adoption and utilization of new information systems.”[9]. Social influence has an impact on adoption and utilization of innovative products and services.
In CBI the formation of communities into interest groups, expert groups, etc. show different types of social influence profiles, depending on the type of group configuration. If a technology is accepted and the technology itself or embedded in an innovative product is purchased, the phase of adoption is completed. Nevertheless the phenomenon of assimilation gap emerges, researched by [15].

2.4 Lead User

Lead users according to van Hippel [18] may form the kernel of an interest group, exerting expert opinion influence on other group members. But lead users are an inhomogeneous group, who may have different experience and different levels of acceptance or resistance to the respective innovation. Based on his empirical study, Lüthje [16] has identified two independent dimensions of lead user behavior in B2C product markets:

- ‘commitment to the product field’ measures the user expertise and knowledge related to the product
- ‘innovation-related benefit’ measures the level of dissatisfaction with existing products and the level of new consumer needs
- A further dimension of lead user behavior is based on van Hippel’s basic assumption that lead users face needs earlier than the rest of the market and that these needs will eventually become common for the rest of the market [18]. This characteristic is equivalent to opinion leadership. Lead users in their role of opinion leaders influence the needs in the market and also the knowledge how to beneficially use product innovation.

We distinguish at least two subgroups of lead users:

- Group A are lead users who are mostly skilled in screening and identifying future demand for problem solutions. We call this group of lead users ‘Scouts’.
- Group B are lead users who are mostly skilled in judging the viability of first functional prototypes of the innovative idea or concept. We call this group of lead users ‘Verifiers’.

In reality group A and B may overlap.
Combining the three characteristics with the two groups A and B results in table 1 of lead user types shown on page 6. Additionally the group of influencers with Positive or Negative Word of Mouth must be considered. [4]
The CBI test bed design will use this classification scheme of lead user characteristics and roles.

2.5 Innovation Resistance

Innovation resistance of customers is an empirically proved phenomenon. It has direct impact on important parameters of a marketing strategy like timing of market entry (see ‚window of opportunity‘), timing of adoption (from early innovators to laggards), influence on risk awareness (physical risk, economic risk, social risk), functional and psychological barriers to use innovative products [19, pp. 5], [17].
A current example of innovation resistance is shown by reluctant acceptance of energy saving lamps, which was overruled by legislative measures of the EU.

Radical innovation evokes a higher degree of innovation resistance than incremental innovation. It is expected that the CBI test bed delivers more insights into how to cope with the various forms of innovation resistance by early studying the hidden Pros and Cons within the open innovation community.

3. A Model of CBI Test Bed for Cross Industry Technology Acceptance

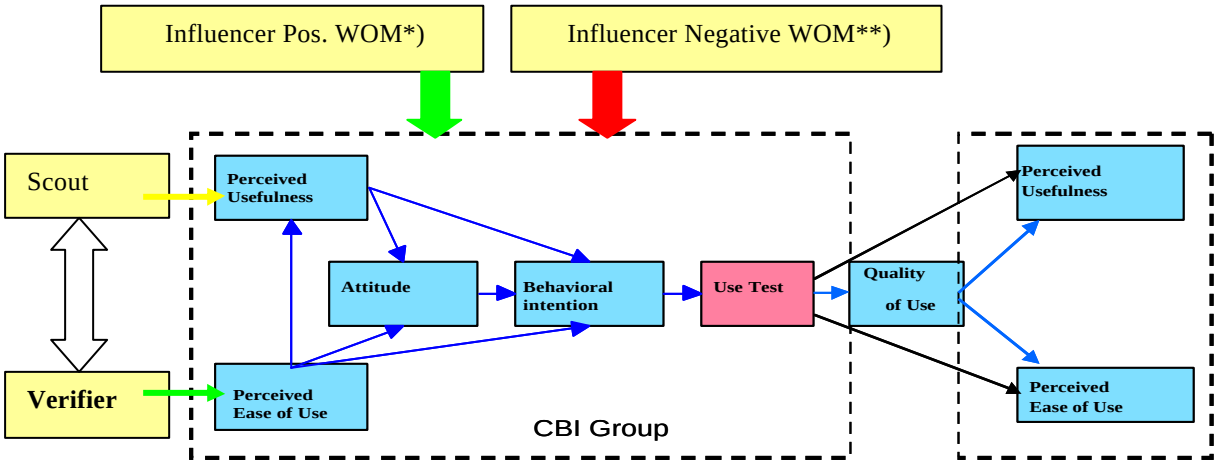
3.1 Microstructure of CBI Test Bed

CBI is a special form of a social network with specific tasks supporting the product innovation process. Communities are fuzzily structured groups of agents (potential customers, users, influencers on buying behavior), which provide outside of innovating company lead user knowledge. This knowledge can be imported into the innovating company, when agents are to play an active role in a CBI network. It is planned to embed the CBI test bed into a technology acceptance monitor regime, which offers the possibility of using a longitudinal evaluation tool applicable to selected technology evaluation tasks. The microstructure of a group of agents can be described by the role types of Tab.1.

	Lead User Role		Influencers	
Characteristics:	Group A: 'Scout'	Group B: 'Verifier'	Positive WOM	Negative WOM
Expected Benefit (Perceived Usefulness)	strong	weak	Positive Word Of Mouth	Negative Word Of Mouth
Expertise (Perceived Ease of Use)	weak	strong		
Opinion Leadership	medium / high	medium / low		

Tab. 1 Microstructure of Agents in CBI Community

The microstructure can be described by a social percolation model which shows the evolution of (positive) technology acceptance and (negative) technology resistance within the CBI group.
The structure of the CBI test bed can be shown by the block diagram:



*) Positive Word of Mouth, **) Negative Word of Mouth

Fig. 2 Test Bed Technology Acceptance Block Diagram

3.2 Social Percolation in the CBI Test Bed

The set of involved persons (called agents) in a CBI process can be considered as a small world network with heterogeneous agent communication behavior. The evolutionary spread of an innovative product can be described using the social percolation theory, a powerful tool developed in mathematical physics and first introduced in marketing science by Mort 1991 (see [27]). Percolation was originally developed to analyze whether a material can be traversed by a fluid or not. [8, pp10]; [6;7;14;20;22;24;25;26].
In this paper we focus on an extension of social percolation by referring to the model of Social Anti Percolation [4], introducing also negative word of mouth (NWOM). NWOM is more informative than PWOM and may spread independently of exposure to the product like a "contagious disease". Marketing theory differentiates between local effects and global effects of marketing communication. Local effects (=word of mouth) are all influences on individual consumers generated by peer consumers (e.g. lead users, experts, friends, etc) while global effects (=advertising) are communication influences by marketing measures. Empirical results show that word of mouth is up to 10 times more effective than marketing efforts [4].

The classical social percolation model SP assumes that each agent (customer) i has a preference value p_i. The CBI agents are active in a community as part of a CBI process. We assume that this social network has a fixed structure. Now we introduce the innovative product (e.g. functional prototype of the product) with the product quality Q to the agents of the community. A randomly selected agent i will adopt the functional prototype if a neighboring agent adopted the functional prototype AND the prototype quality Q is higher than the agent's preference value: $Q > p_i$.

The CBI process must also consider innovation resistance, expressed by negative word of mouth (NWOM), which is the fact of $Q < p_i$. If an agent is exposed to a functional prototype and he is not convinced of the functional prototype, then the agent becomes a source of spreading resistance by NWOM to his neighbors in the social network. Spreading speed of NWOM is assumed to be higher than for PWOM. NWOM affected neighbors become more resistant (less receptive) to the functional prototype which results in a decrease of adoption. An expression for skepticism due to NWOM implies an increasing aspiration level of quality preference of an agent. (more details see [4]).

Scouts and Verifiers are different roles and complementary functionalities for agents in the community of CBI. Therefore they require also different preference values for quality. The detailed parameterization for CBI agents is subject of the test bed development in a research project. The cross industry feature implies the integration of competitive and complementary effects of single industry features in the CBI test bed model.

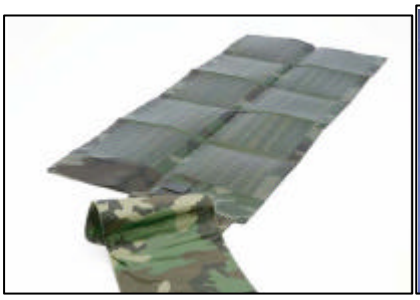
3.3 CBI Test Bed for Smart Textiles

The application content of the CBI test bed will focus on smart textiles as a product group. The cross industry aspect [11] is based on the fact, that a smart textile product, which offers an autonomous functionality, represents an integration of different technologies from different industries and technology fields:

- Elastic energy generating layer: CIGS-PV cells (Copper Indium Gallium diSelenid) (few producers)
- Textile layer (many producers)
- Elastic, textile based rechargeable Li-Ion-battery layer (2 producers)

- Textile circuit board / Teflon coated polyimid based flexible circuit board (few producers)
- Various sensors: temperature, humidity
- Various actuators: LED, heating / cooling / display / mobile communication including mobile augmented reality

Fig. 3 below shows an existing MIL specs compliant product for the US market and Fig. 4 below shows the flexibility of thin film photovoltaic modules suitable for textiles.



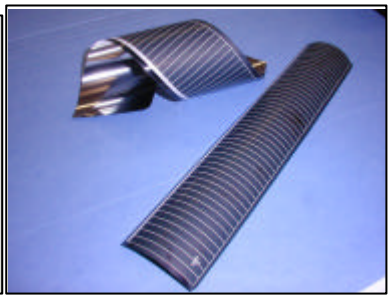


Fig. 3 Flexible PV Module Fig. 4 Thin Film Photovoltaic Cells both produced Global Solar Energy Inc.

Fig. 5 Flexible battery by Leclanché Lithium GmbH

The resulting cross industry product prototype is a sandwich for integrated, autonomous wearable computing.

4. Conclusions

- Cross industry technology acceptance in open innovation regimes requires the introduction of evolutionary economy concepts.
- Community based innovation enriches the degrees of freedom for innovative product development, reduces risk of product failure and enables the development of best practice frontiers for innovation policy.
- Social percolation seems to be an efficient approach to model small world network suited for CBI.
- The foundation of a CBI test bed is a contribution to experimental economics.

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