

Developmental steps from closed innovation to open innovation

Increasing customer involvement through mass customization and customer co-design

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Abstract. In this conceptual-analytical paper we examine and review different customer and production strategies. We focus on continuum from closed innovation to open innovation and especially their intersection in mass customization and customer co-design strategies. We have found that when seeking to increase customer loyalty and attracting new customers, companies need to increase customer involvement in research and design (R&D) operations. This radically changes the innovation process and the way customer interaction is handled. Brokering process is therefore described in this open innovation context. Certain business cases are introduced to demonstrate each described customer strategy. The use and role of information systems in these strategies are discussed.

Introduction

Enterprises in all branches of industries are being forced to react to the growing specialization and customization of demand and to find ways to manage the increasing product variety (Tseng and Piller, 2003). At the same time increased competitive pressures force enterprises to constantly reduce costs and outperform when pursuing efficiency. Combining these two aspects is difficult at best. Traditionally, companies have tried to answer these challenges with reasonable trade-off between variety, functionality, and price. Also enhancing long-term customer relationships has become a central objective for companies enabling to answer customers' increased expectations (Parvatiyar and Seth 2001; Sisodia and Wolfe 2000).

The engine of industrialization during the last century has been standardization and economies of scale of mass production. We describe mass products as products of closed innovation process since products are inflexible and standard and customers doesn't really participate in R&D activities or in production process. Products are "build-to-stock" and then distributed as efficiently as possible to large customer base. As an opposite concept we can use the term open innovation or customer based innovation to describe high customer involvement in innovation process. The concepts of mass customization and customer co-design are considered to represent the developmental steps from closed innovation to open innovation by increasing customer involvement.

In this conceptual-analytical paper (Järvinen, 2004: 17-35) we review the extant literature of production strategies involving high customer involvement. We describe the developmental steps to turn enterprises more customer centric and to promote customer involvement as "there are too many good ideas held by people who don't work for you to ignore" (Chesbrough, 2003).

In the next sections we will illuminate through cases how customers can be better integrated in the innovation process. We start by discussing about the transition from mass production to mass customization and related customer orientation. Then we take a look at how customers may act as co-designers in online communities. The open innovation concept (Chesbrough, 2003) is then contrasted and discussed whether the original definition is too narrow. Questions about brokering and ownership are raised. The example cases are utilized to illustrate differences between these concepts. In addition, issues considering information systems in different stages are also discussed. In the discussion section we reflect our findings with customers' motivational aspects and consider future research paths in this field.

From mass production to mass customization

Pine (1993) suggested that the historical evolution of production strategies have evolved through four phase: starting from craftwork to mass production, to continual process improvement and finally to mass customization. The most of the human history has based on notion of craftsmanship. In craftwork, every product is designed and produced individually and according to customer needs. Limitations have generally been the innovation capability of the customer and/or skills of the craftsman. This kind of mode of operations is inefficient, as every product has to be crafted individually. In need to make production process more efficient and to reduce unit costs the notion of mass production was introduced in the beginning of the 1900-century.

In mass production the production lines are stabilized as far as possible to ensure smooth and efficient operations. Products are inflexible and standard (closed for changes) and customers don't really participate in R&D activities or in production process. Products are "build-to-stock" and then distributed as efficiently as possible to as large customer base as possible. Customer can at most adapt the way s/he uses the product.

Minicase 1: Coca-Cola Company

Everyone knows Coca-Cola Company and their most famous product, The Coca-Cola. Coca-Cola Company's business concept hasn't changed a lot in the last 120 years: Make cola concentrate for pennies, then sell it for dollars through a global bottling system to a mass market that still pretty much drank what it saw on TV. However, the world around and the beverage industry have changed a lot. New product groups have challenged traditional sodas, like bottled water, sport drinks, energy drinks, and coffee.

When current CEO Neville Isdell came out of retirement two years ago to take over at Coke, he understood that Coke has to change. Company analyzed what beverages people drink and why and when they drink them. The goal was set to deliver on its promise to be a nonalcoholic-beverage company with an ever-expanding portfolio to meet consumer needs. That may not sound like much, but for Coke it's what Isdell calls a "revolutionary evolution." The new Coca-Cola, he promised, will innovate--as it did in the first quarter, launching new products with strange-sounding names like Tab Energy (diet energy drink), Coca-Cola Blak (coffee Coke), and Full Throttle Fury (a citrus-flavored energy concoction).

Source: Morris (2006)

The minicase 1 illustrates a typical company building on notion of mass production. By following market shares, sales volume and trends in markets,

Coca-Cola Company will change and expand its product portfolio. However, even when the company is launching new products the basic concept is not changing: mass-producing products for mass markets.

Overall, the superiority of American mass production lasted long until in 1970's Japanese production companies started to outweigh their American counterparts. Especially Japanese automobile industry introduced the notion of continual process improvement that enabled companies to use more flexible processes and to speed up the innovation processes of R&D function. In continual process improvement the focus was still in products and production processes and products were build-to-stock. However, the use of flexible processes enabled companies to increase variation and to quickly and efficiently adapt to changed market demand, which made the introduction of mass customization possible.

To retain customer loyalty companies should serve every customer as an individual offering customized products and services at a reasonable price (Pine, 1993). This contradiction of offering individual products and yet keeping reasonable prices can be solved with a mass customization strategy (Davis, 1987). Idea of Mass Customization is seen as 'ability to use of flexible processes and organizational structures to produce varied and often individually customized products and services at the price of standardized, mass-produced alternatives' (Hart, 1996).

Move from product and process focused organization to customer centric enterprise is huge change that has an influence on enterprise as a whole (Tseng and Piller, 2003). This change brings the customer back to center of economic activity and customer preferences are tried to implement into the products. Usually this happens by creating flexibility not only to production processes but also to the product itself. Product platforms, product families, increased variety and modular structures are some of the way to increase the customizability of the products and yet retain the efficiency of production. Notable is, that for the first time after craftsmanship the customer can have substantial influence to product qualities, yet inside the predefined limits.

Minicase 2: left® foot company

Manufacturing and selling shoes has been a long time already mass business and traditional shoemakers have almost disappeared. Only the most solvent customers still use the luxury to have individually made shoes where as the rest of the people look for nearest right size and appealing appearance in addition to prize. Even the shoe sizes have been standardized to help the selection process the standard only tells you the length of the shoe (which can be measured in different ways) and nothing about the convenience of the boot-tree.

Using the Mass Customization concept the left foot company has changed the way customers buy their shoes. By using modularity in shoes and variety in

shoe parts, direct customer interaction and flexible production lines left® offers the customers individually assembled products fitting their feet. Customer's feet are scanned using 3D-scanning device to find out best fitting boot-tree. Then the customer can choose from different pre-defined alternatives the model, the sole, the leather and the color of the shoes. When ordered, shoes are manufactured and delivered through courier to location specified by customer in two weeks from order.

Source: Mäkipää et al. (2005)

The left foot company has utilized new possibilities to directly interact with customers to gather intensive customer knowledge on product preferences and to modify products according to each individual customer. This way left has opened up previously very closed innovation by increasing modularity and offering changeable elements. The predefined alternatives for choices increase the customizability of products and customer satisfaction. However, mass customization model doesn't give space for customer creativity, and thus it's still leaning towards the closed innovation model.

Mass Customization places development challenges for many organizational information systems. Especially important is the integration of storefront systems used to gather customer preferences with manufacturing systems to enable efficient production of individually customized products. In case of left®, company needed to create seamless information flows from left® outlet (3D scanner data and customer preferences) to manufacturing (automatic cutting machines, stitching, finalizing) and all the way to delivery (delivery to any place in the world specified by customer). In addition to integration challenge certain information systems need development, such as product data management to enable modularity and product configuration tools to enable individual composites of modules.

Customer co-design

In the mass customization mode of operations the customer is put in the middle of organizational strategies. Customers can customize products to better fulfill their own individual needs. However, usually the possibility to customize products is limited to some predefined features. Sometimes companies need to extend these limits and offer customers opportunity to express their product requirements and carryout product realization process by mapping the requirements into the physical domain of the product (Tseng and Piller, 2003). This mode of operations can be called as customer co-design, where customers are recruited to designers of the company. In customer integration the customer "takes part in activities and processes which used to be seen as the domain of the company (Wikström, 1996). Ketola and Ahonen (2005) showed in a mobile phone design example that

customer participation in the innovation processes requires new relationships between customers and (internal) developers. Those relationships are not new but already described in user-centered development methods and in human-computer interaction research literature.

Customer co-design describes a process that allows customers to express their product requirements and carry out product realization processes by mapping the requirements into the physical domain of the product (Khalid & Helander, 2003; von Hippel, 1998). The customer can choose from an infinite set of options an individualized combination or even extend the options and even invent new ones. During this process of elicitation, the customer is being integrated into the value creation of the supplier (Piller et al., 2005).

Characteristic for customer co-design is contribution's importance for customer in certain community. In this article, we extend the understanding of customer co-design in regard to a design process that is conducted in collaboration among the customers or users of a product in an online community context. This process can be called a "collaborative customer co-design in online communities" (Piller et al., 2005). Communities and customer-to-customer interaction are often mentioned in the literature as a promising way to abolish some of the hurdles of integrating customers into company activities (Piller et al., 2005). Further, there is a growing body of research discussing how interaction in communities supports creative activities (Füller et al., 2004; Sawhney & Prandelli, 2000).

Minicase 3: Threadless.com

Threadless.com is a young Chicago-based fashion company that focuses on t-shirts with colorful custom graphics. All products sold by Threadless.com are created by its user community. The proposed designs are inspected and approved by user consensus before the production process starts. This way, company can ensure that markets exist even before making any investment decisions to new products.

Top-rated customer design proposals are transferred into final products and produced in limited editions. Customers are offered t-shirts that they have selected from all posted design proposals. So far, over 250 winning designs have been chosen for print from more than 32,000 submissions, evaluated by customer community of over 100,000 users. Also the customer designers are rewarded: a creator of a winning design gets \$1000 as reward and his/her name is printed on the particular t-shirt's label.

Source: Ogawa and Piller (2006)

In Threadless.com case, it seems that intangible returns related to users own satisfaction are important (Wasko and Faraj 2000). Also, the members' goal is mutual, to design popular t-shirts, which increases the sense of community among

members and will to help others due to the possibility to get some favor from contribution. Even the customers have an opportunity to use their creativity and design the products, Threadless.com still holds the core solutions on its own hands. The production process and core product (plain t-shirt) on which the customer creation is printed on are still in the hands of Threadless.

Customer co-design places some new requirements for organization's information systems. First of all, the system would require tools for designing, voting and collaboration built in the web platform as well as support for building on-line communities via social transparency. These systems should be integrated with company's internal systems like enterprise resource planning systems, product data management systems, CAD/CAM/CIM systems and alike to ensure efficiency of operations. However, from security reasons the customer interaction tools should be kept separate from the company's internal information systems, which places requirements for interoperability of different systems.

Open Innovation

The concept of open innovation describes the next logical step to open up the R&D activities. However, in this context companies only increase consumer involvement in companies' R&D processes, suggesting that consumer innovation concept could be used as a sub-concept of open innovation. Open Innovation could be used when innovation is freely utilized, used and further developed by anyone interested and not tightly bind to any particular organization, as in case of consumer innovation. To clarify these concepts, we will first illustrate a typical, closed, in-house innovation process.

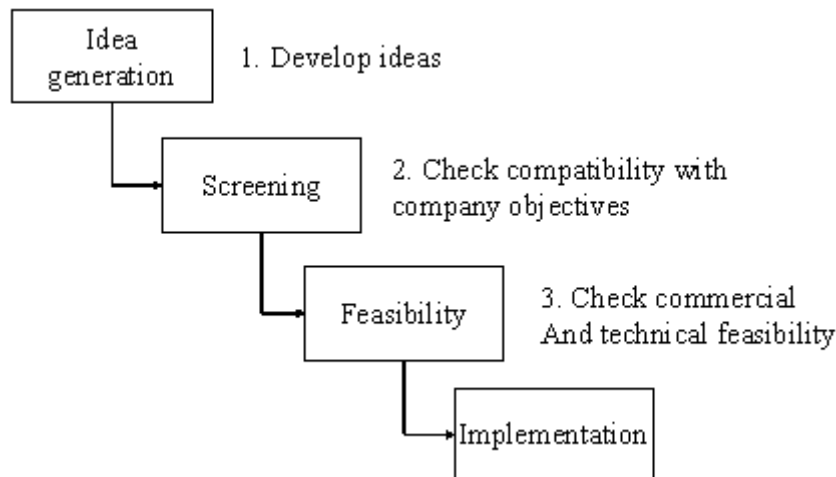


Figure 1. The Innovation Process (Majaro, 1988).

Many current initiative systems, innovation competitions and even innovation management information systems in use in organizations utilize this kind of closed innovation process. The screening and feasibility phases in the picture above are sensitive, both from evaluation and process management perspective. Hargadon and Sutton (1997, 717) put it: “Valuable solutions seldom arrive at the same time as the problems they solve, they seldom arrive to the people working on those problems, and they seldom arrive in forms that are readily recognizable or easily adaptable.”

Clayton Christensen (2001) indicates that a company who listens to it’s customers, provide them with what they want, may still lose in the competition — because a cheaper, not-as-good but good-enough competitor comes in and gets the market share. Therefore, Chesbrough (2003) encourages changing the role of R&D (from earlier creating new knowledge), to focusing on knowledge brokering. The Technology Brokering Process model (Hargadon and Sutton, 1997) describes how an organization can systematically collect information from different domains and combine it for new products and services. Below the model is presented to describe how to search for new ideas and how to store them for further use.

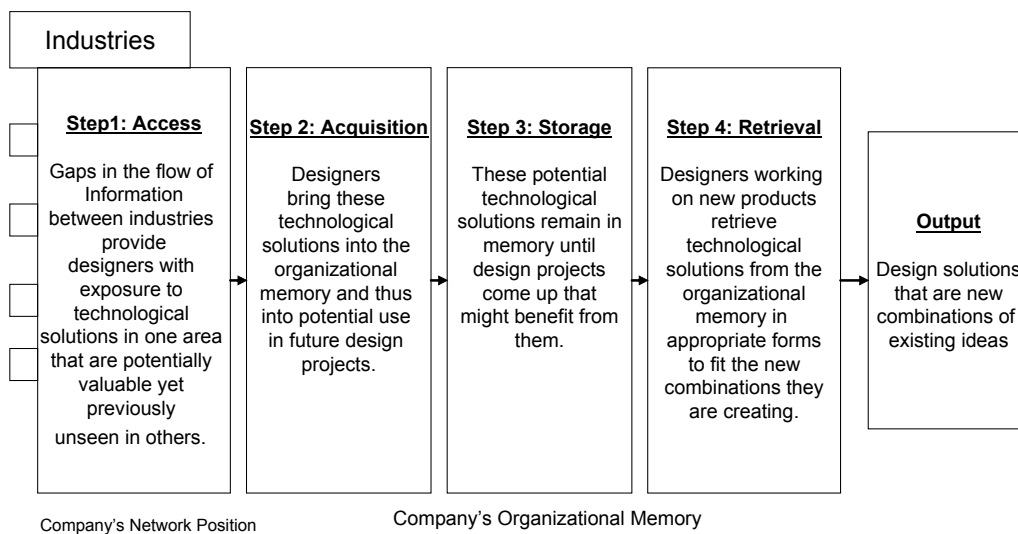


Figure 2. Technology-brokering Model (Hargadon and Sutton, 1997)

The model above is originally based on observations how a certain company (Idea) and its designers develop innovative products. This can be seen as a possible limitation of the model. Concept ‘industries’ in the figure above means different communities and related social networks. Hargadon and Sutton (1997) also used the structural holes theory by Burt (1992) as the basis of technology brokering process model. The structural holes theory as well as social network theory suggests that innovators can innovate routinely because they occupy a “structural hole”, a gap in the flow of information between subgroups in a larger

network. For innovators, these gaps exist between industries where there is and isn't knowledge about the new emerging technologies. Actors filling these gaps are brokers who benefit by transferring resources from groups where they are plentiful to groups where they are dear. (Hargadon & Sutton, 1997, 717)

The Open Innovation model of Chesbrough encourages companies to outsource and co-operate with open source communities and bring ideas from R&D as basis of this co-operation. This new kind of collaboration requires novel focus on intellectual properties. There are new initiatives like the Innovation Commons Network (<http://innovationcommons.blogspot.com/>) which define new IPR (Intellectual Property Rights) approaches, Innovation Commons. This definition work is done by on-line communities.

Similarly, Fuller et al. (2004) introduce a method to utilize the existing innovative potential of online communities by integrating its members virtually into new product development. They introduced a concept of Community Based Innovation, which is grounded on social exchange theory as well as interaction theory. They have divided the innovation process into three stages, which are named as 'idea generation and concepts', 'design and engineering' and 'test and launch'. Although Community Based Innovation gave promising results, Fuller et al. (2004) remind that there are some challenges, which should be noticed. The threat is that competitors may get access to information that should be kept secret. Another challenge is to assure representation for defined market segments. Moreover, budget and interface between marketing and R&D departments may cause some difficulties. Large companies like Procter & Gamble are embracing both the Community Based Innovation and Open Innovation. The next minicase will demonstrate the new role of players in the innovation field.

Minicase 4: Procter & Gamble Company

NineSigma, Inc., a Cleveland-based innovation sourcing firm, and The Procter & Gamble Company announced today a strategic relationship to support the acceleration of P&G's "Connect and Develop" strategy.

Renowned as one of the world's most innovative companies, P&G is now applying those skills to the innovation process itself. Implementing its leading edge "Connect and Develop" strategy, P&G has announced a goal of accessing 50% of its new ideas, technologies, and products from external sources. A key element in this open innovation strategy is the effective utilization of the Internet to match technical needs with the right innovators around the world who have technology solutions and "ready-to-go" products that P&G can utilize. NineSigma is one of the leading companies in the field of innovation sourcing. Through its proprietary Internet-based managed exchange process, NineSigma delivers connections to sources all over the world to meet its clients' most challenging needs. In the past 18 months, P&G and NineSigma

have worked together to find solutions and opportunities across P&G's global business units.

Source: P.G. (2003)

This case illustrates that web-based innovation markets are a strategic alternative of corporate R&D. Like in the technology-brokering process model of Hargadon and Sutton (1997), this NineSigma marketplace provides Procter&Gamble exposure to technological solutions in one area that are potentially valuable yet previously unseen in others.

The bidding process in this innovation market example requires some specific features from information systems. The authors of this paper have used the Nine Sigma information system and it is based on RFPs (requests for proposals) that are submitted by companies as web forms to NineSigma Database. The researchers, other companies and innovators are supposed to reply to these RFPs with their proposals. The system sends a weekly e-mail with current RFPs. This e-mail newsletter contains links to NineSigma database with related RFP-descriptions. Researchers and innovators are able to provide their short research / invention description, but the authors were not able to modify or access it afterwards. In overall, the customization of the service and the online community features are missing from the system (in June 2006).

Developmental steps to increase customer involvement

Above, we have discussed about different ways to increase customer involvement in company's R&D to better serve the customers. We have demonstrated through minicases how different customer strategies are already in use and how they can contribute for created value perceived by customer. We also suggest that these represented concepts form four distinct customer strategies and developmental steps to turn a company more customer centric. As the Table 1 illustrates, the developmental steps start from the closed innovation and end to the open innovation concept.

According to Bunge (1967: 75), a classification must be a) remaining permanent, b) covering, c) pair wise disjoint, and d) natural. Theoretical-conceptual reasoning is often based on criteria a) ... d), and the covering criterion may be the most efficient one (Järvinen, 2004: 21). In classification described in table 1, criteria a) is hardly fulfilled as presented concepts are newly emerging from theory and practice and are still in phase of finding their place and meaning. On the other hand, even the concepts used would change or at least evolve; qualities of each separate class should be more permanent. Also the criteria b) should be fulfilled as open-closed represent two extremes and also opposites.

Two other classes are seen to represent common possibilities for strategies in between. It could be possible to divide these two classes to even more classes but it would, in our view, decrease the applicability of classification to all real-life cases. Also, the fulfillment of criteria c) and d) should be visible in table 1.

Closed Innovation	Mass Customization	Customer Co-Design	Open Innovation
Traditional mass production and process improvement, slow customer feedback cycle (e.g. according to sales), customer surveys, market potential, variety of products	Flexible manufacturing, modularity, variety of modules, customizable / changeable elements, direct customer interaction when defining the product, high customer involvement	Flexible manufacturing capacity, some core solutions like manufacturing methods can be predefined, otherwise customers are offered tools to design products, customer creative contribution and high customer participation	Customer creative contribution, design of core solutions, no ownership (or community ownership), returns on implementation and attached services, multiple stakeholders, high customer commitment

Table 1: Four distinct customer strategies

These four customer strategies are argued to be distinct and separate. However, we acknowledge that in real life not all cases might be possible to classify according to this classification. Especially hard could be to classify a company in transition phase from one customer strategy to another or mixed models of different strategies. Sometimes even the companies might be surprised how strong influence and joint effort customer communities might have. Below, the Lego factory case demonstrates how introducing a customer co-design concept initiated even more profound innovation from customer community.

Minicase 5: Lego factory

Lego factory (<http://www.lego.com/factory>) case exemplifies how mass customization as well as customer co-design is utilized efficiently. Lego offers people a possibility to create their own unique Lego model using interactive software on their web sites. Then, Lego manufactures the bricks necessary for the model and ships them to users so they can assemble their models. Customers can also buy the bricks necessary to build from other people's designs, which are posted on the site. However, a problem occurred in as Lego assembly center has pre-packed packages of bricks, and only matches a user's designs with these packages. As a result customers got and paid often for far more pieces than they really needed. Sometimes that made designing and buying models to be very costly.

At this point the adult Lego community started to solve a problem and very soon they ended up with the solution where customers were able to get a right combination of packages of bricks. With this innovation, users created a very

beneficial addition to the company's offering, the Lego executives stated that: "the adult community found out within a few days how these bags were mixed together. It was a puzzle to us. They took us completely by surprise." The Lego manager added: "We really encourage and embrace some modifications of our software." "It's not surprising to us that they're doing the hacking, because that was the hope, that they would take the core of what we're doing and own the system" for themselves, Jacob McKee, Lego's global community relations specialist is quoted in the CNET Networks article.

Source: Piller (2005)

Lego example demonstrates how communities can act efficiently in problem solving when they have a shared goal, which in this case was to be able to design Lego models and buy their own Lego bricks with affordable price. Customers weren't satisfied with tools offered by Lego and decided to improve them. In other words, customers were given possibility for higher participation but they wanted and took even more.

Discussion

The development path to once again increase customer involvement in product design puts huge pressure to manage these customer designs and to be able to produce them efficiently. This increased pressure to be more customer oriented and at the same time competitive pressure to reduce costs is very difficult dilemma for many businesses (Tseng and Piller, 2003).

Therefore, more academic studies are needed to increase the knowledge about the companies' possibilities to involve customers in R&D projects. Since online communities offer a promising environment for creating innovative communities, they offer interesting context for further empirical studies. In addition to the earlier discussions, approaching the phenomenon of open innovations in online communities from the customers' point of view can provide interesting insights. Online communities offer a number of opportunities to develop products with customers as well as to create innovations (Pitta and Fowler, 2005). Since the competition is tight and relationships with online communities are easy to end, it is necessary to consider how customers can be motivated to visit and contribute in online communities.

Wasko and Faraj (2000) explored reasons why people participate and help each others in online communities. They concentrated on knowledge exchange and therefore, they empirically explored three technical communities in their study. As a result they divided people's reasons to visit online communities into tangible returns, intangible returns, and community interest. By combining customers' motivations to contribute in online communities with the concept of

open innovation an in-depth understanding about the phenomenon can be obtained.

From information systems point of view, customer centric strategies require a little bit different kind of emphasis on Information Systems (IS) portfolio. IS portfolio build to increase efficiency and optimize mass production and mass deliveries in closed innovation context are needed to reconfigure to be more flexible and enable interaction between different parties. Company might be required to implement Product Data Management (PDM) software to handle variations in products and modular structure or a product configuration tool to enable dynamic configuration of customer defined products (Ruohonen et al., 2006). The online communities and web-based designing, posting and rating tools are important in customer co-design context and even more important in open innovation context to enable cooperation in community and creation of innovations.

Interestingly, the development of technology opens up new possibilities for customers to contribute in online communities. Authors are involved in research projects related to Web 2.0 and bottom-up technologies. The Web 2.0 technologies and peer-to-peer networking may radically change those information systems used between R&D and customers. Users have gained new possibilities to create content in online communities since RSS (Really Simple Syndication) format is becoming de facto in blog feeds and in notification messages (http://rss-extensions.org/wiki/Main_Page). Wikis are used more and more in organisations. New aggregator services allow integrating RSS-based data from individual blog messages and wikis to corporate information systems. Collecting customer knowledge may in the future mean aggregating and selecting data from customer's blogs and wikis. However, the licencing and rights management solutions should support this kind of activity. To conclude, further research is needed in this field to be able to understand how these new possibilities impact on open innovation concept and other customer centric strategies.

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