Diffusion of Web-Based Product Innovation

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In a wide array of industries, customer integration leads to improved performance of product development, in terms of both better fit with market needs and faster time to market.[1] The ability to involve customers in the creation of new products is highly recommended in both theory and practice.[2] However, the absorption of customer knowledge is not an easy task. As with any other business process that involves importing knowledge from outside the firm's boundaries, it is organizationally complex and expensive. Customer knowledge is also characterized by idiosyncratic and sticky know-how, which makes it difficult to be learned and transferred.[3] Lastly, knowledge transfer requires direct interaction between firms and customers, which entails considerable physical limitations. While some firms have opted to create internal market research departments, the great majority have usually relied on dedicated third parties—namely, market research operators—in order to absorb market knowledge for innovation purposes.

The advent of information and communication technologies (and the Internet, in particular) has created new opportunities for customer integration. Web-based tools can simplify customer integration and knowledge absorption by facilitating systematic interactions with selected groups of customers at a low cost.[4] The Internet greatly enhances a company's capacity to obtain market

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knowledge without a third party and to regularly interact with a broader category of consumers than just its regular customer base. This would be impossible offline and it represents the revolutionary potential of the web to support the development of product innovation by individual companies. Specifically, various web-based tools have been developed over time to support collaboration with customers at each stage of the innovation process.[5] The question is: To what extent are companies integrating these tools into their web sites to support cooperation with consumers at each innovation stage?

This article reports on an empirical study that maps the web-based mechanisms currently supporting collaborative innovation in five different sectors—the automobile, motorcycle, consumer electronics, food and beverages (hereafter, "food"), and toiletries industries.[6]

The Role of the Web at Each Stage of the Product Development Process

A company's capacity to absorb customer knowledge is vital across the entire product development process. Great emphasis has been placed on the potential of the web as a tool of adaptive co-development of new products, allowing companies to systematically solicit consumers feedback.[7] Web sites can also contribute to increasing consumer trust and, consequently, the consumer's willingness to share information.[8] Of course, not all customers feel the same way about online participation and the representativeness of web-based tools is still being tested. However, it has been proven that customers interacting with the company through the web are the most involved and innovative, showing the highest interest towards experimentation and trend setting.[9]

Idea Generation

The first stage of new product development benefits considerably from the web's potential to enhance consumer input. The simplest application consists of online questionnaires. When searching for successful new product ideas, one should aim to reduce uncertainty by identifying customer preferences and interacting directly with them to absorb new knowledge. The questionnaire usually aims to improve selected aspects of the site, product, or service. To enhance customer involvement in the idea generation stage, companies can even use online suggestion boxes where users express their own innovative ideas. A good example is provided by the Ben & Jerry site, where users can contribute new ideas for both products (pre-packaged ice cream) and services (especially packaging and distribution). Advanced applications of such dialogue windows can also be found in the Procter & Gamble web site. (In all these cases, it is essential to establish clear regulations regarding intellectual property rights so that the company can use the innovative ideas suggested by consumers.)

Product or financial incentives have proven to improve idea generation remarkably.[10] Even reward mechanisms can be introduced to encourage the most competent users to compete with each other in finding new ways to solve

specific company problems. Remuneration is usually paid by the company and, in some cases, can even exceed one hundred thousand dollars (as in the Innocentive.com site created by Eli Lilly). It is also easier to handle complaints online, both for the company and for users. Accurate analysis of the complaints serves to strengthen existing products and can even lead to radical changes. Particularly useful is the technique of "listening in," namely, recording and analyzing the information exchanged between individual users and the experts who provide virtual advice to help identify the product that best satisfies the customers' needs.[11]

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New product generation can also benefit from online virtual communities of customers, which bring together users sharing the same interests and willing to exchange opinions and experiences. By encouraging iterative communication, these groups generate knowledge regarding consumption shared at a social level that is difficult to obtain using other research tools. Intangible incentives, such as those associated with opinion leadership, usually represent a good way to stimulate participation in communities emerging in consumer markets, while economic incentives are more common in business communities.[12] In both cases, members who join on their own accord tend to be particularly involved and often have specific technical competences—as in the case of the communities of videogame (e.g., Idsoftware.com), motorcycle (e.g., Ducati.com), and software (e.g., Sunmicrosystems.com) enthusiasts. Because of their competence, the contributions of such groups are particularly valuable.

Idea Selection

Idea selection represents a critical stage in new product development, one that helps prevent wasteful investments. The most important web-based tools to assist such selection are virtual concept testing and online focus groups. In concept testing, virtual reality allows companies to develop product concepts in detail so that consumers can compare product features and select the most convincing concept. For instance, Volvo has created an ad hoc site—Conceptlab-volvo.com—where users choose the new automobile concepts they like best. Users can also view the evaluations expressed by other consumers in real-time. However, since different customers might have different degrees of knowledge about a specific product, virtual interfaces have to be flexible enough so that the customer does not become frustrated.[13]

The Internet enables companies to take the traditional research technique of the focus group and make it more efficient and accessible to a geographically diverse customer base. Online focus groups use videoconference technology and chat rooms.[14] Consumers are identified according to their characteristics and asked to form virtual teams to discuss different product concepts. An important

aspect of the online focus group is the anonymity the Internet provides. Although the participants are less emotionally involved, they are less inhibited and are less likely to be affected by group-thinking, where the individual contributions merely reflect the views of the dominant group members.[15] The so-called "Information Pump" is based on virtual focus groups where companies identify the best new product concepts by asking participants their opinions on a range of concept ideas.[16] The aim is to obtain an objective evaluation of the quality and reliability of the participants' opinions, which are then evaluated by an impartial expert and by the other participants. To ensure that this method works efficiently, the information must be updated in real-time and an appropriate system of incentives developed for the participants.

Product Design

By allowing consumers to participate in a wide range of activities, from making minor changes in existing products to suggesting more radical ones, digital environments allow consumers to design and develop new products.[17] Consumer priorities can be transformed into engineering priorities by letting customers specify product features to incorporate in the final product. Such a co-definition of product features can range from simply applying mass-customization tools to combining aesthetic and functional features conceived in modular form, to developing cross-functional design teams involving customers, to allowing the customer to design the product entirely by himself.

Consumers can be asked to select different product attributes by applying web-based tools of conjoint analysis. Virtual interfaces are relatively easy for the company to implement and enjoyable for the respondents to navigate. Of course, there are some limitations, including the small screen of most computer monitors that reduces the number of profiles that can be viewed; the limited time and concentration that most respondents give to the task; and the fact that instructions and tasks must be understood without the researcher present.[18] Nevertheless, companies can identify as much information as traditional conjoint analysis—the key features users prefer, the attributes that interact, and the ideal combination of these attributes. This method has been successfully applied in developing a wide range of products, from cameras to toys and detergents. The most advanced applications of web-based conjoint analysis have led to the mass customization of products designed and sold online. One example is the Nike site that allows consumers to customize sneakers. In general, respondents are asked to either add attributes to a basic model or eliminate undesirable ones from the complete configuration.[19]

In order to speed up new product development and make it less costly, toolkits for user innovation can be assembled to exploit new technologies such as computer simulation.[20] These toolkits are coordinated sets of user-friendly tools that allow users to develop their own innovations and also eliminate the problems of sharing customer knowledge, often considered sticky due to its context-specific nature. These tools usually support specific projects, requiring ad hoc competences in a product category. Within this area, the user is free to

innovate, develop customized products by trial and error, and even propose new patents.[21] Prototyping and rapid experimentation are also crucial in supporting this stage.[22] Indeed the cost of developing and testing virtual prototypes is much lower than physical prototypes and virtual reality can enhance the quality of the interaction and the process of distributed learning. A great variety of industries have begun to introduce these applications. For example, in the software industry, users can download beta versions in order to identify possible bugs. Web-based toolkits have also been successfully developed in the industries of computer circuits, plastics, and consumer goods.[23]

User design mechanisms can be applied by ad hoc virtual cross-functional teams created by companies or organically by the larger virtual communities of product users. In the first case, consumers are regarded as partners in the innovation process and are encouraged to participate in specific projects. After undergoing a rigorous selection process and offering appropriate incentives, consumers participate in distance work teams and collaborate with members chosen from the Marketing, R&D, and Production divisions. Networking systems and groupware technologies make it possible for the organization to share consumer knowledge. In the second case, customer-input in the innovation processes is mainly based on open-source mechanisms.[24] These mechanisms support communities run completely by and for the users and allow them to share opinions on specific products that, initially, are mainly technical but can lead to direct collaboration in creating a broad range of new products and services. Many studies show that these mechanisms are particularly useful in developing innovations where systematic new product development is essential.[25] The sense of responsibility towards the group and the awareness of the significant impact on the community are often key motivating factors for qualified participants.[26]

Product Testing

Digital environments can make the new product testing stage more efficient, leveraging technologies such as simulation and combinatorial methods.[27] If the cost of transforming the product concept into a prototype is low, it makes sense to move the selection stage as far up as possible in the innovation process. This allows for increased response flexibility, thereby reducing product development time, promoting the process of trial and error, and preventing the information collected at the beginning of the cycle from becoming outdated.[28]

Web-based tools enhance this approach by exploiting the potential of virtual reality and animation in order to give rise to low-cost virtual prototypes. Indeed, it is virtuality that provides the needed realism that allows customers to understand and evaluate the complexity of the product from different angles. This can be done by applying the Virtual Reality Markup Language.[29] This tool is a three-dimensional virtual representation of the product that, when combined with streaming video and interactive sensory peripherals, allows visual, auditory, and tactile information to be effectively distributed to end users. Consumers can

view detailed descriptions of each prototype combined with virtual tours around and inside the product.

The virtual representation of the product can also be enhanced by reproducing other marketing mix attributes in order to create a total virtual shopping experience. This additional method, aimed at supporting the market forecast for new products, is also defined as Information Acceleration. Like the evaluation of an electric vehicle prototype proposed by Urban and colleagues, each user can not only virtually "enter" the car, but can also interact with other users and the car dealer, as well as view advertising material.[30] The amount of information required to reproduce a simulation of the purchasing experience tends to be much greater compared to simple virtual product testing, and the number of tested prototypes also tends to decrease. Finally, it is worth noting that in both cases, conjoint analysis makes it possible to make reliable estimates of the future market share of each prototype.

Product Launch

The role of web-based customer tools in the innovation process does not end with the product development stage. Online activities such as viral marketing or web-enabled word-of-mouth become strategic tools that can effectively promote the final product launch stage.[31] Companies can initiate viral marketing with techniques such as sending a specific web page "to a friend." Due to the reliability of the information source, these "electronic postcards" can enhance product exposure at a low cost and increase product trust.[32] In order to support this "word-of-mouse" activity, the company can offer ad hoc incentives—such as discount coupons—to both the sender and the recipient of viral messages.[33]

This phenomenon may also be enhanced by virtual communities. The members' reciprocal trust catalyzes the exchange of experiences and, vice versa, the exchange of information enhances member relationships.[34] Since users come together spontaneously, these communities create an interesting target for companies because they are the result of a process of self-segmentation that ensures considerable involvement. Therefore, promoting company-run communication through forums or chat rooms based on shared values can profoundly influence purchasing expectations. In fact, users may even turn into veritable proselytes of the company's products. In order to support the launch of new products to targeted groups, these communities are sometimes hosted by independent minisites, which differ from corporate sites in that they are short term and designed to promote individual product launches. Alternatively, sites dedicated to new products can be set up within the main site, often with links via the home page.

Customer involvement in the product launch stage may also occur by means of personalized communication, especially customized newsletters sent to customers according to permission-based criteria.[35] Providing personalized customer assistance can also enhance customer relationship management. Even organizing events by bringing together offline and online users contributes to strengthening interaction and making the users feel part of a select group. In fact, the activities related to customer relationship management take on crucial

importance throughout the entire new product life cycle. These activities allow the company to systematically interact with its customers and obtain regular feedback, crucial to subsequent product upgrading. Web-based tools therefore foster new product development by making it an ongoing process that continuously benefits from customer input. The recent emergence of 3G mobile networks will substantially increase the opportunity to communicate and provide customer relationship management (CRM) solutions to the end market.[36] In fact, mobile communication enhances the possibility of pursuing *contextual marketing* strategies, because it allows companies to identify the customer's location and to send appropriate messages when the customer is willing to pay more attention to them. For instance, Unilever tried out such an application by offering Northern-European shoppers recipes and suggestions directly in the supermarket via their mobile.[37]

Research Method

We carried out a quantitative analysis of the public web sites of firms in industries exposed to both online technology and the dynamics of innovation and change. The industries we selected are the automobile, motorcycle, electronics, toiletries, and food industries.

We identified 28 variables that represent the web-based tools that companies can adopt to interact with customers to support the different stages of their innovation process. Table 1, in the first two columns, summarizes our classification (for detailed information on the research method adopted, see Appendix 1). The following three areas of results emerged from our study:

- the specific web-based tools that are diffused at each stage of the process;
- the variation in web-based tool presence across companies in different industries; and
- the core features shared by the companies most involved in web-based customer innovation.

The Specific Use of the Web in the Innovation Process

The frequency analysis mainly shows that the sample companies include web-based tools to encourage customer participation particularly during the initial and final stages of new product development—specifically, during idea generation, product launch, and the management of the product life cycle (see Table1, columns 3 and 4).

During the idea generation stage, almost all of the sample companies offer consumers the option of direct company contact, and about 37% of these firms carry out ad hoc online surveys or request specific feedback related to the product or site. Even the suggestion box, used to collect consumer ideas to improve existing products or launch new ones, is drawing attention and is used by 8% of the sample companies.

TABLE 1. Selected Web-Based Tools Used at the Different Stages of the Product Innovation Process

Innovation Process Stage	Selected Tools (28 Variables)	Actual Presence	Percentage
Idea Generation	1. "Contact the Firm" Option 2. Feedback Session/Survey 3. Suggestion Box 4. Complaint Area 5. Virtual Community 6. Formalized Mechanisms of Competition on New Ideas 7. Agreement Area to Manage Intellectual Property Rights 8. Customer Advisor Programs	"Contact the Firm" Option Feedback Session/Survey Suggestion Box	90.4% 36.8% 8.1%
Idea Selection	9. Analysis of Customer Opinions 10. Virtual Concept Test 11. Focus Group On Line	Analysis of Customer Opinions Virtual Concept test	3.8% 1.4%
Product Design	12. Mass Customization of Aesthetic Attributes 13. Mass Customization of Functional Attributes 14. User Patents for New Products 15. Open Source Mechanisms 16. Design Toolkits 17. Virtual Teams	Mass Customization of Functional Attributes Mass Customization of Aesthetic Attributes User Patents for New Products	30.1% 2.9% 1.4%
Product Testing	18. Virtual Product Test 19. MarketMmm Market Test	Market Test Virtual Product Test	24.8% 0.5%
Market Launch	20. New Product Area 21. Events 22. Customized Newsletter 23. Virtual Communities 24. Viral Marketing 25. Customized Assistance in Product Selection 26. Mini Web sites	New Product Area Events Customized Newsletter	63.2% 49.3% 40.7%
Product Life Cycle Management	27. Customized CRM 28. Customized Newsletter	Customized Newsletter Customized CRM	54.1% 32.5%

In contrast, online tools are not widely diffused during the idea selection stage. Regardless of industry, only 4% of the sample companies allow individual users to view the evaluations of other customers and none allows direct interaction among these customers. Furthermore, there is no evidence of online focus groups designed to involve customers in the selection of new product concepts. Compared to the other stages, product design relies on a wider range

of collaborative mechanisms. At the simplest level, input for product design based on the customized aesthetic and functional features of the product (3% and 30% respectively) appears to be a common practice. At a more innovative level, in compliance with intellectual property rights agreements, some companies (1.4%) allow customers to submit their patents to develop new products.

Although the web is not often used during the product testing phase, digital environments are commonly used to verify the overall effectiveness of a particular marketing mix. In fact, almost one-fourth of the sample companies use this tool, especially those operating in the mass-market industry.

Finally, a wide range of tools is used to support the new product launch and the management of the product life cycle. For instance, it is common to find one area of the site dedicated to informing customers about the history and features of new products (63%); there are also mini-sites dedicated to new products, especially in the electronics (e.g., Siemens) and technology (e.g., IBM) industries. In addition, the communication of online events, often combined with offline activities (49%), appears to play a key role in promoting the product launch on the market. In all the sample industries, customized newsletters, sometimes supported by viral marketing mechanisms, are also commonly used to promote a new product launch (41%), or recruit for activities related to subsequent stages of the product life cycle.

Numerous other tools are used to carry out activities related to web-based customer relationship management (32.5%). By resorting to chat rooms and forums, virtual communities not only promote the spread of product or service information within specific user groups, but also contribute to further reinforcing the customer's tendency to buy. Other mechanisms widely used to support a new product launch provide personalized assistance to help consumers select a product. These instruments are often based on product comparison or model selector programs designed to assist the user in identifying the product that best satisfies his or her needs. Such comparison tools are most common among electronic products (e.g., personal computers, Dell; televisions, Blaukpunt; cellular phones, Nokia) and automobiles (e.g., Mercedes, Ford). Some versions of this instrument go beyond merely comparing brands and even compare features of the different models produced by a company. In conclusion, within the framework of growing personalization and enhancement of the interactive features, typical of digital environments, the web plays a fundamental role: at the beginning of the new product development process, during the stage of customer knowledge absorption for idea generation, and at the end of the process, during the product launch and life cycle management stages.

The Impact of Industrial Specificity

We found that companies vary across industries in their use of online customer feedback in the new product development process (see Table 2). For instance, web sites run by companies operating in the toiletries, food, and motorcycle industries provide several tools in the early and final stages. In the

earlier stages of the process, the food and toiletries companies prefer more traditional tools—such as consumer contact with the company or the option for the analysis of other customers' opinions. Companies in these industries offer recipes or advice in dedicated sections, but only in a few cases they systematically attempt to directly involve customers. For example, the Kashi site's "My recipe" section invites customers to "send in your recipe." Although the food and toiletries companies generally prefer one-way communication, there are some interesting exceptions. For example, P&G has a section devoted to new product development that provides a customer advisor option and a collection area for suggestions in the "Share Your Thoughts" section. The Ben & Jerry's and Findus sites also include suggestion boxes. Reward mechanisms for proposing innovative uses of company products can be found on the Hellman's site, while market tests offering customers product samples are available on the P&G and Nestlé sites. In the early stages of the new product development process, companies in the motorcycle industry also include tools on their web sites such as suggestion boxes, reward mechanisms for new product concepts, and customer advisor programs. Motorcycle companies, such as Ducati and Aprilia, also encourage direct consumer participation by offering rewards such as spare motorcycle parts. In most cases, this application of web-based tools is governed by copyright regulations that define the intellectual property rights of customer "projects."

The situation is substantially different in the electronics and automobile industries. These companies provide online mechanisms to support almost all the stages of the innovation process, even the middle stages, which involve product development and testing. However, although electronics companies are more likely to include specific tools in these stages (such as consumer patents for new product solutions, open source mechanisms, product design tools, and virtual product tests), the automobile companies seem to prefer less-innovative tools (such as mass customization and market tests), mainly designed to obtain suggestions from the users indirectly. In the electronics industry, there are many interesting cases. For example, in its "Clip It Covers" section, the users registered with Siemens can design their own mobile phone covers. The company also promotes a contest designed to advance the development of Java technology applied to mobile phones. In its "forum for technology developers" section, Nokia uses the open source mechanism to develop new technologies applied to mobile phones and related value added services (VAS) as well as to applications for computer connectivity. More classic examples of web site sections dedicated to developing new concepts or technologies can be found in the automobile industry. Volvo's and Fiat's "Build your Car" sections as well as "BMW Individual" or "Audi Configurator" sections allow users to combine the colors, components, accessories, and functional attributes of their automobile and also put together financial and insurance service packages. BMW's "Virtual Innovation Agency" allows users to submit innovative ideas that are subsequently evaluated. If the ideas are accepted, the company patents them and the submitting person is duly remunerated. Finally, both the electronics and automobile industries offer web-based tools supporting the testing stage, especially market tests to

assess the appeal of the finished product. In the automobile industry, these tests include driving simulations; in the electronics industry, they include viewing three-dimensional images of the product and simulating its use.

A final note relates to the automobile and motorcycle industries that are both keen to cultivate online customer relations once the product is launched. This need for an ongoing customer relationship is mainly due to the fact that the product is durable and can arouse the owners' interest. For this purpose, CRM tools are widely used.

Profile of Companies Most Likely to Adopt Web-Based Customer Tools

The results of the final step of the research—the PCA/cluster analysis—show that large, brand-name companies and multinationals use web-based tools the most (see Appendix 2). The composition analysis of the clusters confirmed the earlier results of the frequency analysis. To some extent, most of the sample companies generate ideas through consumer input online and involve customers at the new product launch stage. However, only the largest and more diversified companies belong to the cluster in which online support tends to be used in more than one stage of the development process, adopting particularly innovative tools.

Our interpretation of the underlying online approaches to customer integration is based on the analysis of the factor loadings emerging from the PCA (see Appendix 1 for the detailed output of the analysis)." According to these premises, we interpret factor 1 as being a "mass customization" dimension that portrays the approach to the web as strongly oriented to developing personalized products (both in their aesthetic and functional attributes) and customer service based on customer inputs. A good example of this is the Siemens web site where customers can select both their cell phone cover color and its software attributes. We call factor 2 "product choice." This factor reflects companies using the web in order to strengthen customized assistance in supporting the selection of a new product. The customers' final decision is also facilitated through viral marketing initiatives, while active customer involvement is limited to survey initiatives. Design toolkits and formalized mechanisms of competition for new ideas are associated positively with factor 3. This factor expresses a "user input" dimension, representing customers that participate in contests in order to provide the best innovative solution and receive an appropriate remuneration. Competition among users prevails on peer-to-peer collaboration and appropriate incentives play a key role in supporting effective contributions. We called factor 4 "lead users" and consider it an approach that represents the strong positive coefficients for an "agreement area" to manage intellectual property rights and the user's patent for new products, as well as for the use of suggestion boxes. We interpret this factor as the expression of the firms' desire to cooperate with particularly competent customers, encourage their creativity and allow them to completely develop and patent a new product. A good example is Procter & Gamble, in the

TABLE 2. Measuring the Use of Web-Based Tools in the Five Industries

Industry	Main Stages	Main Tools	% of Firms that Use the Tool
Toiletries	Idea Generation	"Contact the Firm" Option	94%
		Feedback Session/Survey	43%
		Suggestion Box	9%
		Agreement Area to Manage Intellectual Property Rights	6%
	Ideas Selection	Analysis of Customer Opinions	9%
	Market Launch	New Product Area	91%
		Customized Newsletters	69%
		Customized Assistance in Product Selection	66%
		Viral Marketing	46%
Consumer Electronics	Product Design	Mass Customization of Functional Attributes	72%
		User Patents for New Products	7%
		Open Source Mechanisms	7%
	Product Testing	Market Test	17%
		Virtual Product Test	3.5%
Food	Ideas Generation	"Contact the Firm" Option	86%
		Feedback Session/Survey	17.5%
		Complaint Area	7%
	Product Launch on the Market	Customized Newsletter	20%
		Events	17.5%
		Viral Marketing	9%
		Virtual Communities	7%
	Product Life Cycle Management	Customized Newsletters	51.5%
Motorbike	Ideas Generation	"Contact the Firm" Option	93%
		Suggestion Box	29%
		Complaint Area	14%
		Agreement Area to Manage Intellectual Property Rights	14%
		Customer Advisor Programs	14%
	Product Testing	Market Test	21%

TABLE 2. Measuring the Use of Web-Based Tools in the Five Industries *(continued)*

Industry	Main Stages	Main Tools	% of Firms that Use the Tool
Motorbike *(continued)*	Market Launch	New Product Are	93%
		Events	93%
		Mini Web Sites	36%
		Viral Marketing	29%
		Virtual Communities	43%
	Product Life Cycle Management	Customized CRM	86%
		Customized Newsletters	71%
Automotive	Ideas Generation	Feedback Session/Survey	47%
		Virtual Communities	21%
		Suggestion Box	12%
	Product Development	Mass Customization of Functional Attributes	68%
		Mass Customization of Aesthetic Attributes	65%
	Product Testing	Market Test	38%
	Market Launch	Events	94%
		New Product Area	68%
		Customized Newsletters	47%

"Patents & Technologies" area of its corporate web site where customers are asked to send in their patented ideas and technologies developed independently. Factor 5 may be defined as "market research" because it presents positive coefficients for the analysis of other customers' opinions, the presence of customer advisor programs, and the use of market tests. It describes the approach of companies involving customers online essentially as "censors" of their own products. We interpret factor 6 as a one-way customized communication or "newsletter" dimension. It emphasizes a limited approach to the web, confined to personalized advertising and customer relations management to support new product launch and management. Factor 7 shows the strongest positive coefficients for complaint areas and mini web sites, such as the sites systematically run by Ferrero for Nutella. This factor therefore expresses a "two-way communication" approach that can include interactions both with and among individual users. We call factor 8 "social collaboration" since it shows positive coefficients for virtual communities enhancing idea generation and events supporting the product introduction phase. Consequently, it represents the typical approach of companies leveraging the web to involve customers in order to enhance creativity and

image, i.e., both product and branding strategies. Finally, open source mechanisms and virtual communities are associated positively with factor 9, labeled "open sourcing." It reflects an approach to collaboration based on peer-to-peer mechanisms, describing customers that work together on the same product, contributing to it according to an incremental approach, as in the Nokia Club where customers can participate in the Developer Platform and contribute to the evolution of Java and Bluetooth applications.

These factors were subsequently used as the variables according to which the sample firms were grouped into six clusters based on their approach to collaborative web-based innovation (Table 3).

Three of the resulting clusters are extremely limited in size, and composed of the top performer companies.[38] Specifically, cluster 2 is made up of only one company, Siemens, and clearly stands out because of the relevance of user input. This factor is very weakly (see cluster 6) or negatively related to any other cluster. In fact, the company shows an unusual tendency to involve customers in virtual product testing activities by creating contests to select the best innovation and offering toolkits to allow customers to design their own products. Ad hoc two-way communication is also relevant. Similarly, cluster 5 is made up of a single company, BMW. It is strongly characterized by lead-user involvement that allows users to submit patents to the company and by customizing offerings (at the aesthetic and the functional level). Finally, cluster 3 includes only two companies: Nokia and HP. The dominant characteristic of this cluster is peer-to-peer collaboration for innovation. Virtual communities and open source tools are very relevant for this purpose. Personalized communication is also an important feature of this cluster, characterized by an approach that goes far beyond simply using the web to support only a new product launch.

The remaining three clusters comprise the largest part of the companies analyzed. The largest cluster is the sixth one, which includes 123 cases. It is characterized by a low tendency to leverage the web to cooperate with customers. In particular, this cluster records negative results compared to the other clusters at all stages of the innovation process. This means that more than half of the web sites analyzed still do not include specific functions to support customer collaboration in new product development. Cluster 6 is mainly made up of food & beverage companies (over 75% of the sector companies belong to cluster 6), with a strong concentration of their sub-brand web sites. However, some important toiletries companies—such as Gillette, Shiseido, Elizabeth Arden, Vichy, and Sephora—and a few consumer electronics companies, especially those operating in consumer electronics and household appliances—such as Acer, Philips, LG, Electrolux, Sharp, and Epson—also belong to this cluster.

Cluster 1 includes 27 cases and is characterized by the tendency to use the web to collaborate with customers at the end of the new product development process, especially to support market launch. In any case, this approach still does not fully exploit the online capacity to promote real product co-development through peer-to-peer competition and collaboration. In this sense, virtual

TABLE 3. Non-Hierarchical Cluster Analysis: Final Cluster Centers

	Cluster					
	1	**2**	**3**	**4**	**5**	**6**
Mass Customization	2.15970	1.33187	–.54274	–.28995	3.17889	–.37228
Product Choice	–.24172	.67352	.92691	.71377	–1.10979	–.27763
User Input	–.28107	13.94470	–.03129	–.00646	–.17846	–.04682
Lead Users	–.21674	–.42127	–.00034	.05752	10.44294	–.05961
Market Research	.24131	.30444	–.51748	–.12163	.06677	.00681
Newsletters	.30699	–.56042	.63097	.95171	–1.90077	–.48320
Two-Way Communication	.55714	.85465	.71522	–.19851	–.73502	–.04614
Social Collaboration	.03949	–.62535	–1.08689	.44466	–.61165	–.17977
Open Sourcing	–.08626	.17747	8.63913	–.13086	1.58350	–.07734
Number of Cases	*27*	*1*	*2*	*55*	*1*	*123*

communities are used only to support the initial product launch on the market together with other online events. An attempt to use the web to evaluate products through market tests and the analysis of other customers' opinions is made by firms such as Aprilia, Volvo, and Nissan. Generally speaking, most of the very large automotive companies with a well-established brand name—including Chrysler, Ford, Jaguar, Maserati, Mazda, Mercedes, Saab, Toyota, and Volkswagen—are grouped in this cluster.

Finally, cluster 4 is made up of 55 companies that show an incremental approach to using the web to support collaboration with customers throughout their innovation process, especially in the initial stage (idea generation) and final stage (new product launch and management on the market). Specifically, this group of companies is mainly characterized by factor 2, i.e., by using the web to facilitate product choice and enhance communication activities supporting the introduction of the new product at the end of the innovation process. Cluster 4 companies also use the web to gather customer input through feedback sessions and surveys at the beginning of the innovation process. This cluster is also characterized by factor 6 (i.e., using the web to support one-way customized communication) and by factor 8 (i.e., using the web to obtain new stimuli through social collaboration at the idea generation stage and enhance brand image by means of events). Excluding cluster 5—made up of only BMW—this is also the only cluster showing a positive coefficient for factor 4, i.e., collaboration with lead-users. Cosmetics, motorbikes, and consumer electronics companies (especially those operating in the mobile phone and computer sectors) mainly make up this cluster. However, it is worth noting that a few food companies that cooperate quite intensively with customers at the idea generation stage, such as Ben and Jerry's and Hellmann's, are also included in this cluster. Similarly, some automotive companies—Ferrari, Peugeot, and Subaru—also belong to cluster 4

and interact with customers online to carry out market research and support the launch of new products. Generally speaking, this cluster comprises multinationals and leading operators, such as P&G, l'Oreal, Lancome, Revlon, IBM, Sony, Dell, Toshiba, Motorola, Ducati, Yamaha, and Honda. In particular, this cluster shows a high concentration of corporate sites of multi-brand companies.

Discussion and Conclusions

Customer involvement in the innovation process represents one of the most promising areas of development in connection with the collaborative marketing strategies that the new virtual customer environments make possible. The over 200 brand and corporate sites analyzed in this study show, however, that web-based tools are not always implemented to accelerate and improve new product development through customer involvement. In fact, only specific stages of the innovation process are supported by the web, a limited set of two-way communication tools are still included and not all companies seem to show an optimal level of interest in leveraging these tools.

First, the analysis highlights that web-based tools designed to involve customers in the innovation process tend to be concentrated in the early stages (i.e., idea generation) and in the later stages (i.e., product launch and management). The core activities of the innovation process are still controlled and managed by the company. In other words, there is a growing tendency to "listen to the customer's voice" through web-based tools, even if this "voice" is then reinterpreted and transformed into specific product features through autonomous, in-company activities. Moreover, only after the product launch does the company go back to considering web-based tools for two-way communication and direct customer involvement. However, industry specificity tends to play a significant role. In particular, some companies in the electronics and automobile industries stand out in their implementation of tools that involve customers even in the most important stages of the innovation process, i.e., product development and testing.

Second, the web-based tools that companies tend to prefer are still those that perform traditional offline activities at a lower cost online. What seems to emerge is a gradual approach in which companies initially adopt web-based tools to support activities already functioning offline and then use these tools more intensively to develop more radical forms of customer interaction and involvement. The tools most commonly considered include direct contact with the company, web-based surveys and feedback sessions, newsletters, personalized support for activities related to customer relations management, and events to support the launch of new products and services. The less commonly used tools include more innovative instruments, especially those designed to support the development stage, such as open source mechanisms and toolkits to design products. However, it is worth mentioning the increasing number of new options, including suggestion boxes and reward mechanisms during the idea generation stage and patents with explicit copyright regulations in the new

product development stage. Although these tools are still not widely available, they point the way to greater customer involvement in the innovation process and the industries that develop products with high levels of digital content are taking the lead.

Finally, large companies, especially multinationals and well-established brand-name companies, are the ones that mainly involve consumers directly in the innovation process. However, across industries, these companies tend to exhibit more qualifying features. The companies in the motorcycle and automobile industry that involve customers more intensively in new product development online tend to have focused consumer groups sharing a common passion. Companies in the toiletries industry and the food industry maintain corporate web sites that promote collaborative marketing together with more traditional sites at the brand level. In the electronics industry, companies operating in mobile phones and personal computers have a wider range of web-based tools than those operating in consumer electronics and household appliances.

To sum up, the dominating approach in leveraging the web to support collaborative innovation is still incremental, and apparently companies are gradually integrating the traditional activities of new product development with online tools to promote systematic customer interaction. However, our results also show that using web tools can go beyond their association with specific stages of the product development process. These tools can, in fact, be aggregated according to the degree of customer involvement they allow. By combining our review of past literature and empirical findings with the results of our data analysis, we have come up with an alternative picture of web-based collaborative innovation (Table 4). Identifying the principal advantages and limitations of each tool provides managers with guidelines to help them in the decision-making process.

APPENDIX I

Data Collection and Measurement

First, we made an explorative analysis on a group of web sites characterized by high visibility, i.e., companies that extensively use their web sites to collaborate with customers in their innovation activities. We considered two cases for each of the five sample industries. Our exploratory analysis led us to include a final stage of the new product development process related to the management of the product life cycle. In order to improve the reliability of the classification that relates each tool to a specific stage of the new product development process, we also ran a focus group involving five managers responsible for the innovation activities of their companies (one for each sample industry). By combining the evidence from both the literature and this explorative analysis, we identified 28 variables. They represent the online mechanisms that companies can adopt to interact with customers in order to support the different stages of the innovation process. To make the analysis as objective as possible, each variable is described

TABLE 4. Managerial Guidelines: Advantages and Limitations of Web-Based Tools for Collaborative Innovation Depending on the Degree of Customer Involvement these Tools Allow

Web-Based Tools	Advantages	Disadvantages
Mass Customization		
Product Customization Options	• Easy to Implement for the Firm • Experiential to Use for Customers • Opportunity To Define Ideal Combinations Of Attributes • Enhanced Customer Loyalty through Personalization	• Product Modularity Needed • Technological Competences • Usage for Incremental Innovation Only • No Access to Customer Competences
Customized CRM	• Reduced Information Overload • Customer Decisions Support • Customer Loyalty and Lock-In, Higher Profits	• Challenges Implementation • Constant Need of Customer Information • Management of Customer Life Cycle • Dedicated Organizational Competences
Product Choice		
Customized Assistance in Products Selection	• Increased Customer Satisfaction • Time-Purchase Decision Reduction • Affective Commitment • Incentive for "Parking" on Web Site	• Need for Collaborative Filtering Applications • Dedicated Organizational Competences
New Product Area	• Enhanced Product Exposure and Product Trust at Low Cost	• High Customer Expectations • Need For Continuously Up-to-Date Information
Viral Marketing	• Enhanced Product Exposure and Product Trust at Low Cost • Dissonance Reduction • Strong Power of Incentives	• Low Possibilities of Control • Rapid Diffusion of Negative Opinions As Well
"Contact the Firm" Option	• Huge Reach at Limited Costs • Enhancement of Firms' Direct Ties • Point of Entrance for Interactivity	• Low Richness • Generic Usage • Low Incentives for Users
Feedback Session/Survey	• High Versatility (Opportunity to Get Feedback on Site, Product, Services) • Limited Costs and Real Time Feedback to Reduce Uncertainty	• Sample Control • Self Filled-In Questionnaires • Predominance of Pre-Codified Items
User Input		
Virtual Product Test	• Response Flexibility and Possible Changes In Market and Technology Reducing Product Development Time • Learning from Low Cost Mistakes • Multimediality	• Product-Related Limitation: Not All Products Can Be Virtually Tested • Lack of Sensory Experience; • Technologies Constraints: Limited Bandwidth.
Design Toolkits	• Access to Sticky Customer Knowledge • Learning by Doing Process • First-Mover Advantages • Contribution to Radical Innovation	• Translating User Designs into Inputs for Production • Need for User-Friendly Technologies • High Development Cost

TABLE 4. Managerial Guidelines: Advantages and Limitations of Web-Based Tools for Collaborative Innovation Depending on the Degree of Customer Involvement these Tools Allow *(continued)*

Web-Based Tools	Advantages	Disadvantages
User Input *(continued)*		
Formalized Mechanisms of Competition on New Ideas	• Selection of the Best Customer Assets • Strong Power of Incentives	• Participation Constraints: Time-Related, Product-Dependent • Cost of Payoffs and Intellectual Property Rights Management
Lead Users		
Agreement Area to Manage Intellectual Property Rights	• Selection of the Best Customer Assets • Strong Power of Incentives	• Need for Strong Focalization • Use of Standard Models for Different Contributions
User Patents for New Products	• Completely Developed New Product • Original and Quality-Certified Ideas	• Property Right Recognition • Patent Management
Suggestion Box	• Leveraging Customer Ideas and Competences • Loyalty: It Provides Individuals with a Sense that Firms Care about what They Think and Want • Easily Supported through Incentives	• Risk of Not Focused Content, Time Consuming • Difficulties In Turning The Contents Into A Solution • Usage Limited To Support Incremental Innovation
Market Research		
Analysis of Customer Opinion	• Eliciting and Comparing Information from a Large Number of Dispersed Customers at the Same Time	• Group-Thinking Phenomena • Management Costs
Customer Advisor Programs	• Cost-Effectiveness • Continuous Feedback • Positive Effect on Loyalty	• Need for Continual Updating • Great Commitment Required
Market Test	• Low Cost of Simulating Product Use • Estimating Future Market Share	• Great Amount of Information Required to Reproduce a Simulation of the Purchasing Experience
Newsletters		
Customized Newsletter (for Market Launch and Product Life Cycle Management)	• Proactivity: News, Innovations, Events at Mouse-Length • Permission-Based Marketing: Sensitive-Use of Customer Profile	• Low Tolerance towards Spamming Effects • Customer Database Management Costs
Two-Way Communication		
Complaint Area	• Focused Content • Immediate Applicability • Low Cost • Real Time Feedback	• Immediate Answer Expected from the Company • Dedicated Personnel Needed • Time Consuming

TABLE 4. Managerial Guidelines: Advantages and Limitations of Web-Based Tools for Collaborative Innovation Depending on the Degree of Customer Involvement these Tools Allow *(continued)*

Web-Based Tools	Advantages	Disadvantages
Two-Way Communication *(continued)*		
Mini Web Sites	• Close Access to Single Product Features • Experiential Marketing	• Costs of Creating and Managing New Web Sites on a Contingent Basis
Social Collaboration		
Virtual Communities	• Enhanced Product Trust and Loyalty • Leveraging Other Customer Experiences to Reduce the Perceived Risk of New Product Purchases	• High Motivation Needed: Restricted Number of Participants • Dedicated Community Managers Enforcing Participation Rules • Animation Costs
Events	• Individual Involvement • Customer Retention	• Need to Continuously Integrate On-and Off-Line Initiatives
Open Sourcing		
Virtual Communities	• Enhanced Product Trust and Loyalty • Leveraging Other Customer Experiences to Reduce the Perceived Risk of New Product Purchases	• High Motivation Needed: Restricted Number Of Participants • Dedicated Community Managers Enforcing Participation Rules • Animation Costs
Open Source Mechanisms	• Reciprocal Relationship in Creating A High Quality Product • Flexibility • Knowledge Sharing and Integration • Enhancement of User Reputation • Sense of Group Responsibility	• Clear Participation Rules and Incentives Needed • Modular Project Structure • Undirected Innovation and Potential Chaos • Low Internal Coordination

by using a number of different attributes. In order to simplify the descriptive analysis, company performance indexes are provided that incorporate the information collected in the single attributes for each variable identified. The indexes were created by giving the same weight to each attribute. In this way, we consider that all the variables have the same relevance for the company. Each attribute has a value of 1 if present and 0 if absent. For each company, the sum of all the attributes considered per variable made it possible to obtain absolute indexes, which were subsequently relativized. For instance, at the idea generation stage, different tools were considered, including a suggestion box. This variable was then described by means of seven attributes: simple presence, use targeted to web site innovation, use targeted to service innovation, use targeted to product innovation, presence of pre-defined leading topics, offer of monetary incentives, and offer of non-monetary incentives. In the case, for instance, of the presence of a suggestion box that is targeted to both web site innovation and product innovation, and whose usage is enhanced through monetary incentives, four out of seven attributes are included. Therefore, the absolute index assumes

the value 4 and the relativized index is equal to 4/7, that is 0.57. Consequently, each variable obtained a score between 0 and 1, where 0 means that the sample company did not include the specific tool and 1 that it included the tool in the most complete way. It is worth highlighting the fact that these variables are not dummy, but rather can assume any value included between the two extremes—0 and 1. The higher the value of the index, the greater the intensity of presence of the related tool in the company's web site.[43] By measuring the average frequency of tool presence, we were able to assess to what extent companies actually include tools supporting customer collaboration in their own websites.

Sample Definition and Data Analysis

The five sample industries selected were characterized by the great importance given to absorbing customer knowledge in the product innovation process and the intense use of the web to support customer interaction. The sample firms were chosen from three geographical areas: Europe, North America, and Asia. They were selected by using both offline and online sources; specifically, we relied on industry reports, the Dun & Bradstreet database, and the Chamber of Commerce annual reports. For each company, we contacted the official corporate web site in order to have a complete list of both global and local versions of the core web site, as well as a detailed list of all the related brand web sites. We then focused our analysis on the global versions of our sample companies' web sites, both at the corporate and brand level. Specifically, the survey covered a sample of 209 web sites, classified as follows: 35 in the automotive industry; 13 in the motorcycle industry; 28 in the consumer electronics industry; 36 in the toiletries industry; and 13 in the food industry (considering, in this case, an additional 84 sub-brand sites).

We analyzed the web sites of all the relevant international players, except for the food industry, which is extremely fragmented. In this case, we focused on the multinational corporations and their related brand sites. By analyzing each site, it was possible to identify the specific tools used to interact with consumers in defining new products or redefining existing ones. Where necessary, we took part in specific web-based initiatives limited to registered users, in order to better clarify the kind and the intensity of the interaction. The same analysis for each web site was repeated three times over a six-month period (January to June 2004) to ensure that the data collected was influenced neither by short-term initiatives nor by the elimination of some tools for unaccounted reasons.

Additional data were subsequently processed by carrying out a cross-industry cluster analysis, in order to show how companies supporting web-based collaboration in new product development share similar features. More precisely, since high correlation among clustering variables can be problematic due to the overweighting of one or more underlying constructs,[44] we first addressed the multicollinearity problem by running a principal component analysis. This allowed us to re-group web-based tools not based on the phases of the new product development process, but rather on the type of data sought and the goals the firm is trying to pursue. To that end, we first eliminated the variables always equal to 0-web-based tools used by no companies, and then we applied the principal component analysis to the remaining 25 variables,

using the Varimax with Kaiser Normalization as a rotation method (see in Table A1 the rotated component matrix). In this way, we were then able to use the resultant nine uncorrelated factor scores as the basis for clustering.[45] Specifically, we based our cluster analysis on a deductive approach, so that the number and sustainability of clustering variables, as well as the expected number and nature of groups in a cluster solution are strongly tied to theory.[46] We used a non-hierarchical algorithm because of it can optimize within-cluster homogeneity and between-cluster heterogeneity.

APPENDIX 2

Four outliers emerged from our cluster analysis. In order to ensure that the presence of these outliers would not make our principal component analysis and the following cluster analysis potentially distorted, we followed the suggestion of one reviewer and we reran the analysis after eliminating the outliers. The results did not change significantly from the analysis presented in the main text of this article. Specifically, we found that eight factors explain 69.4% of total variance. The first factor is the synthesis of the previous factors 4 (lead users) and 5 (market research). Factors 2 and 4 perfectly overlap, respectively, with the previous factors 1 (mass customization) and 6 (newsletter). Factor 3 is basically similar to the previous factor 2 (product choice). These four factors comprehensively account for more than 40% of the total variance. Factor 5 here better expresses the use of virtual communities; factor 6 can be related to viral marketing; factor 7 and factor 8, respectively, are the expression of the presence of complaint areas and formalized mechanisms of competition on new ideas and they can not be aggregated with other variables.

The new factors were then used as the new variables in the cluster analysis. By using again a non-hierarchical algorithm, we achieved the best results when we grouped companies into three clusters. In fact, when analyzing the F tests, factors 4 and 7 are the only factors that are not significant when three clusters are considered. Therefore, we focused our attention on the remaining six factors to describe the characteristics of each group of companies (Table A2).

The most populated cluster is still the first one, which includes 169 companies. It is characterized by a low tendency to leverage the web throughout the entire innovation process in order to cooperate with customers. In particular, consistent with the results obtained in our previous analysis, this cluster records negative results compared to the other ones as regards all stages of the new product development process. The second cluster is made up of 34 companies and is described especially by factors 2 (mass customization), 3 (product choice), 5 (virtual communities) and 8 (formalized mechanisms of competition on new ideas). It includes 3 toiletries companies (l'Oreal, Reflect, and Covergirl), 5 consumer electronics companies (Samsung, Toshiba, Sony, Apple, and Blaupunkt), 4 motorbike companies (Ducati, Aprilia, BMW, and Yamaha) and most of the sample automotive companies, which are characterized by the tendency to use the web to involve customers also at the new product development stage, especially by offering mass customization options. Tools to obtain customer feedback

TABLE A1. Results of the Principal Component Analysis: The Rotated Component Matrix

	Components*								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Mass Customization of Aesthetic Attributes	**.945**	–.030	.122	N.R.	N.R.	N.R.	–.032	N.R.	–.017
Mass Customization of Functional Attributes	**.939**	.112	–.009	N.R.	N.R.	N.R.	–.011	N.R.	N.R.
Customized CRM	**.515**	.388	N.R.	–.031	N.R.	N.R.	N.R.	.329	.166
Customized Assistance in New Product Selection	.116	**.719**	–.089	–.116	.241	N.R.	–.254	–.030	N.R.
New Product Area	N.R.	**.647**	N.R.	–.001	N.R.	.227	.285	N.R.	N.R.
Viral Marketing	–.100	**.534**	N.R.	.281	N.R.	.122	–.146	.296	–.027
"Contact the Firm" Option	–.051	**.490**	N.R.	.310	–.226	.141	.245	–.373	N.R.
Feedback Session/Survey	.713	**.472**	N.R.	.213	.233	.150	.240	N.R.	.221
Virtual Product Test	N.R.	N.R.	**.969**	–.029	N.R.	–.039	N.R.	–.043	N.R.
Design Toolkits	N.R.	N.R.	**.969**	–.029	N.R.	–.039	N.R.	–.043	N.R.
Formalized Mechanisms of Competition on New Ideas	–.113	–.054	**.479**	.150	–.008	.358	–.108	.386	–.107
Agreement Area to Manage Intellectual Property Rights	N.R.	.178	–.003	**.812**	N.R.	N.R.	N.R.	.314	–.069
User Patents for New Products	.165	–.047	–.018	**.787**	.203	–.093	–.060	–.073	N.R.
Box Suggestions	–.025	.113	–.038	**.545**	**.488**	.151	.435	N.R.	–.098
Analysis of Customer Opinions	N.R.	N.R.	N.R.	N.R.	**.722**	N.R.	–.158	N.R.	N.R.
Customer Advisor Programs	–.157	N.R.	–.050	.138	**.705**	N.R.	.365	–.042	–.082
Market Test	.308	.320	.134	.206	**.639**	–.013	N.R.	N.R.	–.020
Customized Newsletter (for Product Life Cycle Management)	N.R.	.144	–.079	N.R.	N.R.	**.883**	N.R.	N.R.	N.R.
Customized Newsletter (for Market Launch)	.160	.249	N.R.	–.045	.122	**.807**	.136	.113	N.R.
Complaint Area	–.028	–.133	–.078	N.R.	–.022	.211	**.677**	–.037	.194
Mini Web Sites	N.R.	.171	.201	–.108	.114	–.125	**.672**	.174	–.097
Virtual Communities for Idea Generation	N.R.	N.R.	–.043	.120	N.R.	N.R.	N.R.	**.814**	.159
Events	.193	.323	N.R.	.104	–.025	.137	.401	**.504**	N.R.
Open Source Mechanisms	–.053	.120	–.002	–.008	–.047	N.R.	N.R.	–.091	**.860**
Virtual Communities for New Product Launch	.142	–.044	–.015	N.R.	N.R.	N.R.	N.R.	.390	**.791**
Share of Variance Explained Tot. Var. Expl. = 70.66%	*9.5%*	*9.0%*	*8.9%*	*7.8%*	*7.7%*	*7.2%*	*7.0%*	*6.9%*	*6.3%*

*****Factor Meanings: 1 = Mass Customization; 2 = Product Choice; 3 = User Input; 4 = Lead Users; 5 = Market Research; 6 = Newsletters; 7 = Two-Way Communication; 8 = Social Collaboration; 9 = Open Sourcing.

TABLE A2. Non-Hierarchical Cluster Analysis Without the Outliers: Final Cluster Centers

	Cluster		
	1	**2**	**3**
Lead User and Market Research	–.12809	.20950	7.26224
Mass Customization	–.36921	1.89039	–.93878
Product Choice	–.09381	.48387	–.29926
Newsletter	.03049	–.20162	.85089
Virtual Community	–.06271	.36116	–.84045
Viral Marketing	–.05770	.15602	2.22307
Complaining Area	–.02028	.10961	–.14967
Formalized Competition Mechanisms	–.05785	.36259	–1.27560
Number of Cases	*169*	*34*	*2*

at the beginning of the new product development process, support the new product launch, and facilitate the appropriate product choice by customers characterize this cluster which aggregates mainly corporate web sites of well established companies. Finally, the last cluster is made up of only P&G, aggregating both its Cosmetic Division and Food Division. This large and diversified multinational company remains an outlier, because of its advanced approach to the web in supporting collaborative innovation with customers. In fact, it shows a positive correlation with factor 1 (lead user and market research) and factor 6 (viral marketing).

Considering that in our dataset only a few companies present web-based tools throughout the entire new product development process, it seems reasonable that after eliminating the original outliers we found an additional outlier and a cluster grouping all the remaining companies which significantly stand out by using the web for innovation purposes.

Notes

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8. See Glen L. Urban "Customer Advocacy: A New Era in Marketing?" *Sloan Management Review*, 24/1 (Spring 2005): 155-159.
9. See, for instance, Mary Beth Solomon, "Targeting Trendsetters," *Marketing Research: a Magazine of Management and Applications*, 8/2 (Summer 1996): 9-13; Taylor Randall, Christian Terwiesch, and Karl T. Ulrich, "Principles for User Design of Customized Products," *California Management Review*, 47/4 (Summer 2005): 68-85.
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13. For Volvo and other examples, please see Emanuela Prandelli, Gianmario Verona, and Deborah Raccagni, "Il ruolo del Web ai fini del coinvolgimento del cliente nei processi di innovazione: teoria e prassi a confronto," *Micro & Macro Marketing*, 3 (2003): 321-359. For theoretical considerations about virtual interfaces, see Randall, Terwiesch, and Ulrich, op. cit.
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31. Steve Jurvetson, "Turning Customers into a Sales Force," *Business2.0*, 1 (March 2000).
32. David Kenny and John F. Marshall, "Contextual Marketing: The Real Business of the Internet," *Harvard Business Review*, 78/6 (November/December 2000): 119-125.
33. In fact on the Internet customers are just "one click away" from each other. Word-of-mouth, hence, turns into what some authors call *word-of-mouse*. See Frederick Reichheld and Phil F. Schefter, "E-Loyalty," *Harvard Business Review*, 78/4 (July/August 2000): 105-113.
34. Lee Sproull and Sara Kiesler, *Connections: New Ways of Working in the Networked Organization* (Cambridge, MA: MIT Press, 1991).
35. Customized newsletters are dedicated newsletters with information of interest for the individual customer. They are customized because they are sent to profiled customers and sometimes also have content that is customer-specific. Regarding permission-based criteria, see Seth Godin, *Permission Marketing: Turning Strangers into Friends, and Friends Into Customers* (New York: NY: Simon & Schuster, 1999).
36. We acknowledge one of the reviewers for letting us note this relevant trend. See, for instance, Tony O'Driscoll, David Reibstein, and Venkatesh Shankar, "Mobile e-Business: Disruptive Technology or Untethered Extension of Business as Usual?" *Strategy+Business 3.0* (2003).
37. Kenny and Marshall, op. cit.
38. These top performer companies can be considered as outliers that implement unique behavior when using the web to support their NPD process. In order to make our principal component analysis and the following cluster analysis strong enough, we eliminated the outliers and reran both the former and the latter. The emerging results confirmed the evidence described here and they are provided in detail in the final appendix. We thank both anonymous reviewers for suggesting this further step in our analysis.
39. We are not differentiating between heavy and light users of each web-based tool. The fact that the web is still not widely used to support innovation makes the median always equal to 0. Therefore, we included among those using a specific tool any player that obtains a result greater than 0, considering the index related to the same tool.
40. David J. Ketchen and Christopher L. Shook, "The Application of Cluster Analysis in Strategic Management Research: An Analysis and Critique," *Strategic Management Journal*, 17/6 (1996): 441-458.
41. Girish Punj and David W. Stewart, "Cluster Analysis in Marketing Research: Review and Suggestions for Application," *Journal of Marketing Research*, 20 (May 1983): 134-148.
42. David J. Ketchen, James B. Thomas, and Charles C. Snow, "Organizational Configurations and Performance: a Comparison of Theoretical Approaches," *Academy of Management Journal*, 36/6 (December 1993): 1278-1313.
43. We are not differentiating between heavy and light users of each web-based tool. The fact that the web is still not widely used to support innovation makes the median always equal to 0. Therefore, we included among those using a specific tool any player which obtains a result greater than 0, considering the index related to the same tool.

44. David J. Ketchen and Christopher L. Shook, "The Application of Cluster Analysis in Strategic Management Research: An Analysis and Critique," *Strategic Management Journal,* 17/6 (1996): 441-458.
45. Punj and Stewart, op. cit.
46. Ketchen, Thomas, and Snow, op. cit.