

# A Manager's Perspective on Virtual Customer Integration for New Product Development

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*Despite the high potential of virtual customer integration (VCI) methods for new product development (NPD) mentioned in the literature, practical use is still limited. This paper aims to provide a deeper understanding of managers' perspectives on VCI and their intentions to use these methods for NPD. The theory of planned behavior (TPB) served as basis for developing a research model, which considers managers' cognition, attitude, subjective norms, and perceived behavioral control as important factors affecting their intention to apply VCI. Because more recent literature has expressed doubts about the explanatory potential of the rather simple TPB model, a more complex alternative model was proposed for comparison. The alternative model included the market orientation of the company, the hierarchical position of the innovation manager as well as the manager's level of innovativeness as additional explanatory variables. An empirical online study was conducted in the field of consumer goods and services. Based on a sample of 216 German-speaking innovation managers, the results show that the model derived from the TPB explains 68% of the variance in the managers' intention to apply VCI compared with 69% of variance explained by the model containing additional explanatory variables. An extension of the model does not significantly improve its explanatory power. Managers show high interest in virtually integrating customers in NPD processes. Managers consider identification of future customer needs, a broader decision basis, increased efficiency in gathering and use of customer information, and increased customer retention as major advantages of VCI. Disadvantages considered by managers in making their overall judgment are the lack of secrecy and only incremental innovations. The perceived potential contribution of VCI to NPD, the assessment of its general acceptance within the company, and the perceived ability of innovation managers to successfully implement VCI mainly influence the adoption decision. Managers' attitudes toward VCI have no significant influence on their intention to use VCI. The results suggest that strong promotion of VCI through senior management would enforce the positive effect of subjective norms on applying VCI. Measures such as including VCI on innovation managers' personal scorecard, trainings offered, and cross-functional meetings could help speed up VCI in NPD processes by increasing innovation managers' perceived behavioral control toward VCI.*

## Introduction

Virtual customer integration (VCI) allows the exchange of information and the sharing of tasks between an innovating company and (potential) customers<sup>1</sup> of its products via the Internet within all stages of new product development (NPD) from idea generation and concepts through development and design to test and market launch (Dahan and Hauser, 2002a, 2002b). Customers are not only able to create their own products but also willing to participate in and provide their know-how during innovation processes

(Franke and Shah, 2003; von Hippel and Katz, 2002). Integrating customers into NPD may increase the success of new products (Urban and Hauser, 2004; Verona, Prandelli, and Sawhney, 2006). It can help establish relationships based on trust and commitment (Nambisan and Nambisan, 2008; Sirdeshmukh, Singh, and Sabol, 2002). Due to high interaction costs, however, the number of customers integrated into NPD processes and the intensity of interaction has been limited (Ernst, 2004). As new technology for interactive communication, virtual product animation, and data handling became available, new promising ways to interact with a mass of formerly anonymous customers via the Internet have emerged (Dahan and Hauser, 2002b; Droge, Stanko, and Pollitte, 2010). However, with the exception of pioneering firms like Adidas, Audi, BMW, Lego, Procter & Gamble, and Sony, which virtually integrate customers into NPD, VCI has found only limited use so far (cf. Prandelli, Verona, and Raccagni, 2006).

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<sup>1</sup> The term customer in this paper refers to actual users in a consumer context. Hence, the term customer is synonymous with consumer and user, and vice versa. This terminology also includes the different states of former, actual, or potential purchase, consumption, or usage.

Today, most research on VCI focuses on the design of tools to use and on the abilities of customers needed for participation in NPD. Some authors have concentrated on toolkits that allow the transfer of tacit knowledge and enable consumers to become innovators themselves (von Hippel, 2001). Others have focused on the development of superior market research tools for valid virtual concept evaluation and product testing (Dahan and Hauser, 2002b; Spann, Ernst, Skiera, and Soll, 2009; Toubia and Florès, 2007). Despite the positive findings, VCI has not widely spread in consumer goods and services industries. To the authors' knowledge, no research has investigated managers' expectations concerning VCI and what influences their intention to apply VCI. This study explores factors that motivate managers to use VCI and/or hinder

its use. The research focuses on two main research questions: (1) What are managers' attitudes toward VCI and what are the salient beliefs leading to this attitude? (2) What factors determine the intentions of managers to virtually integrate customers into NPD?

The paper starts with an introduction of the concept of VCI, followed by the presentation of the research framework and the deduction of hypotheses. Then, the description of the data collection approach and of the sample surveyed precedes the presentation of findings. Finally, the paper discusses the findings and outlines the possible implications. The study provides insights into the requirements to be fulfilled to meet managers' expectations concerning VCI.

#### BIOGRAPHICAL SKETCHES

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## VCI

Wants and needs, as well as the knowledge acquired through the actual use of products, make customers an essential external resource for NPD (Franke, von Hippel, and Schreier, 2006). As the Internet lowers the cost of using large samples of customers (Dahan and Srinivasan, 2000) and allows instantaneous feedback from customers all over the world, new possibilities for customer integration into NPD arise (Franke and Piller, 2004; Nambisan, 2002; Prahalad and Ramaswamy, 2004; Verona et al., 2006). VCI virtually involves customers throughout all stages of NPD and provides managers with unambiguous information about customer expectations and aspirations (Sawhney, Verona, and Prandelli, 2005). By supporting customers in articulating and designing their own customized innovations (Jeppesen, 2005), VCI makes use of customers' know-how, creativity, and judgment. The concept of VCI covers all aspects—for example, tools, tasks, product presentations, incentives, and web design—needed to create an efficient and effective virtual dialogue between customers and producers and to enable the transfer of customers' preferences and knowledge to producers.

The literature has pointed out a number of advantages and disadvantages related to product development in collaboration with customers (Campbell and Cooper, 1999; Gruner and Homburg, 2000; Leonard-Barton, 1996; Littler, Leverick, and Bruce, 1995). As the Internet offers new possibilities to interact with customers (Toubia and Florès, 2007), additional literature has discussed the potential advantages (Table 1) and disadvantages (Table 2) a company can derive from VCI. In view of the many potential pros and cons and managers' apparent reluctance to adopt VCI, there is a need to know more

**Table 1. Potential Advantages of VCI**


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Reduction of market risks: Through virtual customer integration, risks and market uncertainties can be reduced as market feedback is already available in the early NPD stages (Dahan and Hauser, 2002b; Dahan and Srinivasan, 2000; Hemp, 2006)

Identification of future needs: The virtual dialogue with customers allows identification of previously unrecognized customer needs or combinations of needs (Dahan and Hauser, 2002b).

Greater variety of ideas: VCI helps not only to access consumers' opinions and evaluations of new products but also to utilize their creativity to generate new ideas (Dahan and Hauser, 2002b; Füller, Bartl, Ernst, and Mühlbacher, 2006).

Acquisition of new customers: By virtually participating in the development of a new product, consumers become familiar with and at the same time attracted to the new product to which they contributed (Dholakia and Morwitz, 2002).

Increased customer retention: Virtual product development, as a compelling experience in itself, creates trust and commitment. It can serve as a means of establishing and improving relationships with existing or potential customers (Gruner and Homburg, 2000; Nambisan and Nambisan, 2008).

Broader decision basis: Due to the use of virtual prototypes the number of test options can be increased and product alternatives can be tested in parallel throughout all stages of NPD (Dahan and Hauser, 2002b; Urban and Hauser, 2004).

More efficient customer information: The Internet offers simplified and faster modes of interaction with a formerly anonymous mass of consumers at steadily falling costs (Dahan and Hauser, 2002b).

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NPD, new product development; VCI, virtual customer integration.

about managers' perceptions of VCI as well as the pre-disposition impacting those perceptions.

## Conceptual Framework

From a psychological perspective, the usage and implementation of new methods such as VCI depends on managers' individual predispositions. Seen from that perspective, Ajzen's (1985, 1991) theory of planned behavior (TPB) seems particularly well suited to explore what determinants drive the decision of managers to apply or neglect VCI. The TPB has been used frequently to predict the acceptance of new technologies and methods (Venkatesh, Morris, Davis, and Davis, 2003). In a business context, the theory has helped to acquire a deeper understanding of factors influencing the intentions of managers to adopt new concepts or systems (Ajzen, 1993; Armitage and Conner, 2001; Godin and Kok, 1996). Lim (2003), for example, applied TPB to research managers' adoption of negotiation support system software; Hill, Mann, and Wearing (1996) selected TPB to explore managers' intention to benchmark; and Cordano and Frieze (2000) drew on TPB to investigate managers' intention to reduce pollution sources.

In accordance with the TPB, Figure 1 suggests a framework to examine which factors influence the intention of managers to virtually integrate customers in NPD. The framework provides a view of the proposed relationships among cognition, attitude, perceived behavioral control, subjective norms, and intention to implement VCI.

*Attitude* refers to an individual's disposition to react with a certain degree of favor or disfavor toward a certain behavior. The TPB posits that the more favorable the attitude toward a behavior, the stronger is an individual's intention to perform the corresponding behavior. Similarly, managers' overall positive affect toward VCI is expected to have a positive influence on the intention to apply VCI. The first hypothesis states:

*H1: Managers' attitude toward VCI is positively related to their intention to apply VCI.*

*Cognition* refers to the advantages and disadvantages that come into one's mind when thinking about a certain behavior. Most TPB theorists assume that formation of an intention starts with cognitive processing of information, followed by an evaluation of the information and the development of an attitude (Ajzen, 2001; Bagozzi, 1982). Cognitive processing is reflected in expectancy-value (EV) judgments formed through the multiplication of an individual's salient beliefs concerning a behavior by the relevance of these beliefs to the individual. The sum of

**Table 2. Potential Disadvantages of VCI**


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Customers' inability to articulate: Even if customers know what they want, they may not be qualified or able to articulate their needs, and transfer their knowledge in a way useful to producers (von Hippel, 2001; von Hippel and Katz, 2002).

Unbalanced target group orientation: Needs and ideas articulated by participating customers may be very specific and not transferable to a larger target group (Littler et al., 1995; Urban and von Hippel, 1988).

Intellectual property problems: Exploiting customers' virtual contributions may result in legal problems concerning intellectual property (Sawhney and Prandelli, 2000).

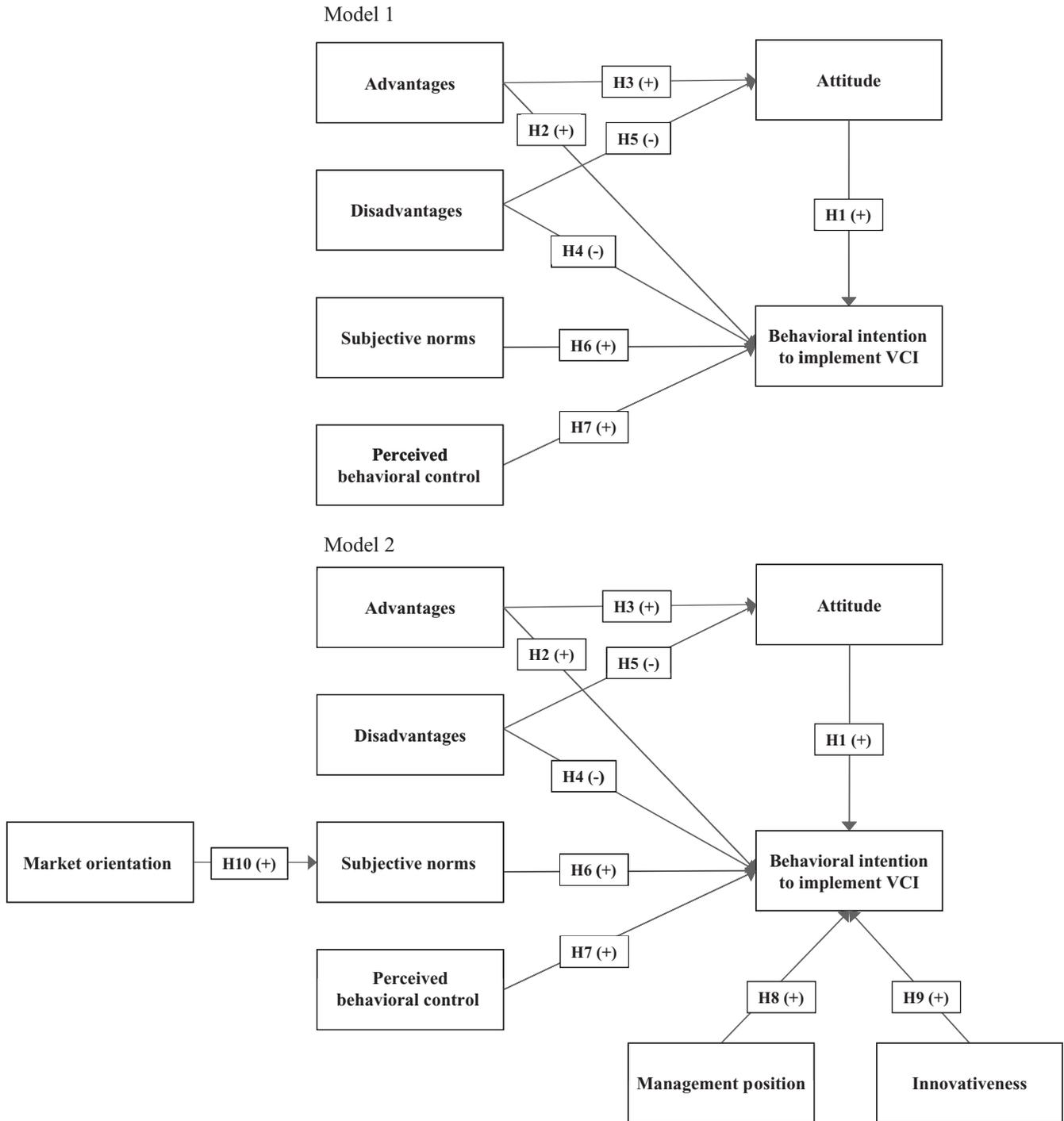
Disturbance of internal processes: VCI may affect and disturb current innovation processes. It may cause frictions, as innovation teams are reluctant to react to external ideas and product developments (Katz and Allen, 1982).

Lack of secrecy: By virtually integrating customers into NPD, a company may provide competitors with access to information that should be kept secret (Brown and Duguid, 2001; Liebeskind, 1996).

Incremental innovations: Customers' ideas and suggestions most often are based on current solutions. Aligning product design to customer wants and needs may result in only incremental improvements (Christensen, 1997; Veryzer, 1998).

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NPD, new product development; VCI, virtual customer integration.



**Figure 1. Research Models of Managers' Intention to Implement Virtual Customer Integration (VCI) in New Product Development**

the EV judgments leads to an overall cognitive disposition toward a behavior, which in turn has an effect on both attitude and behavioral intention (Bagozzi, 1982). Hence, the EV judgments of managers concerning the advantages and disadvantages of virtually integrating customers in NPD should influence the managers' attitude toward VCI and their adoption intention.

*H2: Managers' perceived advantages of VCI are positively related to their intention to implement VCI in NPD.*

*H3: Managers' perceived advantages of VCI are positively related to their attitude concerning VCI.*

*H4: Managers perceived disadvantages of VCI are negatively related to their intention to implement VCI in NPD.*

*H5: Managers' perceived disadvantages of VCI are negatively related to their attitude concerning VCI.*

*Subjective norms* refer to an individual's perceived social pressure to behave, or not to behave, in a certain manner. In other words, the intentions of managers concerning a certain behavior depend on their internalized expectations of relevant others (Ajzen, 1985). In an organizational setting, pressure may stem from peer group members, subordinates, and superiors. Bagozzi and Schnedlitz (1985) claim that subjective norms depend on the person's need for approval, which is defined as a general predisposition to conform to expectations expressed by relevant others. Within a strong organizational culture, behavioral intentions may rather be a function of perceived rewards or sanctions than personal attitude. In weak social contexts, a person's attitude will presumably have more influence on behavioral intention (Bagozzi and Schnedlitz, 1985). This means that although innovation managers should have substantial authority to adopt VCI—as it is within their area of responsibility—the decision to a certain extent will depend on the perceived refusal or acceptance of VCI by other people in the organization who are important to these innovation managers. Due to positive and negative reward mechanisms, managers will feel forced to align their actions with the norms dominant in their social context. Thus, the following hypothesis can be formulated:

*H6: Managers subjective norms are positively related to their intention to apply VCI.*

*Perceived behavioral control* refers to the perceived mastery over performing a certain behavior (Ajzen, 1991). People will avoid doing things that do not realistically seem to be attainable, as failure is costly in terms of self-esteem, wasted time, and resources (Sheppard, Hartwick, and Warshaw, 1988). Following a more recent publication of Ajzen's (2006) perceived behavioral control comprises two separable components that reflect beliefs about (1) self-efficacy, that is, the perceived ease or difficulty of performing a behavior, and (2) controllability, that is, the extent to which performance is up to the actor. VCI requires several competencies rarely available to an individual, such as innovation management, online research, and virtual product design. This variety of skills may only be available in interdisciplinary teams. To successfully implement VCI in NPD, innovation managers will depend on the cooperation of people who are only more or less under their control. They will not personally carry out VCI. The managers need to win and to maintain the cooperation of others.

Thus, beliefs about self-efficacy concerning VCI are not relevant in this case, but controllability is important. Managers who believe themselves to be in control of actions should have a stronger tendency to apply VCI.

*H7: Managers' perceived extent of behavioral control is positively related to their intention to apply VCI.*

According to the sufficiency assumption of the TPB, the intention of managers to virtually integrate customers in NPD can be adequately determined by their cognitions, attitude, subjective norms, and perceived behavioral control (Ajzen, 2001). Context factors and individual characteristics do not have a direct effect on intentions and behavior (Kantola, Syme, and Campbell, 1982). Some scholars (e.g., Karavdic and Gregory, 2005; Kidwell and Jewell, 2003; Venkatesh et al., 2003) have challenged the assumption that the small number of predictors in the TPB can fully account for behavioral intentions. In the case of VCI in NPD, the hierarchical position of the decision-maker, the manager's level of innovativeness, and the market orientation of the company may directly influence the intention of managers to virtually integrate customers. Adding these constructs to the basic theoretical model may increase the model's explanatory power (see Figure 1).

*Hierarchical position* is related to the control over resources. Virtually integrating customers in NPD not only demands the cooperation of people having various specific skills. VCI also needs developing and spending financial, personal, and intellectual resources. The higher the hierarchical position is of the manager in charge of product innovation, the easier it may appear to that manager to have the needed resources available.

*H8: The hierarchical position of an innovation manager is positively related to the manager's intention to virtually integrate customers in NPD.*

*Innovativeness* refers to the degree to which the manager is receptive to new ideas and makes innovation decisions independently of communicated experiences (Midgley and Dowling, 1978; Pallister and Foxall, 1998). VCI is still new to many managers. Depending on the individual level of innovativeness, the introduction of VCI may appear more or less attractive.

*H9: The innovativeness of managers is positively related to their intention to virtually integrate customers in NPD.*

*Market orientation* of a company determines the importance of customer information gathering to the

company (Narver and Slater, 1990). Therefore, the extent of the company's market orientation may have an impact on the subjective norms of innovation managers concerning VCI (D'Ambra, Rice, and O'Connor, 1998). The more market oriented the company is, the stronger should be the perceived social pressure to integrate customers in NPD processes.

*H10: The extent of the company's market orientation is positively related to the subjective norms of managers concerning the implementation of VCI.*

## Sample and Data Collection

The data were collected through an online questionnaire because face-to-face surveys in empirical studies based on the TPB are prone to socially desirable responding and lower accuracy than computer-administered questionnaires (Podsakoff, MacKenzie, Lee, and Podsakoff, 2003). Web-based instruments reduce possible common-method variance problems that could result in inflated reliability measures (Stanton, 1998). Relevant literature, preliminary interviews with marketing and research and development (R&D) managers, and experiences obtained in several VCI business projects guided the development of the survey instrument. The online questionnaire contained several sections focusing on different aspects of VCI from a company perspective. To introduce VCI to the respondents, the questionnaire defined the term as task sharing and exchange of information between an innovating company and (potential) consumers via the Internet within the NPD stages of *idea generation and concepts, development and design*, as well as *test and market launch*. To make respondents answer the following questions based on similar and more precise information concerning VCI, the questionnaire presented six short descriptions of examples from different industries supported by web-based illustrations. The examples demonstrated the application of different tools, methods, and activities of VCI to various product categories and in different stages of NPD. The examples provided the respondents with a deeper understanding of the broad range of how and when customers could be virtually integrated in their companies' NPD. Figure 2 shows four of the examples presented.

After having gone through the examples, participants evaluated the existence and relevance of potential advantages and disadvantages of VCI. The presented list of potential advantages and disadvantages (Table 3) was based on the literature. The list was carefully pretested in interviews with other managers to avoid ambiguous terms

and complicated syntax, and to verify the salience of the listed items. The evaluation task primarily served the purpose of making the respondents explicitly think about the potential advantages and disadvantages of VCI, and to consequently form an overall cognitive disposition concerning VCI. This overall cognitive disposition was measured by the question: "After having evaluated the advantages and disadvantages regarding the application of VCI: What potential do you think VCI has to support and improve new product development in your company?"

To methodologically separate attitude from cognition measurement, attitude as affect toward VCI was measured with a classical semantic differential previously used by Barki and Hartwick (1994) in a similar context. (See Table 5 for the list of items used in the questionnaire.)

To avoid priming effects, the measure of the intention to apply VCI preceded the questions asking for potential subjective norms and perceived behavioral control. The behavioral intention concerning VCI was measured with three items using a 7-point Likert-type scale anchored with "very much" and "not at all." The items taken from Bagozzi and Warshaw (1990) and Loken (1983) were either directly applied or slightly adapted to the context of VCI. The first item was relatively specific for action and target; the second item was specific in time; and the third item tested the behavioral commitment to use VCI in the future.

The three items that measured subjective norms addressed the perceived appreciation of VCI by superiors and the perceived impact of carrying out a VCI project on the respondent's career (Bagozzi and Schnedlitz, 1985; Venkatesh et al., 2003). The items contained 7-point Likert-type scales anchored with "strongly agree" and "strongly disagree."

A single item expressing the perceived capability of the respondents to make their organizations accept the virtual integration of customers in NPD was used to measure the respondents' perceived behavioral control. A single item seemed to be sufficient in this case. Following Fuchs and Diamantopoulos' (2009) single-item measures can be both reliable and valid when a construct is concrete and one-dimensional, the semantic redundancy of multi-items would be high, the sampled population is diverse, and the sample size is limited. Bergkvist and Rossiter (2007) suggest using single items for measuring constructs that consist of a concrete singular object and a concrete attribute. This is the case with perceived behavioral control of innovation managers concerning VCI. Again, a 7-point Likert-type scale was applied, this time anchored with "very easily" and "very difficult."



Figure 2. Examples of Virtual Customer Integration Applications in Different Stages of New Product Development Processes as Shown in the Survey Instrument

Five items based on Narver and Slater (1990) served as measure for market orientation. Managers’ innovativeness was measured by a set of another five items suggested by Pallister and Foxall (1998). All items were scored on 7-point Likert-type scales. Management position was split into upper, middle, and lower management categories, and company size was measured by the number of employees.

Because all items were taken from English sources, they had to be translated into German. To ensure that the German translations accurately represented the meanings of the English items, the translation procedure followed the current methodological standard of double-blind translation (Douglas and Nijssen, 2002).

The questionnaire underwent extensive pretesting by means of a three-step approach. The first pretest involved

five assistant professors and doctoral students; the second and third pretests each involved 10 managers from different consumer goods and services firms. The pretests examined completeness, clarity, ambiguities, usability, technical problems, and time estimates of the questionnaire. Feedback from each phase led to revisions that improved the readability, wording, construct measures, layout, and functionality of the study.

The online survey focused on firms in the consumer goods and services industries. Field interviews had shown that a minimum size of approximately 100 employees seemed to offer a proper organizational setting with an established NPD process suitable for implementing VCI. The German Chamber of Industry and Commerce provided the addresses of companies in our target group. Overall, 1698 firms were contacted by telephone

**Table 3. Means and Standard Deviations of Positive and Negative Expectancy Value Judgments**

Managers' beliefs concerning the effects of VCI and evaluation of their relevance for VCI implementation decisions	Saliency		Relevance		Expectancy Value
	Mean	S.D.	Mean	S.D.	Mean
Advantages resulting from VCI					
To what extent do you agree/disagree with the following benefits resulting from VCI?					
How relevant are these benefits for your decision to apply VCI in your company or not?					
EV1: Reduction of market risks (sales forecast, market acceptance, flop risk).	4.34	1.55	3.78	1.97	17.50
EV2: Information about product use in order to determine future needs and requirements.	4.87	1.33	4.12	1.86	21.04
EV3: Greater variety of ideas gained through customer-initiated and technically elaborated solutions of customer problems.	4.52	1.55	3.72	1.73	18.05
EV4: Acquisition of new customers.	3.99	1.68	3.66	1.87	15.86
EV5: Increased customer retention.	4.54	1.68	4.18	1.94	20.84
EV6: Broader decision basis: Several product alternatives presented as virtual options can be tested simultaneously.	4.67	1.58	3.60	1.85	17.80
EV7: Increased efficiency (time, cost) in gathering and use of customer information relevant to NPD.	4.63	1.59	3.88	1.86	18.81
Disadvantages resulting from VCI					
To what extent do you agree/disagree with the following disadvantages resulting from VCI?					
How relevant are these disadvantages for your decision to apply VCI in your company or not?					
EV8: Customers are not able to articulate their requirements for new products (because they lack technical knowledge).	3.91	1.59	3.80	1.86	16.32
EV9: Consideration of individual customer contributions leads to a lack of target group orientation.	3.87	1.63	3.65	2.05	15.94
EV10: Problems regarding intellectual property when exploiting customers' contributions (copyright, licensing).	3.82	1.85	3.67	1.60	16.62
EV11: VCI disturbs current NPD processes.	2.73	1.45	2.74	2.15	8.73
EV12: Lacking secrecy: Competitors could get access to crucial information.	4.63	1.82	4.48	1.80	23.32
EV13: Incremental innovations: Customers' ideas and suggestions only build on current solutions.	4.52	1.52	3.86	1.86	18.91

Expectancy value (EV) = salient beliefs (b) × subjective evaluations (e); b was measured on a 7-point Likert-type scale, anchored by (1) "strongly disagree" and (7) "strongly agree"; e was measured on a 7-point Likert-type scale, anchored by (1) "not relevant" and (7) "very relevant"; EV ranges from 1 to 49. NPD, new product development; S.D., standard deviation; VCI, virtual customer integration.

to identify managers from the R&D and marketing departments who seemed to be responsible for initiatives such as VCI. The second step of the sampling procedure consisted of a telephone call to the identified managers to give a brief presentation of the research project and to find out if VCI belonged to their area of responsibility. Two hundred twenty participants willing to take part in the survey received an e-mail invitation including the link to the online questionnaire. Each participant was issued with a unique identifying code. To improve the response rates, nonrespondents got a first follow-up mail after two weeks, and a second follow-up e-mail after two additional weeks. As an incentive for taking part in the study, the researchers offered an online summary of the research findings and participation in a workshop presenting and discussing these findings. The data collection strategy led to a sample of 216 respondents who had completely filled

out the questionnaire—a response rate of 12.7%. The applied offline recruiting technique based on telephone interviews allowed preventing an online selection bias. Further, comparing company and participant profiles with the original data of the Chamber of Industry and Commerce showed no significant differences (Armstrong and Overton, 1977). Table 4 presents sample descriptions on company as well as on management levels.

## Measures

Tables 3 and 5 list all measures concerning the measurement models of the study.

Confirmatory factor analysis was used to determine the psychometric properties of the scales. Table 5 reports the local fit indices. Some measurement purification was needed because of either low factor loadings or high

**Table 4. Sample Description**

Sample Description—Company Level	%
<b>Consumer goods sector/services sector</b>	
Bank/insurance	24.1
Electronics	17.0
Food	17.6
Automotive	6.7
Transportation	15.8
Sports/games	7.9
Others	10.9
<b>Number of employees</b>	
≤100	13.9
>100–≤1000	46.7
>1000–≤10000	20.0
>10000	19.4
<b>Percentage of sales used for R&amp;D</b>	
≤5	66.7
>5–≤10	19.4
>10–≤15	3.7
>15–≤20	3.7
>20	6.5
<b>Percentage of sales generated with products not older than three years</b>	
≤10	36.0
>10–≤20	17.2
>20–≤30	10.8
>30–≤40	7.2
>40–≤50	8.1
>50	20.7
<b>Sample Description—Management Level</b>	
<b>Gender</b>	
Female	19.5
Male	80.5
<b>Age (mean: 37.19; S.D.: 8.68)</b>	
≤25	4.5
>25–≤35	41.0
>35–≤45	40.2
>45–≤55	11.1
>55	3.2
<b>Management position</b>	
Upper	13.2
Middle	51.7
Lower	35.1

R&D, research and development; S.D., standard deviation.

cross-loadings. The attitude item (A4), the subjective norm item (SN3), the two innovativeness items (IN4) and (IN5), and the two market orientation items (MO4) and (MO5) were discarded. Further, two positive EV judgments (EV4) and (EV5) as well as three negative EV judgments (EV10), (EV11), and (EV12) were discarded when forming managers' perceived advantages and disadvantages regarding VCI. Standardized indicator loadings, composite reliability, and average variance

extracted of the purified constructs indicate good psychometric properties of the scales. Discriminant validity of the scales was analyzed by applying the Fornell and Larcker (1981) ratio. The local fit measures for the final constructs shown in Table 5 meet all required standards concerning average variance extracted (> .50), composite reliability (> .60), and discriminant validity (Fornell–Larcker ratio < 1).

Two measurement models had to be evaluated: one according to the TPB and an extended model with additional explanatory variables added. Multiple indexes of model fit served for examining and evaluating the measurement models. The fit was assessed with the chi-square test, the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the normed fit index (NFI), and the root mean squared error of approximation (RMSEA). Satisfactory fits are obtained when the GFI, AGFI, CFI, and NFI are greater than or equal to .9, and the RMSEA is less than or equal to .08. Because of sample size effects, the ratio of chi-square and the degrees of freedom were the preferred fit measure rather than using only the chi-square value (Bearden, Sharma, and Teel, 1982). The ratio should be less than or equal to 5. The results for the model fit were:  $\chi^2/d.f.$  (degrees of freedom) = 1.57, GFI = .93, AGFI = .89, CFI = .97, NFI = .93, and RMSEA = .05 for the TPB model; and  $\chi^2/d.f.$  = 1.47, GFI = .90, AGFI = .87, CFI = .96, NFI = .90, and RMSEA = .05 for the extended model. The overall picture shows that the models fit well, although the AGFI slightly missed the proposed fit value.

## Results

### Descriptives

Only 1% of the surveyed companies continuously integrate customers virtually in all stages of their NPD processes. Fifty-three percent of respondents have never applied VCI in any NPD process. These results indicate the high degree of novelty of the VCI approach to managers and their companies. VCI has only started its diffusion within and among firms on a trial basis and for specific purposes.

Overall, the managers' attitude (A) concerning VCI is slightly positive (mean = 4.79; on a 7-point scale ranging from very negative = 1 to very positive = 7; SD [standard deviation] = 1.18). Nearly two thirds of the managers participating in the study (64.8%;  $A > 4.25$ ) have a positive affective disposition toward VCI. Only 11.6% have a negative attitude ( $A < 3.50$ ). However, at the same time,

**Table 5. Psychometric Properties of the Scales**

Construct and Items	Mean	S.D.	Standardized Indicator Loadings	Composite Reliability	Average Variance Extracted	Fornell–Larcker Ratio
<b>Behavioral intention</b> (Bagozzi and Warshaw, 1990; Loken, 1983; Venkatesh et al., 2003)				.91	.76	.82
BI1: Do you intend to integrate customers virtually in NPD?	2.87	1.58	.83			
BI2: Do you plan further steps within the next 12 months in order to implement VCI?	2.55	1.64	.90			
BI3: In the future, you will use virtual customer integration as integral part of your NPD process.	2.50	1.46	.88			
<b>Attitude</b> (Barki and Hartwick, 1994)				.92	.79	.41
Indicate your feelings toward VCI, I consider VCI to be						
A1: Bad/good	5.02	1.32	.83			
A2: Useless/useful	4.97	1.40	.90			
A3: Worthless/valuable	4.81	1.38	.92			
A4: Terrible/terrific <sup>b</sup>	4.36	1.25				
<b>Subjective norms</b> (Bagozzi and Schnedlitz, 1985; Venkatesh et al., 2003)				.85	.74	.85
SN1: Management would appreciate it if you initiate a VCI project.	2.92	1.60	.96			
SN2: The management would assume that carrying out a VCI project is beneficial for your career.	2.74	1.58	.74			
SN3: Management would dissuade you from initiating a VCI-project. <sup>b</sup>	3.84	1.70				
<b>Perceived behavioral control</b> (Bagozzi and Warshaw, 1990)				.60 <sup>a</sup>		.44
Assuming that you intend to carry out a VCI project, you could push through such a project in your company very easily/very difficult	3.35	1.77	1.00			
<b>Advantages of VCI</b>				.90	.64	.70
EV1: Reduction of market risks (sales forecast, market acceptance, flop risk).	2.50	1.79	.76			
EV2: Information about product use to determine future needs and requirements.	3.01	1.77	.79			
EV3: Greater variety of ideas gained through customer-initiated and technically elaborated solutions of customer problems	2.58	1.72	.78			
EV6: Broader decision basis: Several product alternatives presented as virtual options can be tested simultaneously.	2.55	1.77	.82			
EV7: Increased efficiency (time and cost) in gathering and use of customer information relevant to NPD	2.69	1.79	.82			
<b>Disadvantages of VCI</b>				.72	.57	.05
EV8: Customers are not able to articulate their requirements for new products (because they lack technical knowledge).	2.33	1.77	.78			
EV9: Consideration of individual customer contributions leads to a lack of target group orientation.	2.28	1.81	.69			
EV13: Incremental innovations: Customers' ideas and suggestions only build on current solutions.	2.70	1.76	.57			
<b>Innovativeness</b> (Pallister and Foxall, 1998)				.72	.47	.03
IN1: I must see other people using new innovations before I will consider them.	2.37	1.19	.80			
IN2: I rarely trust new ideas until I can see whether the vast majority of people around me accept them.	3.16	1.56	.73			
IN3: I am suspicious of new inventions and new ways of thinking.	2.59	1.44	.51			
IN4: I am challenged by ambiguities and unsolved problems. <sup>b</sup>	5.35	1.35				
IN5: I consider myself to be creative and original in my thinking and behavior. <sup>b</sup>	4.95	1.35				
<b>Market orientation</b> (Narver and Slater, 1990)				.85	.66	.02
MO 1: We constantly monitor our level of commitment and orientation to serving customers' needs.	4.90	1.69	.78			
MO2: Our business strategies are driven by our beliefs about how we can create greater value for customers.	5.36	1.49	.87			
MO3: All of our business functions (e.g., marketing/sales, manufacturing, R&D, finance/accounting, etc.) are integrated in serving the needs of our target markets.	4.69	1.74	.81			
MO4: Our strategy for competitive advantage is based on our understanding of customer needs. <sup>b</sup>	5.36	1.52				
MO5: We rapidly respond to competitive action that threaten us. <sup>b</sup>	4.87	1.66				
<b>Management position</b>				.60 <sup>a</sup>		.05
MP: Which position do you have in your company: lower, middle, or higher management?	2.22	.66	1.00			
<b>Cognitive judgment of VCI</b>				.60 <sup>a</sup>		.85
After having evaluated the advantages and disadvantages regarding the application of VCI: CJ: What potential do you think VCI has to support and improve NPD in your company?	3.44	1.55	1.00			

Items measured on a 7-point Likert-type scale; attitude items were recoded from 1- to 7-point scales to a bipolar range of -3 to +3. <sup>a</sup> As we cannot assume that a single item measure is error free, the reliability of the measures of perceived behavioral control and management position were set to .60, assuming that the reliability of these measures is not lower than the lowest acceptable level of reliability of other items in the survey instrument (Hair et al., 2010). <sup>b</sup> Items have been deleted from the final construct because of measurement purification.

NPD, new product development; R&D, research and development; S.D., standard deviation; VCI, virtual customer integration.

the overall perceived potential of VCI to support and improve NPD is only moderate (mean = 3.44 on a 7-point scale ranging from very low = 1 to very high = 7; SD = 1.55). Only 30.6% of respondents see a rather high potential (cognitive judgment; CJ > 4), whereas 53.7% consider the potential for NPD improvement to be rather low (CJ < 4).

The reason for that discrepancy may be found in the perceived advantages and disadvantages of VCI (summarized in Table 4) showing participants' EV judgments. Information about product use to determine future needs and requirements (EV2), increased customer retention (EV5), and the increased efficiency in gathering and use of customer information (EV7) turned out to be the highest ranked advantages of VCI in terms of saliency times relevance. The fear of lacking secrecy (EV12) dominates the EVs on the list of potential disadvantages, followed by the belief that customers' ideas and suggestions would lead to incremental innovations only (EV13). The potentially disturbing effect of VCI on currently established NPD processes neither receives much agreement nor is perceived as relevant for the decision to apply VCI.

Backward multiple regression analysis served to check which EVs are significantly related to managers' overall cognitive disposition measured by the overall statement (Table 6). Backward regression analysis is appropriate for regressions with a large number of independent variables to determine the most powerful variables and to avoid multicollinearity (Hair, Black, Babin, and Anderson, 2010). Our results show that managers' EVs explain the 44.4% of variance in cognitive dispositions toward VCI. The EVs concerning the reduction of market risks (EV1, beta = .259\*\*\*), information about future needs and requirements (EV2, beta = .196\*\*), and the broader decision basis provided by VCI (EV6, beta = .237\*\*\*) have strong positive effects on managers' cognitive disposition toward VCI. The EV concerning customers' ability to articulate their requirements for new products (EV8, beta = -.122\*) shows the expected negative relationship.

Most of the participating managers do not expect positive feedback from their superiors when virtually integrating customers in the NPD processes of their companies (mean = 2.82 on a 7-point scale; SD = 1.60). Overall, 23.6% of participants considered appreciation of management as very unlikely. Only 15.7% considered management appreciation as more likely than unlikely. Similarly, for the 30.1%, it is very unlikely that carrying out a VCI project would be beneficial for their career (mean = 2.74; SD = 1.58). Only 14.4% considered beneficial effects as more likely than unlikely.

**Table 6. Summary of Backward Regression Analysis: Impact of Expectancy Values on Overall Cognitive Disposition**

Independent Variables	Dependent Variables Managers' Overall Cognitive Disposition
EV1: Reduction of market risks (sales forecast, market acceptance, flop risk).	.259***
EV2: Information about product use in order to determine future needs and requirements.	.196**
EV4: Acquisition of new customers.	n.s.
EV6: Broader decision basis: Several product alternatives presented as virtual options can be tested simultaneously.	.237***
EV7: Increased efficiency (time and cost) in gathering and use of customer information relevant to NPD	n.s.
EV8: Customers are not able to articulate their requirements for new products (because they lack technical knowledge).	-.122*
EV9: Consideration of individual customer contributions leads to a lack of target group orientation.	n.s.
EV11: VCI disturbs current NPD processes.	n.s.
<i>R</i> <sup>2</sup>	.444
<i>F</i>	27.791***

\* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.

NPD, new product development; VCI, virtual customer integration; n.s., not significant.

Less than 30% of the participating managers think that they would be able to successfully implement VCI in their company (mean = 3.35 on a 7-point scale; SD = 1.77). For the 55.1%, it is more unlikely than likely that they could convince their organization to realize a VCI project.

In view of these findings, the rather low intention to apply VCI measured with behavioral intention (BI) as an overall factor (mean = 2.64 on a 7-point scale; SD = 1.42) does not come as a big surprise. Although the behavioral intention seems to be low at first sight, it can be stated that 17.6% of the respondents were more likely than unlikely to implement VCI, and 11.6% of the participants were still undecided. This is in line with the 16% share of innovators and early adopters found in innovation diffusion literature (Rogers, 1995). In line with the findings above, 28.7% of the respondents expressed their interest in attending a workshop to learn more about the results of this study. This interest underscores the intention of part of the respondents to become better informed about VCI and its application.

**Table 7. Summary of Path Coefficients**

Path	Model 1	Model 2	Model 3
	Not Controlling for CMB	Not Controlling for CMB	Controlling for CMB
Attitude → behavioral intention	n.s.	n.s.	n.s.
Advantages → attitude	.618***	.614***	.354***
Disadvantages → attitude	-.213**	-.219**	-.259*
Advantages → behavioral intention	.169*	.171*	n.s.
Disadvantages → behavioral intention	-.120*	-.112*	-.189*
Subjective norms → behavioral intention	.573***	.572***	.322*
Perceived behavioral control → behavioral intention	.215***	.217***	.377***
Management position → behavioral intention		n.s.	n.s.
Innovativeness → behavioral intention		n.s.	n.s.
Market orientation → subjective norms		n.s.	n.s.

$n = 216$ ; \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

CMB, common-method bias; n.s., not significant.

### The Structural Model

A comparison of variance explained in managers' intention to apply VCI by the model based on TPB ( $R^2 = 68\%$ ) to the variance explained by the model containing additional explanatory variables ( $R^2 = 69\%$ ) shows that an extension of the model does not significantly improve its explanatory power (Table 7). None of the explanatory variables added to the TPB model had a significant effect on the behavioral intention concerning the implementation of VCI in NPD rejecting H8, H9, and H10. Table 7 shows that, consistent with expectations, cognitions, subjective norms, and perceived behavioral control significantly predict managers' intention to implement VCI. The managers' attitude failed to significantly predict behavioral intention ( $\beta = \text{n.s.}$ ), rejecting H1. Perceived advantages had a significant positive effect on behavioral intention of  $\gamma = .171$  ( $p < .05$ ), and perceived disadvantages had a significant negative effect of  $\gamma = -.112$  ( $p < .05$ ), confirming H2 and H4. Further, perceived advantages produced a positive standardized path coefficient of  $\gamma = .614$  ( $p < .001$ ), and perceived disadvantages produced a negative path coefficient of  $\gamma = -.219$  ( $p < .01$ ) on managers' attitude toward VCI, confirming H3 and H5 and accounting for 42% of the variance in managers' attitude. Subjective norms showed the strongest impact on intention with a path coefficient of  $\beta = .572$  ( $p \leq .001$ ), supporting H6. Perceived behavioral control predicted intentions with a path coefficient of  $\gamma = .217$  ( $p \leq .001$ ), supporting H7. In total, cognition represented by managers' perceived advantages and disadvantages, subjective norms, and perceived behavioral control accounted for 68% of the variance in behavioral intention.

To control the results for potential common-method bias, a single unmeasured latent method factor was introduced in the causal model. That is, an unmeasured latent construct was added, and all items were allowed to load on their theoretical constructs, as well as on the latent common-methods variance factor. This procedure allows controlling the portion of variance in the indicators due to their same source and other same-method effects. For identification purposes, method factor loadings had to be constrained to be equal when estimating this model (Podsakoff et al., 2003). Examination of the significance of the structural parameters with and without this factor in the model showed a similar fit of the model when the common-methods variance factor was included. Besides the previously encountered significant positive effect of perceived advantages on behavioral intention formulated in H2, which turned out to become nonsignificant, all other path effects remained the same (i.e., the effects that were significant or nonsignificant when common-method variance was not controlled remained significant or nonsignificant when it was controlled) (Podsakoff et al., 2003). While these relationships were not strongly affected by the common-method variance factor, they changed slightly. The relationship between perceived advantages and attitude as well as subjective norms and behavioral intention decreased to a small extent, while the relationship between perceived behavioral control and the relationship somewhat increased (Table 7). Overall, common-method bias slightly affected but did not change the picture of the presented results. In line with Spector (2006), the study has established that the variables of interest are related. Future research may "do a series of studies and analyses to control and test for plausible biases that might have distorted the observed relationship" (Spector, 2006, p. 230).

## Discussion

The study was performed to shed light on (1) managers' attitudes toward VCI in NPD processes and what salient beliefs have the greatest impact on these attitudes; and (2) what are the determinant factors of influence on managers' intention to virtually integrate customers into NPD. Three key findings arise from the study.

Managers' affective reaction to VCI is positive. They appreciate the general idea of virtually integrating customers in their NPD process. However, although various advantages of VCI in different stages of NPD processes are suggested in the literature, managers consider efficient information gathering regarding future needs and requirements of customers as the main benefit. A greater variety of ideas, a broader decision basis, and the reduction of market uncertainties are related advantages. VCIs' potential for acquiring new customers has been perceived to be relatively weak until now. The perceived problems of VCI do not differ much from the problems associated with innovation collaboration in offline settings. Managers regard incremental innovations, lack of secrecy, problems regarding intellectual property, and the inability of customers to articulate their requirements for new products as the main disadvantages of VCI. However, with the exception of the danger to overfocus on the needs of some very active customers, the perceived disadvantages do not have a major impact on managers' overall cognitive disposition toward virtually integrating customers. The potential disturbance of currently established NPD processes by VCI has even a positive effect on managers' evaluations of VCI. One explanation might be that managers who are interested in virtually integrating customers are aware of potential disturbances of current NPD processes but expect rather positive effects once customers are virtually integrated.

The most important finding is that positive affect toward VCI is not enough to effect action, but rather cognitive judgments, perceived social norms, and perceived behavioral control predominantly influence intentions. The intention to implement VCI seems to be the result of an evaluation process considering the perceived advantages and disadvantages of VCI and the perceived potential to successfully implement VCI given the norms currently dominating in the company. In our study, the managers' favorable attitude toward VCI reflected by the positive feelings has no significant impact on its application. Although individuals differ in their tendency to rely on thoughts and feelings (Haddock and Zanna, 1998), this result contrasts the widely held theoretical assumption that attitude tends to predominate as a primary deter-

minant of intended behavior (Ajzen, 2001; Lavine, Thomson, Zanna, and Borgida, 1998). The reason why attitude toward VCI has no significant impact on managers' intentions may not so much be a business world dominated by attitudes and cognitions but rather the influence of the organizational context (Bagozzi and Schnedlitz, 1985). It is more important to managers how the decision is perceived by relevant others. The impact of managers' attitude on their intention to apply VCI may be drastically reduced by the dominant role of subjective norms and the perceived lack of control over the potential implementation of VCI. The opinion of peer group members and senior management toward VCI dominates some managers' intention to adopt. As VCI requires interdisciplinary teams, skills, and interfaces within the organization, its successful implementation demands convincing other members of the organization of the benefits and value of VCI for NPD. VCI projects may require some organizational changes of the established innovation process and may be considered as disturbance of the widely followed stage-gate process. Many companies are not yet ready or willing for a change toward open innovation (Chesbrough, 2003) and the new culture of virtual cocreation (Prahalad and Ramaswamy, 2004). Consequently, an attempt to virtually integrate customers in NPD may have a potentially negative impact on managers' career. Hill et al. (1996), who investigated the intention to benchmark among managers with no benchmarking experience, observed similar findings regarding the primacy of subjective norms. Although benchmarking was intuitively appealing, the policies and beliefs of senior management seemed to determine whether or not the practice would be introduced into the company. The Lead User approach to NPD had a similar faith. It took almost 20 years from the first application and several research studies impressively demonstrating the benefits to be gained to make the Lead User approach popular in NPD processes.

A related explanation for managers neglecting their own attitudes may lie in the lack of perceived behavioral control when implementing VCI. More than 80% of the innovation managers in our study hold lower or middle management positions. The individual manager's attitude in such a position does not seem to be the dominant driver of decision-making. Because VCI is relatively new to many managers, uncertainties regarding the organizational context and technical specificities of implementing VCI prevail. The responsibilities for implementing VCI may not yet be clearly assigned to R&D, marketing, e-business, or other organizational units. The managers' decision is not completely their own. The strong impact

of subjective norms and perceived behavioral control on managers' intentions leads to the indication that middle managers are encouraged to take decisions only in alignment with top-level management and may suppress entrepreneurially guided decision-making.

The third key finding is that frequently studied factors from NPD literature, such as the company's market orientation, the managers' innovativeness, and their hierarchical position do not have a significant effect on the managers' intentions concerning VCI. That is, the intention of managers to implement VCI in the NPD processes of their companies mainly depends on their personal judgment concerning the reaction of peers and superiors and the perceived chance of successfully implementing VCI.

## Implications and Outlook

Up to now, VCI as defined in this research contribution is rarely used to actively integrate end users in the innovation process. Despite the novelty of the concept, the study revealed that responsible managers show high interest in VCI. Our results suggest that if an organization is interested in increasing the acceptance of VCI and in speeding up its implementation, strong promotion of VCI through senior management would enforce the positive effect of subjective norms on applying VCI. Including VCI on innovation managers' personal scorecard would further increase the effect. Trainings offered and cross-functional meetings could help to increase innovation managers' perceived behavioral control toward VCI. As suggested by Verona et al. (2006), managers who perceive the implementation of VCI methods being under their responsibility but not under their complete control and hence, as failure prone may rely on knowledge brokers—third-party actors who facilitate the knowledge transfer and are specialized in the virtual dialogue with communities—to apply VCI.

The fact that our sample only contains respondents from German companies is a potential limitation of this study's external validity. Because of cultural differences, such as a lower tendency of Germans to adopt new trends compared with people from other parts of the world, such as the United States, the results of this study may present a rather conservative picture of reality. However, the basic factors of influence and their effects on the intention to use VCI in NPD very probably are the same across cultures even if effect sizes may vary. The managerial implications, therefore, remain the same.

The choice of the TPB as basic theory for this research resulted in individual respondents as single data sources

and the only reasonable means of assessing the variables of interest. Such choice bares the risk of serious bias. Therefore, closely following the suggestions of Podsakoff et al. (2003) of how to avoid common-method biases in behavioral research, the authors used all available procedural remedies related to questionnaire design, separated the measurement of variables methodologically as far as possible, and guaranteed response anonymity. The comparison of structural parameters and their levels of significance as well as the fit measures for causal models with and without an additional common-methods variance factor showed that common-method bias was not totally avoided but did not have a disturbing impact on the results of the study.

The results of our study should stimulate further research on this evolving issue of product development. Future research on an organizational level may help to overcome managers' objections by providing convincing evidence under which conditions VCI can effectively produce substantial innovations, how secrecy problems may be overcome or the lack of secrecy may even be turned into an advantage, and how legal problems can be avoided. Case studies may offer improved insights how VCI in all stages of NPD works. Cost–benefit analyses can provide reliable material on when to favor VCI over traditional NPD.

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