

Creating Major Innovations with Customers: Insights from Small and Young Technology Firms

The marketing literature typically argues that customers cannot easily be involved with, and contribute to, the creation of major innovation (MI). This article finds otherwise. The authors use an inductive process method to study how six MIs were developed for business-to-business markets by small and young technology firms. Three of the MIs were successful, and three failed. The firms with MI success are distinguished by a nonconventional new product development process that includes five iterative and overlapping activities and up to ten different customer roles. These activities and roles are captured in a multifaceted taxonomy of customer participation. The analysis also uncovers three capabilities relevant to the development of successful MI—capabilities that are effectual rather than adaptive in nature. These findings and the propositions derived from them offer a more complete understanding of customer participation, new product development across contexts, and marketing capabilities.

Keywords: effectuation, innovation, customer participation, cocreation, capabilities

Customers have long been recognized as instrumental to new product development (NPD), with Penrose (1959) observing they provide the inside track to innovation. Certainly, the marketing literature is rich in studies linking customers to NPD success, from the seminal work of Rothwell et al. (1974) to the more recent study by Ramaswami, Srivastava, and Bhargava (2009). In particular, research shows that customer involvement with NPD improves knowledge exchange (Fang, Palmatier, and Evans 2008; Noordhoff et al. 2011), and the literature discusses many ways to incorporate the voice of the customer (Griffin and Hauser 1993). These techniques range from, for example, surveys and focus groups to empathic design (Leonard and Rayport 1997).

Although the literature implies that customers are an important resource for NPD, there are two critical gaps in the field's knowledge. First, it lacks a rich understanding of how customers participate in NPD in terms of their roles and contributions. Prior research tends to confine customers

to being (1) an information source in NPD, (2) a codeveloper (e.g. Fang 2008), and/or (3) a recipient of information (Athaide and Stump 1999). This means that studies have focused on a predetermined, and potentially restricted, set of customer roles. Previous investigations also tend to ignore the possibility that different NPD activities require different types of customer involvement, and the literature rarely examines the dynamics of customer participation throughout NPD. Although previous research reports that customer characteristics and the level of interaction intensity varies for different NPD stages (Gruner and Homburg 2000), little is yet known about what customers actually do during the development process.

The second major gap in the literature pertains to marketing capabilities. If customers are a resource for NPD, it is necessary to understand the capabilities for managing and leveraging them. However, knowledge in this area is lacking (Hauser, Tellis, and Griffin 2006). In addition, scholars continue to discuss the nature of relevant capabilities. In marketing, for example, Day (2011) argues that to help firms position for rapid change in unpredictable environments, they need a new class of capabilities that he terms "adaptive." Although these capabilities are described as anticipatory and responsive (rather than reactive), Day's reasoning appears to consider the environment as outside the control of the firm and its decision makers. This contrasts with Teece's (2007) position that firms must shape, and not just adapt to, the environment in a way that is inherently entrepreneurial. Day's view also seems inconsistent with March (2006, p. 206), who observes that theories emphasizing adaptation are myopic in that they do not "provide powerful understandings about the generation of new ideas, actions, attributes or how persistent novelty is sup-

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ported.” This suggests that perhaps other, nonadaptive capabilities are germane to NPD, particularly in fast-moving market environments. Empirical evidence, however, is absent. This, combined with conflicting arguments in the recent literature indicates a need for research on the issue.

Following from the preceding discussion, our research addresses two important yet understudied questions: (1) How do customers participate in NPD? and (2) What are the capabilities relevant to this process? We study the NPD processes of small and young firms developing major innovation (MI). Our choice of organizational context was influenced by the emphasis of prior customer participation research on larger, established firms (e.g., Fang 2008; Fang, Palmatier, and Evans 2008; Gruner and Homburg 2000)—organizations with the financial resources and human capital to allocate to NPD. This type of firm also tends to have systematic business processes, can afford to take a real-options approach to funding and evaluating projects, and has a propensity to experiment with a portfolio of products (O’Connor, Ravichandran, and Robeson 2008; Song, Di Benedetto, and Song 2010). What does this mean for the firm that is small, young, and relatively less resourced? Such firms play a crucial role in a nation’s economic growth, but they are understudied in NPD research (Rao, Chandy, and Prabhu 2008; Song and Di Benedetto 2008; Yli-Renko and Janakiraman 2008). Many also create novel products. This raises a notable question: If small and young firms have fewer resources, how are they able to succeed with their NPD, especially for MI?

As defined by O’Connor (2008), MI involves either a really new or radical product characterized by market, technology, resource, and organizational uncertainties.¹ We chose MI because not only is it characterized by uncertainty, but in addition, the literature is mixed on the issue of customer involvement. On the one hand, traditional wisdom considers MI an environment in which customers cannot and perhaps should not be involved with NPD. Some suggest that in technology firms, interactions with customers can be particularly complex and unfocused (Mohr and Sarin 2009). Others argue that customer preferences and demands may be unclear or unknown in MI (Leonard and Rayport 1997; Lynn, Morone, and Paulson 1996), and the voice of the customer is inappropriate when time to market, organizational alignment, and opportunity costs are high (Jaworski and Kohli 2006). On the other hand, the open innovation literature (Chesbrough 2003; Von Hippel 1986) regards innovation as the result of a process that couples a firm with partners—including customers—and the service dominant

logic considers customers an operant resource active in, for example, coproduction (Vargo and Lusch 2004). Because leveraging spillovers and partnering with other organizations are ways that the smaller and younger firm might be able to develop MI (Chandy and Tellis 2000) and customers are, arguably, the most important type of external partner for such firms (Yli-Renko, Sapienza, and Hay 2001), we reason that it is vital to study the role of customers in small and young firm NPD for MI. In turn, it is essential to investigate the capabilities appropriate for managing the customer resource during the NPD process. This is reinforced by observations that empirical studies on the capabilities of small and young firms are rare (Zahra, Sapienza, and Davidsson 2006).

Our work is exploratory, and this necessitates a grounded approach, one that allows us to extend existing theory and begin to close the gaps we identify in the literature. Because we view the NPD process as a complex social system, a single theoretical lens may be inappropriate. Thus, although we inform our research with existing theory, we follow Pratt (2008) by distancing ourselves from it to generate new insight. This means that we approach the study with an open frame, drawing on a range of theoretical arguments to inform our findings and develop suggestive arguments regarding customer participation in NPD for MI.

We offer four distinctive contributions to the marketing literature. First, we shed much-needed light on what customers do in NPD by identifying ten distinct roles, each of which represents a different form of input. Presented as a taxonomy, these findings offer a view of customer participation more nuanced and dynamic than that found in the extant literature. Second, we show that successful innovators pursue an atypical and iterative process of NPD for MI, one that (1) leverages customers as an operant resource throughout all of NPD and (2) augments conventional NPD activities with others not discussed in prior research. Firms with MI failure do not take this approach. These findings are novel because they contradict widely accepted patterns in the literature. Third, we provide new insight into the capabilities of firms that succeed with MI. By using empirical evidence to reason that the requisite capabilities are effectual in nature, we question recent conceptual and anecdotal arguments that call for an adaptive approach (Day 2011). Finally, because we study customer participation in the context of small and young firms creating MI, we investigate two important contexts that have received relatively little attention in the marketing literature, and we help address the paradox of how such firms can successfully create novel outputs.

Method

By definition, NPD is a process, and we explore phenomena associated with that process. Accordingly, we use an inductive qualitative method similar to other process research in marketing that uses an open-ended and interpretive approach to obtain rich insight (e.g., Gebhardt, Carpenter, and Sherry 2006; Narayandas and Rangan 2004). We combine biographic histories and archival documents to identify how, when, and which customers participate in

¹Garcia and Calantone (2002) highlight a lack of consistency in research on innovativeness and newness, identifying 15 different constructs and 51 scale items in 21 studies. Their synthesis explains that “really new” innovations include a market or technical breakthrough and a “radical” innovation involves both. O’Connor (2008) argues that the difference between these two types is one of degree, and both are markedly unlike that for incremental innovation. Consequently, she uses the term “major innovation” to include both radical and really new products, and Veryzer (1988) uses the term “discontinuous.” In this study, we follow O’Connor’s conceptualization.

NPD for MI.² We then uncover emergent patterns across MI successes and failures. Because customers are a market-based asset to be managed (Penrose 1959; Srivastava, Shervani, and Fahey 1998), we take the perspective of the developer firm and its decision makers. This is also consistent with other research in this area (Gruner and Homburg 2000; Yli-Renko and Janakiraman 2008). Although customers are not the only external participants in NPD (e.g., Song and Di Benedetto [2008] investigate the supplier's involvement in new venture MI), we examine customers alone to contribute to theory in a specific area. Again, this is similar to Gruner and Homburg (2000) and Yli-Renko and Janakiraman (2008).

Data Collection

The setting for our study is six small and young technology firms serving business-to-business (B2B) markets. Studying this type of firm is important because research shows that high-growth technology companies are the driver of nearly all economic and job growth in, for example, the United States (Kane 2010). The setting also allows us to generate insight into what Rao, Chandy, and Prabhu (2008) believe is a critical yet understudied area: marketing in entrepreneurial settings.

In each firm, we took a retrospective approach to studying the NPD process for one MI. Each MI involves noncustomized information and communication technology (ICT) equipment (for MI and firm characteristics, see Table 1). We chose the ICT industry because it has a history of MI creation. Similar to other inductive studies employing qualitative methods, we recognized that there would be a practical maximum number of firms with which to work. This necessitated sampling MI projects along multiple criteria (Eisenhardt 1989). The first criterion was demographic, and we generated an initial pool of ten innovations, each developed by a small, young, and independent ICT firm serving B2B markets. Second, because the research design required access to key people who were involved throughout the entire NPD process, we met with each firm to assess whether the informants we needed were still with the company and willing to participate and provide access to information.

As detailed subsequently, we also screened each firm to (1) ensure their innovation was either really new or radical (and thus an MI as defined by O'Connor 2008) and (2) determine its market performance. These were our third and fourth criteria, with performance used to ensure that our MIs had diverse outcomes. That is, because our study was retrospective, outcomes were known, and we were able to select innovations that either succeeded or failed. In the process of reviewing firms, we also decided that although

²We use the term "customer" at a general level. As in Yli-Renko and Janakiraman (2008), "customer" usually refers to the next channel members in the value chain (parties to which the firm sells for revenue). However, because market performance is reliant on multiple downstream parties adopting the MI, we take an inductive approach to identify any other customer form that emerges from the data. Thus, customers can include channel members that are influential to the sale and/or use of the MI (Millier 1999), currently and in the future.

they varied in NPD experience (see Table 1), it was appropriate to focus on firms creating their first MI. This allows for better comparison, and organizational memory was less likely to have influenced the firm's ability to move into uncharted territory (Moorman and Miner 1998; O'Connor 1998). The screening procedures excluded four firms, leaving the six firms we present in Table 1. Each organization is a legal entity based in New Zealand, with the MI already launched and sold.

To assess each product, an expert panel rated them using Chandy and Tellis's (2000) index for radicalness of innovations. This index considers two dimensions: substantial differences in core technology and substantial increases in customer benefits, both relative to the previous product generation. The panel consisted of one academic and two industry experts, all specializing in areas related to new technology. They rated differences in core technology on a nine-point scale (1 = "not at all different," and 9 = "substantially different"), and they rated superiority in user benefits on a nine-point scale (1 = "not at all higher," and 9 = "substantially higher"). The experts were given a half-page written description of the product and asked to provide ratings based on these two scales. Consistent with Chandy and Tellis (2000), products qualified for this study only if the average rating from all three judges on each dimension was equal to or more than five on the nine-point scale. As we summarize in Table 1, the six products scored between six and eight. This indicates that they are MIs based on very different technologies and offer substantially greater benefits to customers.³

To identify patterns differentiating more and less successful MIs, we drew on Song and Parry (1997) to measure managerial perceptions of performance because these perceptions underlie decision processes and reflect each firm's industry, time horizon, economic conditions, and goals. We adapted the original measurement items because no firm had other new products with which to make comparisons, nor did the MIs have direct competitors. The measures included items for profits, sales, and market share. Our informants rated performance in each area on a ten-point Likert-type scale (1 = "far less than the objectives," and 10 = "far exceeded the objectives"). We also included a measure of perceived overall profitability (1 = "a great financial failure," and 10 = "a great financial success"). Table 1 reports the averaged success scores and highlights that the MIs were polarized by managerial perceptions of success and failure.

We disguised each firm using the following convention: Names beginning with S indicate a successful innovation (S1, S2, and S3), F indicates a failed innovation (F1, F2, and F3), and customer firms are represented by other letters

³Although all six products meet Chandy and Tellis's (2000) criteria for radical innovation, Christensen (1997) would likely consider them sustaining (but revolutionary or discontinuous). Accordingly, there is more scope for customers, such as lead users, to be involved in NPD than with fully disruptive innovation. We use the label MI (covering both radical and really new products) because truly radical products are rare and perhaps best represented by very high ratings on Chandy and Tellis's scale.

TABLE 1
Major Innovation, Firm and Informant Characteristics

Firm ^c	MI ^a			Firm Characteristics ^b				Informants
	Nature of Technology	Average Difference in Technology (1–9)	Average Superiority of User Benefits (1–9)	Average Success (1–10)	Firm Size (Full-Time Employees)	Firm Age (Years)	NPD Experience	
S1	Imaging and measurement	7.7	7.0	7.8	6	5	Some	CTO (co-owner) Project manager
S2	Sorting and measurement	7.7	7.3	8	130	7	Some	Manager of general R&D Engineer
S3	Wireless monitoring	6.7	6.3	7.4	1	New	None	Founder/CEO
F1	Tracking	6.7	6.0	2.5	1	2	Some	Founder/managing director
F2	Imaging	7.7	8.0	2.6	200	9	Some	General manager/CTO
F3	Solar communication	7.3	6.0	3.5	1	New	None	Cofounder 1 Cofounder 2

^aWe adapted MI measures for radicalness from Chandy and Tellis (2000). We averaged success measures adapted from Song and Parry (1997).

^bData for size, revenue, and age reflect each firm at the beginning of NPD process. S3 and F3 were startups based around the MI investigated here, while S2 and F2 were larger SMEs. Note that we report only full-time employees; S3, F1, and F3 also had between one and three part-time employees at the beginning of NPD.

^cFirm names are disguised.

of the alphabet. The firms with successful MIs were all five to six years into NPD at the time of data collection, had ongoing sales for the technology, and had regular expansion into new markets. In contrast, two of the MI failures had been recently abandoned six to seven years into the process (F1 and F3). The third was still available but was not being actively marketed (F2). All six firms remain in operation.

The first MI we targeted (F2) was a failure developed by a high-profile small to medium-sized enterprise (SME). The willingness of this firm to participate was a supportive signal to other firms we wanted to study. Having established a base project with F2, we began analysis and then selected and began analyzing two successes: S2 and S3. S2 was similar to F2 in terms of size and age, whereas S3 was a startup. We then added three more firms for comparison: one with an MI success (S1, a very small firm) and two with MI failures (F1, another very small firm, and F3, another startup). This approach to analyzing data and then adding firms that differed in size, age, and success is consistent with replication logic (Eisenhardt 1989) and improved the robustness of the study. As in other research taking a process approach (e.g. Gebhardt, Carpenter, and Sherry 2006), we ended data collection when it appeared that additional fieldwork was unlikely to change our findings. This is considered theoretical model saturation (Glaser and Strauss 1967).

To explore how the firms engaged with customers during NPD, data collection included (1) semistructured in-depth interviews with informants in each developer firm; (2) informal follow-ups with e-mails and telephone calls; and (3) review of extensive archives of funding applications, collaborative agreements, meeting minutes, and project diaries. As we summarize in Table 1, informants included founders/owners, senior managers (chief executive officers [CEOs], general managers, and managing directors), technology managers (chief technology officers [CTOs] and research-and-development [R&D] managers), project-level managers, and engineers. All informants were directly involved with the entire NPD process and were knowledgeable about their MI. As such, we expected their interviews to be accurate (Kumar, Stern, and Anderson 1993). According to Pettigrew (1990), using informants from the developer firm is also appropriate because we study the firm's perspective on NPD and seek to understand organizational capabilities. By promising anonymity, we obtained a high level of candor and access to privileged archives. We conducted multiple interviews with each informant to ensure that we captured all relevant aspects of NPD for the MI. We also interviewed informants separately to help validate event histories and mitigate recall bias. If necessary, we brought informants from a firm together to help reconcile information. We conducted 27 interviews over 14 months, generating 67 hours of taped data that were transcribed verbatim.

The starting point for discussion in each interview was an overview of the firm, the informant, and his or her role in the firm and NPD. We then discussed the background to the MI and the "life story" of the NPD process. Consistent with Pettigrew, Woodman, and Cameron's (2001) recommendations for generating the history of a temporal process, we adopted a probe-learn-iterate approach to questioning.

More specifically, we used the language of what, who, where, why, when, and how to stimulate narratives that described the events, relationships, decisions, and actions relevant to NPD. Each set of data provided the basis for the next round of interviews because we were able to check specific events or comments and then proceed. We also finished the final interviews with closed-ended questions to help us clarify the intent of each customer relationship, its history, and so on. To reduce informant bias and recall issues, we used interview techniques appropriate when people assume multiple roles in a firm or when the number of informants per firm is limited. These included event tracking with each informant to ensure chronological accuracy and probing for specific explanations through the data review process.

Because chronological events can be stepping stones in the search for patterns over time (Pettigrew, Woodman, and Cameron 2001), we used narrative restructuring of the transcripts and archival data to construct a detailed chronology of each MI's NPD process. We initially developed the chronologies using event listing matrices. Through various iterations, we discussed and revised each chronology with the informants until they considered it comprehensive and accurate. Our approach to interviewing and data preparation was consistent across all MIs. When the chronology raised no further questions, we agreed that our understanding of the MI's NPD was complete and concluded fieldwork with that firm. We also required a sign-off from each informant to ensure we had captured the history of the MI's development. Overall, the use of multiple sources of evidence combined with the active involvement of participants and their final release of the data for analysis enhanced the credibility and quality of each chronology (Yin 2003).

Data Analysis

After each NPD chronology was fully developed, we manually transformed the data into discrete but connected blocks to allow for comparison of event sequences across innovations, over time. This "temporal bracketing" (Langley 1999) allows extraction of information on *when* customers are involved in NPD. As a starting point, we took a flexible approach to bracketing in line with Veryzer (1998, p. 318), who finds that discontinuous innovation is an "inherently messy process," because we wanted to allow for patterns to emerge. Nonetheless, we also needed to be able to analyze our process data systematically. As Baron (2007) argues, activities are useful markers in this regard, and because NPD activity models are common in the marketing literature, we first reviewed the events and interactions with customers in each firm's chronology to identify activities pertaining to NPD. We then examined the sequencing of activities and the decisions, actions, and outcomes pertaining to them. When common activities became apparent, we tried to match them to extant models. Initially, we identified three general activity categories, all appearing in the extant literature: idea generation, development/testing, and launch (though further analysis suggested alternate labels were appropriate for some). Additional activities also emerged, and these were unusual in scope and/or timing. We labeled

these anomalies and ultimately identified five NPD activities. We then linked each event and interaction (from the chronologies) to an activity. Often, some activities overlapped others, or an activity that (theoretically) was expected to occur later took place earlier. We reduced the chronologies to include only the events/interactions that involved the developer firm and its downstream customers. Because some argue that a key to NPD success is the type of customer involved (Gruner and Homburg 2000; Veryzer 1998), we continued with our inductive approach to uncover who was active in NPD. This process identified six types of customer, and in total, we analyzed 96 interactions. Although we identified other forms of NPD participant (e.g. suppliers, investors), we excluded them from the current analysis because our focus is on customers.

To explore *how* customers were involved with NPD, we openly coded for information relevant to firm–customer interactions. When this revealed different forms of customer participation, we applied qualitative analysis software (nVivo) to the narrative data in the original transcripts and also to the chronologies, which enabled us to check and refine our understanding of emerging patterns. We systematically examined and coded each interaction to understand *which* kinds of customer were involved in NPD, as well as *when*, and the nature of their relationship with the developer firm. We selectively coded for the characteristics of customer interactions and focus here on the history, nature, intent, and output of each relationship. To ensure coding consistency, we developed decision rules and applied them. These rules were guided by the B2B and NPD literatures, but we refined them when necessary as data emerged. When linking interactions to NPD activities, we checked each other's interpretations and coded iteratively, using interviews, notes, and firm archives as our base. We added and revised information incrementally, following replication logic (Yin 2003).

The analytic approach took place within and then across MI projects. We initially made comparisons between the first pair of MIs using event and sequence analysis. When we noted inconsistencies, we investigated them by revisiting the data. As patterns emerged, the other MIs were added to (1) develop a more robust coding scheme and (2) better understand the NPD process and customer participation. Then, as our understanding of the data intensified, we compared patterns for the MI successes and failures, checking our results against the literature. This also helped us realize that the successful innovators displayed an NPD process distinct from those with MI failure. Consequently, we revisited the data to refine our interpretation of each type of process and the activities they involved. Our iterations through the data, emerging insights, and extant literature are typical for inductive research, and we compared and contrasted findings using Glaser and Strauss's (1967) discovery-based approach.

Results and Research Propositions

When it comes to MI, involving customers is generally regarded as difficult (e.g., Gruner and Homburg 2000; Mohr and Sarin 2009). Certainly, our study shows that cus-

tomers participate very little in the NPD activities of some firms. However, these were the firms with MI failures; those that enjoyed MI success did not follow this path. Our analysis reveals two approaches for NPD for MI. We begin with those results because they provide background to the other findings. Then, we address (1) how customers participate in NPD for MI and (2) capabilities for MI. For each topic, we present the findings and then explain and reconcile them with existing literature and theory. This leads to a series of propositions to guide further study.

Two Approaches to NPD for MI

The NPD process characterizing the three firms with MI success involved four activities reinforced by a fifth: opportunity recognition, customer-based funding, development and testing, wider commercialization, and, underpinning them all, ongoing feedback. These activities overlapped one another and iterated through NPD. In contrast, firms with MI failure followed a more traditional model for NPD in which a set of activities proceeded sequentially: (1) opportunity recognition, (2) (early) feedback, (3) development and testing, and (4) commercialization (i.e., launch). Both approaches to NPD involved customers, but the nature and extent of customer participation varied by firm and, most clearly, across MI successes and failures. As we summarize in Table 2, ten customer roles, which differ by activity, emerge. In addition, roles are initiated either by the firm or by the customer, be they current customers, potential ones, or noncustomers. We found that the successful innovators engaged with customers in all five activities, and customers participated in seven to eight of the ten roles. In sharp contrast, customers participated in only three activities at the firms with MI failure and only one to three of the ten roles.

Proposition. We observe first that certain activities commonly discussed in the NPD literature are not present in either process found here: (1) formal screening of ideas and (2) business and market opportunity analyses. This may indicate a lack of control mechanisms in NPD for MI, but it is also consistent with Veryzer's (1998) conclusion that even in large firms, NPD for discontinuous products is not managed by a highly structured process. Such results are also consistent with the finding that small firm activities are informal and less controlled (Coviello, Brodie, and Munro 2000), and detailed market studies are not of great value in a context such as MI (Song and Montoya-Weiss 1998). Another observation is that NPD at the firms with MI success reflects a process inconsistent with the orderly progression through periodic stages as portrayed in Gruner and Homburg (2000) or Fang (2008). It also differs from Cooper's (2008) stage-gate arguments for major new products. Instead, the successful innovators displayed activities that spilled over into each other. This might be expected because such behavior is consistent with novel startups (Sommer, Loch, and Dong 2009). It is also inherently entrepreneurial (Baron 2007) and mirrors explorative innovation (Danneels 2002), and we note that neither of these characteristics is restricted to small and young firms.

In addition, NPD at the successful innovators demonstrated a self-reinforcing cycle of firm–customer interactions

TABLE 2
A Taxonomy of NPD Activities and Customer Roles in Major Innovation: Comparing Successes and Failures

Activities/Roles		S1	S2	S3	F1	F2	F3
Opportunity Recognition							
Source of latent needs	Firm identifies unarticulated or latent needs when observing or questioning customer.	✓	✓	✓			
Requester	Customer approaches the firm for a product with features not currently available or complains about technical limitations.	✓	✓	✓	✓	✓	✓
Customer-Based Funding							
Development buyer	Firm approaches and sells the concept as a development deal to specific customers for R&D funding.	✓	✓				
Early buyer	Customer approaches the firm for an early sale, thus providing a revenue base for R&D.			✓			
Development and Testing							
Technical advisor	Firm asks customer for technical input or specifications and technical guidance through development and testing.	✓		✓			
Codeveloper	Customer engages in hands-on development and trials through development and testing.	✓	✓				
(Wider) Commercialization							
Approver	Firm asks customers to provide information on the product to other potential customers or seeks approval from standards authorities regarding the technology.	✓					
Promoter	Customer refers MI to other potential customers and/or leverages network for sales development.		✓	✓	✓		
Feedback							
Sounding board	Firm asks customer for feedback on the concept, product, or market (can occur throughout NPD).	✓	✓	✓	✓		✓
Critic	Customer offers extensive opinions, feedback, or data on the concept, product, or market (can occur throughout NPD).	✓	✓	✓			

Notes: NPD activities occur in an overlapping and iterative manner. For example, opportunity recognition continues to occur throughout the NPD process as new needs are identified. Feedback can occur early or later (and throughout NPD). Their order here is simply to communicate NPD activities and customer roles.

comparable to a reciprocal process of enactment (Danneels 2003) and open innovation (Chesbrough 2003). It might be argued that this finding also reflects spiral development, but interactions were not restricted to occurring within a specific activity (as depicted by Cooper 2008). Rather, as we discuss in detail subsequently, customers participated throughout NPD, in many roles beyond information source, codeveloper, and information recipient (from Athaide and Stump 1999; Fang 2008). Finally, NPD activities at the successful innovators were iterative. For example, there was no “single” launch per se, and opportunity recognition was ongoing. These findings are similar to others from large firms (Lynn, Morone, and Paulson 1996; O’Connor and Rice 2001). Overall, the emergent patterns for successful MI are notably different from existing NPD models and clearly involve customers. Our findings suggest that, regardless of firm size or age:

P₁: Successful MI is more likely for technology firms that (a) employ a process of NPD in which activities overlap and iterate and (b) conduct NPD with customers who participate in (i) all activities and (ii) multiple roles.

How Do Customers Participate in NPD for MI?

As stated previously, we identified five NPD activities at the firms with MI success. In the following subsections, we present each activity and the customer roles relevant to it. Our analysis also shows patterns regarding the types of customer involved with NPD for MI. In discussing these results, we inform our findings by drawing on various bodies of literature.

Opportunity recognition. At all six firms, opportunity recognition involved customers in one or both of two roles: Customers were sources of latent needs, and/or they requested features of a new technology by loosely describing desired attributes or features. S1 provides a good example of both roles. According to the CTO, this small, relatively new firm glimpsed its opportunity when an existing customer (a user-operator) asked if S1 had anything that “could maybe do [xxx].” As the CTO explains,

That seeded the idea.... Then [another] customer wanted more specific measurement of [yyy], and tied up with that, we could see the frustration of the engineers [users] out in the field.... We started to connect the dots. It

seemed like they needed something to do [zzz], but the market wasn't there to start with.

Internal discussions at S1 ensued, and the project manager recalled the following:

We threw ideas around.... It was trial and error,... and we eventually got to the [MI]. We kind of did it backwards because asking "Do you think this is of value?" would probably get the wrong information because the customer doesn't understand what you are asking.

S1 did not conduct concept testing or formal market research. Instead, they observed and questioned users—operators to develop an understanding of unable-to-be-articulated needs.

The patterns for opportunity recognition at S2 and S3 were slightly different from S1, though again, customers were requesters and sources of latent needs. S2 is a larger SME, and opportunity recognition was triggered in several related ways. When a member of the development team was using S2's existing technology under unconventional conditions, something unexpected occurred, and that sparked an idea. The project engineer also recalled that S2 had received requests from existing customers and noncustomers who were seeking "unavailable" technologies. Finally, like S1, S2 spent time with key users—operators to watch them interact with existing equipment. The project engineer commented that S2 did this throughout NPD for the firm's MI (i.e., not just at the beginning), and this helped the firm see new possibilities as its MI emerged. At S3, the startup, initial opportunity recognition occurred when one of the cofounders (now CEO) could not solve a problem that users—operators were experiencing in her university lab—a problem that could not quite be defined. Later, as NPD for S3's MI unfolded, opportunities related to it emerged as potential customers made requests. Consequently, opportunity recognition at S1, S2, and S3 was an ongoing activity in which each firm integrated its insights with those from different customers to shape the opportunity over time.

How do the patterns for the firms with MI failures compare? As with their counterparts, customers were involved with opportunity recognition, but they participated quite differently. At F1, opportunity recognition was triggered by an existing customer asking for a version of the firm's original product. This might have led to a simple extension of existing technology, but while the founder worked on a modification to suit his customer, he came up with other ideas to "maybe take bits from [aaa] and [bbb] and [ccc] ... do new things ... raise things to a new standard." Thus, customer requests did not spark the concept for the MI per se, but they helped F1's founder identify his opportunity. In contrast, opportunity recognition at F2 occurred when one project finished and developers asked, "What's next?" The general manager/CTO of this SME recalls that F2 turned to a preexisting list of user requests for inspiration, and this led to the idea for what ultimately became the MI. At F3, opportunity recognition was triggered when a major organization (Firm V) began looking for new technology to enhance its core offering. Firm V approached cofounder 1 (an expert in a particular field) for his ideas. As he recalls,

They put out a tender ... left the door open for new ideas. I came up with this concept,... made a drawing.... I took it

into [Firm V] and they put me onto their consultant [Firm W] to talk it through.

Propositions. In Song and Montoya-Weiss's (1998) model of NPD, customers are not involved until product testing (i.e., directly before commercialization). A similar pattern appears in large-firm studies of discontinuous NPD (O'Connor 1998; Veryzer 1998). What appears to separate the innovators here, however, is that coincident with or shortly after initial opportunity recognition, the firms with MI success engaged in a process of enactment more typical of creation than discovery theory (Alvarez and Barney 2007). That is, rather than relying on exogenous change (e.g., a technology shift) to enable an alert entrepreneur to discover an opportunity, S1, S2, and S3 initiated action with their customer portfolio to create their opportunities. They did so by quickly meshing technology push and market pull; that is, they combined internal ideas with external insights. At these three firms, customers played both roles: sources of latent needs and requesters. In contrast, F1, F2, and F3 relied solely on internal search or customer requests. In addition, opportunity recognition at F1 and F2 involved little dialogue with customers, and F3's efforts were mediated by a third party that likely had less commitment to the MI. Moreover, opportunity recognition was not restricted to the beginning of NPD at S1, S2, and S3. Instead, it was "ongoing cocreation" of the MI opportunity, and this is consistent with service dominant logic (Vargo and Lusch 2004). In comparison, opportunity recognition was a one-off activity at F1, F2, and F3. These results suggest the following proposition:

P₂: MI success is more likely when (a) the opportunity is cocreated by the technology firm with customers who participate as sources of latent needs and requestors and (b) opportunity creation is allowed to occur over time rather than being restricted to early in NPD.

Customer-based funding. The successful innovators all made early sales of the MI—an activity we refer to as "customer-based funding," given the impact on the firm. They sold their concept to development buyers or they sold in-progress technology to early buyers. As one example, S1 conducted internal R&D for the first year to "get a prototype up and running so we could show someone" (project manager). Simultaneously, they reviewed their small customer base for a firm that would commit to the concept. According to the CTO, S1 targeted Firm A (a large organization)

because we needed money for R&D.... We could test our ideas and technology with them. They were one of those customers you would class as keen on accepting new technology.

S1 agreed with Firm A to provide it with data while the MI was being developed. Thus, Firm A became a development buyer and a precommitted source of funding for NPD. S2 used this approach as well: Three customers paid first for partial development and later provided more funding as the MI moved successfully through testing with them. Somewhat different from S1 and S2, the first customer for S3 was not part of a development deal. Rather, two international contacts from the cofounder/CEO's research network

heard about the MI while it was in a very early form. They both contacted S3 and bought the in-progress technology to help their own research. Therefore, these purchases were sales to early buyers (rather than development buyers), but again, they injected funds for R&D. Of note, although the successful innovators had some degree of government support for R&D, they did not involve other types of investors. Finally, all three successful innovators recognized some risk associated with early sales and development deals, but rather than focusing on the analysis of risk, S3 had no reservations about selling its early-stage MI, and S1 and S2 were willing to share ideas with customers to further NPD.

In sharp contrast, F1, F2, and F3 did not approach customers for development deals, nor did they make early sales. F2 (the larger SME) preferred to support R&D with internal funds, whereas the startup, F3, relied on government grants. F1 had both government funding and a private investor. By relying on non-customer-based sources of funding, all three firms with MI failure lacked early customer commitment to the MI and, perhaps just as importantly, never sought it.

Propositions. Two points relate to our findings regarding the sale of an MI when it is a concept or in early development. First, this is a form of early launch that appears important for MI success. However, it contrasts with the general NPD literature and Veryzer's (1998) large-firm finding that commercialization occurs late in NPD. Second, these sales resulted in customer-based funding, an activity that did not occur at F1, F2, and F3. It is also a type of innovation investment distinct from those Chesbrough (2003) discusses; he describes innovation funding sources as, for example, venture capital firms, angel investors, or government institutions providing R&D grants. It might be argued that S1, S2, and S3's use of customers for funding is somewhat similar to a harvesting strategy, an approach used by large, mature developers to determine demand and highlight adoption barriers (O'Connor, Ravichandran, and Robeson 2008). However, the development deals and early sales did more than help confirm demand for the small and young firms in this study; they contributed funds for R&D. Thus, customer-based funding mitigated financial risk. It also signaled market legitimacy (consistent with Millier 1999; Rao, Chandy, and Prabhu 2008) and, consequently, helped overcome a major impediment not only to smaller and younger ventures but also to MI: skepticism. Consequently, we offer the following proposition:

P₃: Successful MI is more likely when technology firms generate customer-based funding near the beginning of NPD from sales to customers who participate as early buyers and development buyers.

Development and testing. In this study, MI development and testing were iterative. The firms with successful MIs worked with chosen customers who provided specific technical advice or were active codevelopers. As an example of the first role, S1's CTO spent three months with a potential distributor in the United States, using its data to help build and test the MI. He also approached several U.S. contractors for technical advice. At S3, development and testing advice came from the first user-operator of early versions

of the MI: the university lab. As the cofounder/R&D manager notes,

The technology would get sent up [to the lab] for testing and installation.... Within a day, we'd get information back.

Turning to an example of codevelopment, S1's major contact at Firm A (their development buyer) was described by the project manager as follows:

"He likes technology.... He likes to push the boundaries.... He liked to challenge us to come up with better things because he wanted [Firm A] to be a forerunner in the industry.

Firm A's representative was a hands-on codeveloper, working directly with S1. However, as the MI progressed, concerns emerged about intellectual property rights, and although Firm A remained involved, the representative's participation ended. S2 had some experiences similar to S1, but by identifying three customers (rather than one), S2 realized it could test the MI in different environments. The project engineer recalls that one development buyer (a small organization) was especially active and "sometimes we'd spend weeks there working and helping each other." This customer identified technical bugs on an ongoing basis, and the general manager of R&D recalled that their users-operators also refined and tested the technology independently:

They weren't frustrated when it didn't work, since they were on a special deal. They had sort of ex-engineer-type people that would do their own experimentation and come up with things.... so there was definitely a loop.

Indeed, S2's project engineer said that one improvisation improved efficiency by 8%. The general manager of R&D observed that working with customers "did speed things up.... They got us there quicker." However, this did not mean everything went smoothly. S2's trials at a large development buyer strained the relationship. The general manager of R&D describes this as a learning experience:

We didn't do very well with them, because I think we were busy doing other things. And when we did spend time with them, we found they didn't really have anyone that we could work with. They needed to be using [the MI] and working on it themselves. [The customer's] commitment to make it work was important.

If we compare the evidence of customer participation in development and testing for the successful and unsuccessful MIs, there was a striking difference at the firms with MI failure. F1's prototype underwent limited testing with Firm N's users-operators, and although Firm N endorsed a government funding proposal, it was not asked for technical advice, nor did it participate in codevelopment activities. At F2, after the idea was transformed into a prototype, the firm conducted only in-house testing. As the general manager/CTO recalled,

Originally, we thought we'd take it round the distributors and then install it, talk them through it. That was the theory. It never happened because of the rush of time, pressure of getting the thing working right, and, you know, the best-laid plans...."

Finally, F3 built prototypes for the MI, essentially independent of Firm V and Broker W. Only after these were nearly complete did Broker W request testing and Firm V test the MI. Because there was a steep learning curve with using the MI, F3 trained Firm V's senior operators, who then "passed [the training] on to the rest" (Cofounder 1). These were F3's only customer interactions during development and testing. Later, unexpected technical problems led Firm V to retender for maintenance of the MI, and a competitor won the contract. Then, Firm V developed concerns with the MI and contacted F3. One of the cofounders immediately checked the problems but considered them minor. This confirmed for him that Firm V "did not understand the technology we had built." Again, and as with F1 and F2, customers of F3 had not participated as either technical advisors or codevelopers.

Proposition. When S1, S2, and S3's customers provided technical advice and/or became actual codevelopers of the MI, a form of bilateral product development (Athaide and Stump 1999) resulted. As is evident here, S1, S2, and S3 created de facto multifunctional teams and an expanded resource base for development and testing. We also note that customer relationships at S1, S2, and S3 were central to both MI testing and development; the latter result is inconsistent with O'Connor (1998) and Veryzer (1998). However, an important benefit of customer involvement emerged: Because NPD for MI is typically long, with changes occurring to the market and technology (Lynn, Morone, and Paulson 1996), working with customers in development seemed to help keep the MIs at S1, S2, and S3 relevant. At the same time, it is important to acknowledge that S1 had challenges with protecting proprietary knowledge and S2 struggled when working with a larger customer. This offers some evidence of the risks expected by resource-dependence theory (Pfeffer and Salancik 1978), but we suggest that F1, F2, and F3 suffered from a lack of resource dependence in development and testing. These findings lead us to propose the following:

P₄: Successful MI is more likely when technology firms conduct development and testing with customers who participate as technical advisors and codevelopers.

(Wider) commercialization. As we reported previously, the successful innovators sold their MI concept early in NPD. Therefore, we refer to later sales as "wider commercialization." In this activity, customers were either approvers or promoters. As an example of the first role, S1 learned from the CTO's U.S. visit that support from specifying engineers would be crucial to the success of its MI. As the CTO explained, "By getting [the MI] specified, the contractor has no choice but to purchase." S1 also approached and worked with standards organizations in the United States and the European Union. Due to their influence on adoption, these authorities are considered a nontraditional form of customer, and their certification was, in essence, a seal of approval that helped wider commercialization. As S1's project manager observed,

We can say it is C and D and E approved,... and as more recognition for standards comes into play, the more the market sees that there is a need; we're gaining momentum.

We observed the second role (promoter) at S2, in that two development buyers recommended the MI to others in their network. These firms then bought the MI and did so without a development deal. At S3, users-operators (lab researchers) published results obtained with the MI. This too promoted the innovation to international markets.

Now consider the three firms with MI failures: F1, F2, and F3 exhibited a very different type of customer participation during wider commercialization. At these firms, that activity was a more typical product launch. We begin with F3. This firm had no customers take part in commercialization other than as targets of sales efforts made to compensate for the loss of Firm V. When it became apparent that the MI was no longer compatible with newer platforms that had emerged, commercialization efforts ended.

At F1, after the MI was tested by Firm N, the founder was surprised to receive a "no" decision from that firm and two others it had approached (O and P). He commented:

Suddenly we [realized], "We've developed what they wanted but they don't want it or if they do want it, they can't afford it."... I could sell it at one level and they'd be keen and take it for approval, and that's where it would get knocked back. No one wants to be a guinea pig.

F1's founder then cold-called Firm Q and offered a leasing option to overcome what he thought were financial barriers. Firm Q signed on for three years. F1's founder believed this provided credibility for both the MI and his firm, though Firm Q was neither an approver nor promoter per se. More contacts then emerged through Firm O. These included two large international companies (Firms R and S); both agreed to lease the technology. Firm R was particularly excited about the MI and asked to be F1's North American agent (i.e., a promoter). However, the economic climate and the aftermath of the 2001 terrorist attacks in the United States weakened the relationship, and Firm R backed out. Firms Q and S then raised technical concerns about the MI. Relevant here is that although F1 had not involved customers with, for example, development and testing, F1's founder remarked with some surprise, "But nobody had told me about the problems before." Until that point, F1's primary investor had been enthusiastic about the MI. When commercialization took longer than hoped, he took control of the firm, later ending the MI development.

The late identification of technical problems also occurred at F2. Because F2 had a positive history with an earlier product, two prospects showed interest in the MI's launch. However, the general manager/CTO related that the first demonstration was disappointing:

The reality of it struck home: We always said that this would be a pretty technical install—[but] we weren't set up for it. The electronics people that might install are the opposite of the operators.... You needed a person who could cope with both. For whatever reason, the system didn't work. They got the impression this was not a good product. It reflected badly on us.

Despite problems at the demonstration, interest in the MI was such that distributors had prebooked orders in New Zealand, Australia, the United States, and Europe. However, because the installation challenges had not been recti-

fied, F2 was forced to work directly with installers around the world because the MI was nonfunctional without their support. Ongoing dissatisfaction from installers led to a sales decline, and F2 stopped promoting the MI. At the time of data collection, the MI's future was unresolved after more than a year of meetings.

Proposition. The customer roles that emerged in wider commercialization (i.e., approver and promoter) seemed possible because the successful innovators engaged with customers in all the other NPD activities. Following Lengnick-Hall (1996), we suggest that their customers' experience during NPD became a useful by-product of the process. Similar to large-firm findings (O'Connor and Rice 2001), customers provided testimonials and confirmed the value of the MI. Thus, the NPD relationship with customers was a signal of market legitimacy (Rao, Chandy, and Prabhu 2008). Although F1 had one customer willing to promote its MI, all three firms with MI failure lacked experiential NPD history with customers. Consequently, they also lacked leverage potential. Our results lead us to suggest the following proposition:

P₅: Successful MI is more likely when technology firms attempt wider commercialization using customers as approvers and promoters.

Feedback. We label an activity distinct from those already discussed as "feedback." Throughout NPD, each firm with MI success used customers as sounding boards for their concept and market. For example, S1 approached users of their original product for general feedback on the emerging MI. S1 also attended trade shows with early prototypes because as the CTO observed, "We didn't fully understand the value offered by the [MI], and we could not communicate it clearly." S1 was also receptive to more analytical challenges from customers who acted in another role: critics. For example, when trade show attendees showed excitement for the MI (albeit tempered by uncertainty about its use and benefits), the CTO decided to visit the United States to learn how to explain (i.e., sell) the technology. He joined a major distributor on more than 20 sales visits for other products (as an observer). This generated insight for S1 that was less technical and more focused on possible users and potential benefits of the MI. As S1's project manager explained, "We learned a lot [about] ... areas where we didn't realize it could be applied."

S2 and S3 also welcomed feedback, though their patterns were slightly different. At S2, users-operators at their three development buyers participated as sounding boards throughout NPD: "We got them all to come here and talk about the technology and what we could do better" (general manager of R&D). Those customers also raised application questions as the MI evolved, taking a proactive role as critics. At S3, a research group was formed to act as a formal sounding board and later, when the CEO and R&D manager wanted to "talk to more people about [the MI]," they traveled to meetings attended by the research staff of firms that were part of the possible market. While these researchers were sounding boards, they were also proactive critics. S3's iterative process of seeking and responding to criticisms led to changes in the MI. This included some simplification of

the technology because "various things on it confused customers" (R&D manager). As the CEO recalled,

I don't think we sold anything, but we got a heck of a lot of feedback. Then we went back for the third time with the new product and got some more.

Relevant here is that all three successful innovators tried to learn from customer feedback throughout NPD. This information fed directly into opportunity recognition and development/testing activities. It also provided insight that aided wider commercialization.

In contrast, the feedback activity at F1, F2, and F3 was quite different. For example, F1's founder approached the customer that had helped trigger opportunity recognition (Firm N). In turn, Firm N (moving to a broker role) introduced him to Firm O. Then, Firm P was contacted by both Firms N and O. F1's founder also recalled that he "chatted to them [users-operators] ... about the shortcomings of what they were currently doing," asking if they might be interested in his concept. However, because F1 had no prototype, the idea could only be described. As such, Firms N, O, and P—a mix of previous and potential customers—were early sounding boards, but F1's founder did little to engage them on a deeper level (e.g., as critics), either early or later in NPD. F3 showed a similar pattern, with Broker W acting as an early sounding board for F3's ideas. However, there was no evidence of customers participating as critics at F3, and the firm sought little feedback from customers later in NPD. Finally, there were no customers involved with the feedback activity at F2. Indeed, the general manager of R&D described the entire NPD process as

expert opinion from our people rather than direct market research;... no voice of customer or whatever you want to call it—this was an in-house development, it really was.

Proposition. At the successful innovators, the feedback activity resembled an ongoing conversation—one that informed the firm (and customers) all throughout NPD on many issues. Like the other NPD activities we identified, this was a basis for knowledge generation, an important aspect of social capital (Nahapiet and Ghoshal 1998). Because conversation was ongoing, trust and mutual goals were fostered. This reflects the relational dimension of social capital, and it is also central to relationship development (Naryandas and Rangan 2004). In addition, knowledge fed into other NPD activities. For example, the successful innovators used feedback to refine their emerging opportunity, identify who could be useful with development, and learn who was relevant to wider commercialization. In contrast, if the firms with MI failure were in conversation with customers, they restricted it to early in NPD. Our results suggest the following proposition:

P₆: Successful MI is more likely when technology firms inform all NPD activities with ongoing feedback from customers who participate as sounding boards and critics.

Customer characteristics. In considering the types of customers involved with NPD, our results reveal one rather typical group that includes buyer organizations, users-operators, and distributors. However, three other types of customer also emerge: specifiers, brokers, and installers. Specifiers

include engineers (e.g., at S1) and researchers (e.g., at S3) that make decisions on behalf of their own or client companies. Brokers connect the firm to the buyer organization (e.g., at F3) or other types of customers (e.g., at S1 or F1). Finally, installers (e.g., at F2) are considered customers because they are critical to ensuring that the technology is able to be used.

In addition, certain customer characteristics appear to distinguish the firms with MI success and failure. Although existing and prospective customers influenced opportunity recognition for all six MIs (suggesting they had identifiable needs earlier than the mainstream market), the successful innovators involved customers who were keen to participate because of the potential value created for their own business; that is, they were lead users. This did not occur with F1, F2, and F3. The successful innovators also benefited from customers we label “technically eager,” given their readiness to work with the firm for NPD. These customers were not technical experts, per se; rather, they were reported to be inventive and creative. Finally, the early and development buyers at S1, S2, and S3 varied in size and market power, and they did not necessarily represent target market(s) because these were unknown until later in MI. They were, however, willing to financially support a premature form of the MI. F1, F2, and F3 had no such buyers.

Proposition. The many forms of customer relevant to NPD (e.g., buyers, users, specifiers, brokers, installers or customer-technicians) are also evident in Millier’s (1999) innovation research. This indicates that it is important to acknowledge the diversity of customers in the B2B adoption process; a customer portfolio is also relevant to firms developing MI. What differentiates the MI successes and failures however, are three patterns. First, Von Hippel’s (1986) lead users took part in creating the former, a finding consistent with large firms (Veryzer 1998). Second, the participation of other technically eager customers is notable. Gruner and Homburg (2000) show that customers with technical innovativeness and know-how do not affect new product success. However, their study examined midrange innovation in larger firms, and as the authors state, firms might involve competent customers if it is difficult to solve technical problems in-house. Our findings suggest that technically eager customers were willing to learn during NPD, and this may have overcome (1) any potential lack of technical knowledge or foresight (a concern with MI) and (2) the risk of overly knowledgeable customers driving the process (as expected by resource-dependence theory). Third, for MI, it appears that financially attractive customers are not necessarily determined by their reputation and market representativeness (as per Gruner and Homburg 2000). Rather, initial buyers were financially attractive because of their willingness to precommit to an idea. Again, this distinguishes the firms with MI success from those with MI failure. Thus:

P₇: Successful MI is more likely when technology firms conduct NPD with customers who are (a) lead users, (b) technically eager, and/or (c) willing to commit financial resources early in the process.

What Are the Capabilities for MI?

We have discussed how NPD differs between MIs that are more and less successful and the roles that customers can take through NPD. Equally important is insight on the firm’s capabilities for MI. To uncover these capabilities, we draw on the preceding findings and, again, interpret them using the extant literature. Central to our analysis is Day’s (2011) recent contention that adaptive capabilities are needed for fast-moving, complex markets. He defines adaptive capabilities as (1) open marketing, (2) vigilant market learning, and (3) adaptive experimentation. Accordingly, we assess our findings in the light of his arguments.

Customer mobilization. We find that the immediate identification and involvement of customers in NPD is central to a successful MI. We call this a “customer mobilization” capability. Relational in nature, it extends beyond communication and coordination as discussed by Sivadas and Dwyer (2000). It also extends beyond Day’s (1994) customer linking by not only assembling the resources for NPD but also activating them through deliberate engagement and being open to customer-initiated efforts. At S1, S2, and S3, customers were mobilized as proxies for functions such as development and testing that, in other firms, might be conducted in-house. In addition, mobilizing customers for early funding and wider commercialization distributed the risks and costs of NPD. For opportunity recognition, it seemed to facilitate the early commitment of customers to both NPD and the MI.

How does this compare with the adaptive capability that Day (2011) terms “open marketing” (i.e., when the firm taps into its wider, open network through alliance mechanisms and knowledge-sharing interactive technologies)? In our study, there is no evidence of the firms leveraging such technologies for NPD. Instead, the clear emphasis was on individual-level interactions. Therefore, while we concur with Day (2011) that alliances are relevant for resource access, what appears important is the nature and mix of customer relationships that are mobilized. Here, the successful innovators seemed to benefit from engaging with not only close customers (consistent with Gruner and Homburg 2000; Rindfleisch and Moorman 2001) but also those with whom they had weak connections. For example, S3 had close and frequent interactions with the university lab (a user). At the same time, their NPD involved infrequent contact with firms that became early buyers and prospects that were specifiers for other organizations. Similar patterns appeared at S1 and S2. In comparison, the firms with MI failure did not seem to seek, recognize, or graft knowledge from customers into NPD (F1, F2), or NPD was dominated by a customer that, in turn, effectively blocked the firm’s access through hierarchical lines of communication (F3). Overall, the tight relationships observed at S1, S2, and S3 facilitated information flow, while their more distant or loose relationships seemed to aid innovation—patterns consistent with Danneels (2003) and network theory (Burt 1992). This balance also seems to have reduced the resource-dependence risk of developing an overly customized technology (e.g., the experience at F3).

Finally, this capability of mobilizing a mix of customers seems consistent with findings from expert entrepreneurs (Read et al. 2009; Sarasvathy 2008). That is, the successful innovators appeared to realize they needed to work with “who they knew” and thus leveraged customers willing to make an actual commitment to the MI. This supported a collective means of problem solving that was characterized by joint creation (rather than unilateral discovery) of the opportunity. Sarasvathy (2001) explicitly refers to this type of action as nonadaptive. She also describes it as effectual, in that the firm’s iterative and interactive process of acquiring stakeholders (including customers) allows it to cocreate new products (or firms or markets) with those partners. The precommitment of customers also demonstrates effectuation logic (Read et al. 2009; Sarasvathy 2001, 2008). As such, the customer mobilization capability is explorative and has an outside-in mind-set, but it is effectual rather than adaptive. Because Sarasvathy’s (2008) results are based on the experiences of entrepreneurs who, individually or as part of a team, had founded at least three firms, participated in taking at least one company public, and built companies that ranged in annual sales from \$200 million to \$6.5 billion and serving a wide range of sectors, we believe our findings are not necessarily size and age specific. Accordingly, although an open marketing capability may be relevant in some contexts, our results suggest the following:

P₈: Successful MI is more likely for technology firms that mobilize a portfolio of tightly and loosely coupled customer relationships for NPD.

Learning agility. The second capability is labeled “learning agility” and draws on a relatively new concept: the learning advantages of newness (Autio, Sapienza, and Almeida 2000). All six firms were small, young, and without experience with MI. However, the successful innovators demonstrated three characteristics that are benefits of being new. First, they showed a nimble approach to learning, easily generating and transferring knowledge within the firm and across partners in a way that encouraged knowledge spillover (such that knowledge is accrued to all parties). Second, they demonstrated a flexible stance toward NPD. This was evident, for example, in their willingness to make early sales and take an informal approach to customers and procedures. Third, they were aware of the potential to learn from others and were willing to do so. This is evident in the narrative results in which S1, S2, and S3 were comfortable with exploring ideas and exploiting solutions with various customers. Together, these three characteristics reflect cognitive, structural, and relational flexibility, all of which lead to learning agility.

Very different patterns were apparent in the firms with MI failures. Although F1, F2, and F3 could have benefited from learning advantages of newness, they did not. Rather than demonstrating learning agility, these firms appeared more rigid. They followed a more traditional and staged approach to NPD and relied primarily on their preexisting, congenital knowledge. Notably, congenital knowledge should contribute to absorptive capacity (i.e., the ability to recognize the value of external knowledge situated in another firm assimilate it, and apply it; Cohen and

Levinthal 1990). However, congenital knowledge was limited by each firm’s age, size, and lack of MI experience. What seems to set the successful innovators apart was their ability to import knowledge from their customer portfolio into NPD and, thus, the MI.

How does this compare with Day’s (2011) adaptive capability of “vigilant market learning” (i.e., when the firm has, for example, an open-minded approach to latent needs, a willingness to be immersed in the lives of their customers, and an ability to sense and act on weak signals from the periphery)? On the one hand, S1, S2, and S3 displayed these characteristics. They also appeared curious, alert, and willing to act on partial information, terms Day (2011) also uses. On the other hand, our data do not show that market insights at S1, S2, and S3 came from employing emerging technologies to amplify customer data. There is also no evidence of scenario planning, deep analytics, or triangulating with multiple inquiry methods—all aspects Day (2011) argues to be characteristic of vigilant market learning. Instead, and in line with Sanchez (1995), the firms with MI success recognized, acquired, and coordinated resources in a manner that enabled a mutual creation and sharing of information throughout NPD. Like expert entrepreneurs (Sarasvathy 2008, p. 35), the successful innovators focused on building relationships to create a future rather than “analyzing the competitive landscape.” Furthermore, NPD did not begin with a precise idea for the MI. Instead, the learning agility of S1, S2, and S3 seems to have helped them be forward looking and frame breaking. Rather than being adaptive, in which case actions are a response to environmental change and knowledge is transferred from customers to the firm, the capability of learning agility appears similar to the actions of expert entrepreneurs (Sarasvathy 2008) and, thus, effectuation logic. This leads us to suggest that although a vigilant market learning capability may be appropriate in some circumstances:

P₉: Successful MI is more likely for technology firms that leverage their learning agility in NPD.

Mindful trial and error. Trial and error is one type of exploratory learning (Miner, Bassoff, and Moorman 2001), the others being improvisation and experimentation. Here, all six firms demonstrated improvisation, in which unplanned action informed NPD as the action occurred. Examples include S3’s response to requests for an early sale of the MI and F1’s actions resulting from talks with Firm V’s broker. However, what distinguishes the successful innovators from those with failure is learning by trial and error. That is, S1, S2, and S3 took a combination of planned and unplanned actions to inform future decisions. Examples include S1’s behavior that resulted from its CTO’s immersion with potential customers to learn during NPD, S2’s insights generated by its decision to involve customers as development buyers, and S3’s regular visits to research meetings to challenge its nascent MI. Notably, Moorman and Miner (1998) suggest that trial and error is appropriate if there is high organizational memory. We believe that this may have been relevant at the successful innovators, but not because of well-defined processes or past experience. Rather, as firms new to MI, they approached trial and error mindfully and,

together with customers, generated real-time, realistic, and shared knowledge that was valuable to NPD. Thus, S1, S2, and S3 began to create organizational memory in a way not evident at F1, F2, and F3.

Does this fit with Day's (2011) capability of "adaptive experimentation" (i.e., when the firm invests in experiments, codifies and shares the results, and learns from the experience of partners)? S1, S2, and S3 certainly learned from their partners, but they did not codify insights per se, use technology to conduct rigorous and statistically defensible experiments, or develop and test parallel versions of the technology in a strategic approach to controlled experimentation. Instead, the firms with MI success focused on the MI itself, using a simple, nonlinear, and experiential (rather than experimental) process of sense making with customers who, as mentioned previously, are both tightly and loosely coupled. As a result, learning through trial and error with a mix of customers limited the downside potential of MI. While this approach may reflect the small and young firm's lack of resources to develop and test multiple products, it is also nonadaptive and thus, again, effectual (Read et al. 2009). This parallels another premise of effectuation logic, in which expert entrepreneurs make decisions on the basis of affordable loss rather than potential return (Sarasvathy 2001). Consequently, Day's (2011) adaptive experimentation capability may apply in some contexts, but we suggest the following:

P₁₀: Successful MI is more likely for technology firms using mindful trial and error in NPD.

Discussion

Theoretical Implications

Our goal is to extend prior theory, and this research does so in several ways. First, we deconstruct the concept of customer participation into ten distinct customer roles, each of which is linked to an NPD activity. Some of these activities were previously known, whereas others are newly identified. We summarize these roles and activities in an empirically derived taxonomy. Our taxonomy enhances the understanding of how and when customers contribute to NPD. Viewing customer participation as a multidimensional and dynamic concept also helps inform the broader discussion on cocreation.

Second, we provide an alternative to the traditional views of NPD, including those that are compressed or scalable (e.g. Cooper 2008) and, until now, perhaps considered suitable for MI. This addresses Hauser, Tellis, and Griffin's (2006) call for research on this issue, and we suggest that a compressed stage model is not conducive to MI. Indeed, successful innovators appear to pursue a nonconventional approach to NPD that includes five overlapping and iterative activities.

Third, we find that the capabilities distinguishing firms with MI success from those with failure are effectual. These results help address another priority area for research from Hauser, Tellis, and Griffin (2006): linking product develop-

ment processes with marketing capabilities. By using entrepreneurship theory, we help inform the wider capabilities literature, and by focusing on NPD, we interpret effectuation logic in a new context. Interest in effectuation has only recently emerged in marketing (e.g., Read et al. 2009). To the best of our knowledge, it has received little attention in the NPD and capabilities literatures, but we use it here to make sense of capabilities for MI and augment Day (2011). We believe that this provides a more complete and contemporary picture of capabilities relevant to marketing.

Fourth, this research demonstrates that to study questions such as ours and others involving paradoxical or unusual phenomena, it can be helpful to study revelatory contexts. Here, we broke with more traditional approaches in the literature to study MI created by small and young firms. This reveals both a new understanding of NPD and evidence that customers can indeed help create successful MI. Such findings are contrary to the logic of the mainstream NPD literature as well as certain cocreation arguments (e.g., Jaworski and Kohli 2006). At the same time, they support the service dominant logic (Vargo and Lusch 2004) in that we show that the customer is endogenous to the creation of innovation, even in MI.

Finally, it can also be helpful to interpret data with multiple theories. This contrasts with much of the extant NPD and customer participation literature that applies a single lens to guide study (e.g., Gruner and Homburg 2000; O'Connor 1998). In positioning relative to Penrose (1959), our work is generally informed by her theory of the growth of the firm and, thus, the resource-based view. We also draw insight from the relational view, in which relationships between firms allow for resource sharing, which in turn contributes to competitive advantage (Dyer and Singh 1998). In addition, ideas from social capital and network theory, as well as resource-dependence theory, are pertinent because in relationships between firms there is an inherent power dependence balance to be managed (Pfeffer and Salancik 1978). Aspects of organization learning theory are instructive because it is relevant to the development of marketing capabilities and innovation. Finally, we have made use of several disciplines to understand the capabilities relevant to NPD for MI. Entrepreneurship research has been particularly helpful, vis à vis Sarasvathy's (2001, 2008) effectuation logic.

Managerial Implications

All firms face uncertainty with NPD, particularly if it is for their first product and an MI. Our results suggest that some of the uncertainty associated with MI can be mitigated by involving customers. We recognize the potential for multiple influences on the success (or failure) of the MIs we studied, and any performance implications are tentative. Nevertheless, we believe that our findings offer practical insight. In considering whether our results are specific to small and young firms, entrepreneurial behavior is not determined by firm age or size. Indeed, it is required to maintain dynamic capabilities in all firms (Teece 2007). Thus, our results should be equally relevant to larger, more

established firms creating MI. Indeed, some of our findings are similar to those from large firms (e.g., ongoing opportunity recognition being necessary for MI). In addition, larger, more established firms may be hampered by structures and procedures that restrict innovation, thus requiring them to learn how to “think small.” We also recognize that managers experienced with a more traditional approach to NPD may feel ill-equipped to use effectuation logic. However, Read and Sarasvathy (2005) explain that effectuation is a form of teachable and testable expertise. It is a learned process consisting of specific skills, techniques, and heuristics. Thus, we believe managers can deliberately develop effectual, rather than adaptive, capabilities.

Let MI be messy. The path to successful MI seems to be characterized by an “almost ready, fire, do a bit more, refire” approach. It has no conventional market assessment and includes very early sales of a not-nearly-ready concept or technology. This has implications for how NPD is managed because following an analysis-driven staged method for MI might restrict customer participation and abort innovation. Therefore, NPD for MI is a process perhaps best viewed as socially constructed and generative rather than linear and predictive. In addition, it is relevant that although the firms with MI success involved customers in all five NPD activities, firm-by-firm patterns for what activities occurred when (and with who) were idiosyncratic. Thus, predictive models of what to do when, and with who, are likely constraining for MI.

Capitalize on the learning advantages of newness. A firm’s lack of previous knowledge and experience matters less in NPD for MI. Indeed, it may be an advantage to have less to unlearn. There is also a potential advantage in being “new”—either small and young or new to developing MI. Making the most of this advantage entails the firm cultivating an agile approach to knowledge creation, decision processes, and relationships. Because any firm new to MI is faced with a type of newness, even large firms should be able to benefit from taking a flexible approach to NPD for MI, mimicking the behavior of S1, S2, or S3. This means that firms need to be prepared to (1) share in knowledge generation and (2) share technology early. Decision makers should be receptive to ideas and actions initiated, and even driven by, customers.

Mobilize a mix of customers. Working with members of a broad customer portfolio, even for MI, allows the firm to increase and diversify its resource base and obtain market legitimacy. It also creates a type of multifunctional team. Some customers may be lead users, but equally relevant are those that are technically eager, open to learning, and willing to commit to the nascent MI. However, because involving customers has its own risks (e.g., imprinting effects on the MI, intellectual property issues) firms should engage a pool of customers, the mix of which suits the different roles in our taxonomy. Although there might be some risk of early exposure, we suggest that if the firm is too wary of the risks associated with knowledge spillover, it may not benefit from knowledge created external to the firm—knowl-

edge that could trigger and improve innovation. In addition, informality typifies NPD for MI, and this means that customer roles are fluid, as are their relationships with the firm.

Play to learn. Creating an MI does not call for a firm to be customer centered or led. Rather, the relevant focus involves learning with customers through early engagement and conversation. Encouraging mindful trial and error with a customer portfolio made up of a mix of contacts playing different roles seems to be particularly helpful. This is not to say that a firm should not experiment with products if it has the means to do so, but our successful innovators did not pursue strategic experimentation per se. Instead, their learning was characterized by efforts to graft the knowledge of others into NPD in a way that stimulated the creativity necessary for MI. We also note that the firm is not the only innovator in MI. Instead, the firm facilitates a process of information sharing and mutual learning with co-innovators.

Limitations and Future Research Directions

Our arguments stem from the practices of a set of purposefully chosen firms. Pavitt’s (1984) taxonomy of organizations suggests our results may extend to other science-based ventures. This requires investigation, and our propositions are developed for that purpose. We specifically call for examination of our propositions with older and larger technology firms developing MI for the first time. Although such organizations will not suffer the liabilities of newness associated with age or size, they will be new to MI. In addition, we recognize that the MI successes and failures in our study were not from the same firm. However, there are practical challenges to finding a smaller or younger firm that has survived a product failure, particularly an MI. This problem may be overcome if older and larger firms are investigated.

Beyond research stemming from the limitations of this study, our findings lead to other questions, examples of which are in Table 3. The first set of questions focuses on the combinations of customers participating in NPD for MI. These combinations move our findings to another level by examining how the customer portfolio affects performance, thus extending the work of Yli-Renko and Janakiraman (2008). The second set of questions pertains to effectual capabilities in terms of studying the individual capabilities we identify and investigating how they might change as the firm develops experience in the market and with MI. On a related point, our study suggests that effectual capabilities are relevant to MI, while Day’s (2011) adaptive capabilities seem less so. Given that our study is exploratory and Day’s (2011) conceptual, it would be appropriate to examine both types of capabilities across contexts. However, measures will need to be developed. Our findings also suggest a need for more research on learning in NPD. For example, we argue that agile learning is important, rather than absorptive capacity. However, when does absorptive capacity become relevant? Is it ever relevant for MI? Although all six firms had the potential to benefit from learning advantages of newness, F1, F2, and F3 did not. Why?

TABLE 3
Examples of Research Questions

Topic	Potential Research Questions ^a
Customer participation	<ul style="list-style-type: none"> •For MI success, is there an optimal combination of customer roles (e.g., critic, codeveloper, promoter)? •For MI success, is there an optimal combination of customer types (e.g., user, buyer, specifier) linked to customer roles?
Effectual capabilities	<ul style="list-style-type: none"> •When mobilizing customers for NPD of MI, is there an optimal balance of tightly and loosely coupled relationships? How is this mix reflected in NPD activities and customer roles? •Can a firm's learning agility be characterized by an optimal combination of flexibilities (cognitive, structural, and relational)? •Might a firm's learning agility lead it to chaos? Alternatively, with experience, will firms with first-time MI success become more rigid? •With experience, will mindful trial and error be replaced by experimentation? With what impact? •With experience, will firms that fail with first-time MI repeat their approach to NPD? Will they develop more adaptive capabilities? Or will they develop more effectual capabilities? Why?
Customer perceptions and capabilities	<ul style="list-style-type: none"> •How do the different types of customer we identify (e.g., user, specifier) perceive their role(s) in NPD for MI? •What motivates different types of customers to participate in NPD for MI? What influences the roles they take? •Are the characteristics and capabilities of the customer portfolio in NPD for MI complementary to, or the same as, those of the firm? •Do both the firm and its customer portfolio (or members of it) need to be effectual in NPD for MI? •What is the nature of customer agency when participating in NPD for MI? How does it compare with that of individuals in the firm?
Network characteristics	<ul style="list-style-type: none"> •Beyond customers, who are influential members of the wider network when creating an MI? How and when do they participate in NPD for MI? •How do the networks of participating customers affect NPD for MI? •What are the social capital dimensions of the wider NPD network for MI? •Are there network characteristics (size, density) and social capital dimensions associated with more and less successful MI? •What types of resource (e.g., intellectual, financial) are accessed and leveraged through the wider network for MI? When?
Decision-maker characteristics	<ul style="list-style-type: none"> •How do effectual capabilities (or potential rigidities) in NPD for MI reflect a decision-maker's past experience? Education? Their leadership characteristics and abilities? •How is NPD for MI influenced by a decision maker's proclivity to effectuate or to learn to do so? •Who is responsible for involving customers in NPD for MI? What is the role of their social competence and other characteristics?

^aGiven that this study reports on MI in small and young technology firms, the questions outlined here should be examined in different organizational and environmental contexts.

The third set of questions in Table 3 take the customers' point of view: their perceptions, motivations, characteristics, and capabilities regarding NPD for MI. Research in this area will better define the boundaries of effective customer involvement in MI. Like Fang (2008), we see the benefit of studying firm–customer dyads, but we recommend inductive process investigations of theoretically chosen pairs. This would allow for dual perspectives to be explored, providing insight into whether both firm and customer have a similar sense of agency in NPD and if both sides of the relationship need effectual capabilities.

Because customers are just one part of a wider group of NPD participants, the fourth set of questions are network focused. These encourage research comparing participants in the broader NPD network, as well as the study of network characteristics, dimensions of social capital, and resource flows in NPD for MI. Finally, the spirit and skills of the entrepreneur reside in the people who may imprint NPD. Because imprinting has costs and benefits, it is important to understand how the firm's approach to NPD and its capabilities for MI are influenced by individuals. In a related vein, research could explore the relative reliance on congenital versus collaborative learning in NPD, com-

paring MI successes and failures. It is also relevant to know if, how, and when social competence affects NPD for MI and if all decision makers have the potential to effectuate (as per Read and Sarasvathy 2005; Sarasvathy 2001).

Finally, our results may have alternative explanations. It is possible to view the failures at F1, F2, and F3 as a result of customers simply disliking the MI. We believe this is unlikely, because potential customers sent positive signals to these firms during the NPD process. Were the MI failures the result of unfortunate timing or external shocks? Possibly, but all six firms moved through NPD in the same time period. They all benefited from government grants, and all developed MIs with the potential for international markets. Furthermore, they all had setbacks. For example, S1 experienced conflict with an important codeveloper over knowledge, S2 had challenges working with a development buyer, and S3 had product reliability issues as late as data collection for this study. Overall, the six firms experienced similar macro conditions. If anything, we might have expected cohort effects (Baron 2007), but this is not readily apparent. What is evident is that customer involvement and the nature of capabilities for NPD appears distinctly different for those firms that succeeded with their MI and those that failed.

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