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INNOVATION ROADMAPPING: BUILDING A THEORETICAL FRAMEWORK FROM MULTIPLE CASES OF INDUSTRIAL FIRMS

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ABSTRACT

This paper investigates the phenomenon of innovation roadmapping from the dimensions of activity and performance. We employed a multiple case analysis on 12 cases of industrial firms to identify the commonly shared roadmapping characteristics in a systematic way. Drawing on the strategic innovation management theory, we define five concepts that are constructed from the richness of clarifications and descriptions of roadmapping experiences.

As results, we found that innovation roadmapping is established by a (1) strategy of time pacing, (2) synchronizing dialogues and (3) mapping innovation elements to a timeline. Furthermore, our findings indicate that innovation roadmapping affects either (4) competitive timing or (5) industry synergy, in innovation performance. This led to the development of a theoretical framework for innovation roadmapping with the formulation of six propositions.

The key insights for innovation managers in industrial firms are that, in striving for competitive timing or innovation synergy, roadmapping provides a means to achieve these objectives and, in deploying roadmapping in the organization, dialogue and pacing are critically important.

Keywords: roadmapping, dialogue, platform strategies, early design phases, design management

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1 INTRODUCTION

Knowing when to launch innovations in competitive environments poses a challenge to firms, as markets are changing at a faster pace, and the effectiveness of innovations depends more than ever on competitive offerings (Katila and Chen, 2008). To determine the right moment of entry, a firm needs to correctly balance the risks of premature entry and the missed opportunity of late entry (Langerak et al., 2008). Timing has become equally important as a strategic factor in adapting to increasingly competitive dynamics. Firms that match their pace to the fast-changing environment are better performers (Eisenhardt and Brown, 1998). At firms such as Motorola and Philips, innovation managers have indicated that innovation roadmapping enables a firm to match its market dynamics with "*an excellent review of product direction and technology timing*" (Willyard and McClees, 1984) in order to improve its performance in terms of "*time-to-market and time-to-money, thereby achieving a better competitive edge*" (Groenveld, 1997). However, there is a lack of clarity about what innovation roadmapping actually is and what it is not, and what the commonly shared roadmapping characteristics are across the situational practices of these innovation managers. 16 different definitions for roadmapping were listed in a recent bibliometric study on roadmapping (Carvalho et al., 2013). Overall, the phenomenon of innovation roadmapping lacks clear definitions grounded in a systematic analysis across cases. The aim of this paper is to make a contribution here with a qualitative inductive research based on a multiple case analysis. To the initial scholarly work on roadmapping, we add a theoretical contribution from a strategic innovation management perspective. As such, this paper makes three contributions. First, it lays out the groundwork for a theory on innovation roadmapping with grounded definitions for the activity of innovation roadmapping and the strategic performance of roadmapping. Second, it provides a model with six related propositions. Third, this article provides further research directions to test the propositions and extend the findings.

The next section first describes the theoretical background of innovation roadmapping and the research questions. Then, the methodology is described, followed by the research results concerning grounded definitions for the activity and performance of roadmapping and the interrelations between the roadmapping constructs translated into propositions. The paper closes with a discussion of the limitations of research, potential pathways for future research and a discussion of managerial implications.

2 THEORETICAL BACKGROUND

On the origins of roadmapping, we traced back the term roadmap in the strategic management literature. Hamel and Prahalad (1994) use "road map" as part of a recommendation related to opportunity identification and developing one's own vision of the future: "*creating the future is more challenging than playing catch up, in that you have to create your own road map. The goal is not simply to benchmark a competitor's products and process and imitate its methods, but to develop an independent point of view about tomorrow's opportunities and how to exploit them*" (Hamel and Prahalad, 1994, p. 22). Furthermore, several articles on the strategic practices of Intel mention a "roadmap for developing next-generation microprocessors" (Browning et al., 1995; Burgelman, 2002). However, we could not trace back in this stream of literature what the roadmap phenomenon is and how it is distinguished from a strategy or an innovation plan.

In the stream of innovation management literature, several scholars have acknowledged the importance of roadmapping as a phenomenon. The first to do so were Wheelwright and Clark (1992) who noticed Motorola's practices (Willyard and McClees, 1984). They were followed by a growing number of scholars (e.a.Ulrich and Eppinger, 2004; Cooper and Edgett, 2009) who explicitly use the term "roadmapping" and captured the practices of Philips, Lucent and Honeywell to highlight roadmapping as a valuable process for implementing a new product development and technology strategy. Furthermore, in this stream of literature, dedicated studies seeking to understand the phenomenon of roadmapping have been published since the turn of the millennium (Kostoff and Schaller, 2001; Kappel, 2003; Phaal et al., 2004; 2007; 2009; Mohrle and Isenmann, 2005). Kostoff and Schaller (2001) introduce an engineering perspective on how to roadmap effectively. They provide a first overview of the characteristics of the roadmapping process with a taxonomy of roadmapping objectives and uses, and ten fundamental principles for how to construct a roadmap. Kappel (2001) provides an organization behavior perspective on roadmapping. He introduces three levels of decision influence as outcomes of roadmapping. In addition to the engineering perspective, Phaal et al. (2004)

extended the methods from the pioneering work of the practitioners with a schematic view of the roadmap architecture, further explored visual representations (Phaal and Muller, 2009), and introduced a workshop approach (Phaal et al., 2007). Concurrently, Mohrle and Isenmann (2005) extended the initial roadmapping methods and support tools by compiling a casebook and providing an integrative view on roadmapping tools and methods. Overall, the theoretical understanding of roadmapping is at an emerging stage of theory building, as recently confirmed by a bibliometric analysis of innovation roadmapping. Carvalho et al. (2013) present a long list of 16 different definitions of "roadmapping." This makes it clear that there is a need for a grounded concept definition across roadmapping practices. To fill this theoretical gap, we carried out a systematic qualitative inductive research to build concept definitions for the roadmapping phenomenon in a useful and rigorous way. We departed from the central research question – "What variables determine roadmapping?" – by expanding it into a two-part question: What variables determine (1) the activity of roadmapping and (2) the performance impact of roadmapping? Across 12 cases, we analyzed what is shared and what is different as well as how the variables relate to each other to answer these questions. As qualitative data, we used the wealth of clarifications and explanations that have been put forward by roadmapping practitioners in industrial firms. As background theory, we found a matching perspective in the strategic innovation management literature. From this body of knowledge, we deducted, confronted and compared existing theoretical concepts with the concepts of roadmapping derived from the multiple case analysis.
In the next section we report on the methodology and results of our qualitative inductive research.

3 METHODOLOGY

Multiple case analysis

We chose to employ qualitative inductive research (Eisenhardt, 1989) to generate concepts that define innovation roadmapping and how it contributes to strategic innovation effectiveness. Our research project involved several steps. We began with the collection of qualitative data documented by roadmapping practitioners. Then, we compared iteratively the practitioners' documented experiences with concepts that have already been defined in theories of strategic innovation management and, finally, we generated roadmapping concepts by induction (Eisenhardt, 1989; Pratt, 2009).
To develop concepts that "are grounded in the real world" and that are relevant to innovation managers, we used a grounded-theory approach (Glaser and Strauss, 1967; Charmaz, 2006). In our research design we chose to gather data from practitioners' documentation, given the wealth of clarifications and explanations offered by these publications. We based our research on a multiple case analysis with both a within case analysis as a cross-case analysis. We used the inductive method of memo writing to generate the constructs (Glaser and Strauss, 1967; Charmaz, 2006). By a construct we mean according to Locke (2001), constructs that bring order to the world expressed in data documents, highlighting what things go together and which things are distinct from each other.

Sample

The sample consists of 12 cases with anecdotal evidence on roadmapping practice. We collected cases from a broad range of different types of industries, from high-tech consumer electronics to the business-to-business process industry and component suppliers. We collected cases representing industrial firms operating across Europe and the US. From a longitudinal perspective, we included cases representing the earliest documented experiences on roadmapping in 1987 up to cases dating to 2008. We selected those cases that met the criteria of first being widely cited and second of being written by a practitioner. We considered all those authors who hold a position inside a company or network organization as practitioners. By this selection, we excluded publications by journalists and consultancies, but included articles from managers and professionals working in industrial firms. 14 articles related to 12 innovative firms met our criteria. We listed these documented roadmapping cases in the sample, as presented in Table 1. All the selected cases are characterized as industrial firms, but they operate in different value chain positions: some operate as system integrators in a high-tech industry, some as component or module suppliers, some as material suppliers. Some cases report on small-scale roadmapping projects, some on a medium-sized company or unit process and others on a corporate roadmapping program. Overall, the 12 cases in the sample constitute a balanced selection of

Table 1. Sample of cases for qualitative data collection

No.	Case	Roadmapping Context	Memos	Sample reference
1	Motorola	Under the leadership of its CEO initiated a corporate-wide change process. For each of its many businesses a strategic plan based on the anticipated advancements in certain technologies.	# 34	Willyard & McClees (1987) Robert Galvin (1998)
2	Philips	Introduced integrated 'Product-Technology Roadmapping' in 1993 with a small scale pilot which has extended throughout the company over the years. Implementation has been via a variety of methods including workshops, small-scale trails and integrated business unit approaches.	# 22	Groenveld (1997) - EIRMA WG 52 report (1997) (in collaboration with Groenveld)
3	BP	Group's strategy change from the technically-driven diversification approach to one of concentration on core activities; "around 20 Roadmaps were necessary to cover the whole range of activities requiring R&D in the 3 core Business Divisions."	# 38	Barker & Smith (1995)
4	Hoogovens	Technology Roadmapping as an initiative pushed by the board. Each BU chose a specific product / market area to Roadmap. Two pilots: 1. Packaging steel Business Unit (BU) in IJmuiden, Holland 2. Hoogovens Aluminum in Duffel, Belgium.	# 10	EIRMA WG 52 report (1997) (in collaboration with Rudolph, De Roose & van Dongen)
5	Lucas Varity	First used roadmapping in 1990 to meet customer demand in the Aerospace market. Group wide application started in 1993 as part of the annual budget process. In 1996 a standard format for the Technology Roadmaps was introduced as the project was pushed through by the CEO. Technology Roadmapping is conducted at divisional level.	# 18	EIRMA WG 52 report (1997) (in collaboration with Robinson)
6	Asea Brown Boveri Ltd (ABB)	Introduced roadmapping to corporate research in 1991 as part of the 'Strategic Technology Planning' (STP) process. Use of Roadmapping is wide-spread but not universal. The firms produce Product Roadmaps independently, ideally at business area (BA) level. Together with business plans, product and technology Roadmaps form a key part of the justification for R&D projects."	# 11	EIRMA WG 52 report (1997) (in collaboration with Schaub)
7	Lucent	Deploying roadmaps across the corporation for each product line of Lucent Technologies. Covering the experience of deployment and use of the roadmapping methodology during several years. A small group shepherded the deployment and use of roadmaps during that time, and the format and application evolved with the experience gained.	# 28	Albright and Kappel (2003)
8	Sandia National Laboratories	Standardized the use of technology roadmapping as a technology planning tool to better position themselves and their products.	# 39	Garcia & Bray (1997)
9	Siemens	From the company-wide execution of numerous roadmapping project, selected the promising best practice innovation projects with Innovation Business Plan - Portfolio-based Roadmapping	#11	Farrokhzad, Kern & Fritzhanns (2005)
10	Aircraft Aluminium Devices	Started in 1998 with Technologie roadmapping for the Product area Aircraft Aluminum Devices that produces ground floors (plates) and large sheets for aircrafts as part of an international steel and aluminum company. And now addresses the issue of updating technology roadmaps and how to maintain roadmaps over time with new environment influences and technologies.	#14	Vinkemeier (2005)
11	Software Systems GmbH	At the unit of Insiders Technologies, that is part of a specialist software house concern for intelligent Document management and Business process optimization, roadmapping is used since 1998 for all Artificial Intelligence Technology projects.	#25	Weiss & Stuhlmann (2005)
12	Honeywell	From 1999 to 2002, in support of strategic and technology planning, a company-wide roadmapping practice was created.	#30	Whalen (2007)

different types of industry firms in terms of both industry position and size of roadmapping deployment.

Data Collection

We collected the qualitative data with the use of data matrix tabulation (Miles and Huberman, 1984). First, we established a large data matrix with extracted qualitative descriptions, the so-called "raw data memos." From each case document, we extracted the data that included qualitative descriptions providing explanations or clarifications on roadmapping activity and roadmapping performance. We classified the raw data memos into the data matrix that we had constructed using the basic categories of activity and performance. After collecting the raw data memos of all case documents, we split up the bulky qualitative data matrix into two separate category data matrices.

Data Analysis

The first category data matrix (Miles and Huberman, 1984) that we analyzed concerned roadmapping activity. Our second category data matrix analysis was roadmapping performance. We examined the fractured data overviews by comparing the qualitative descriptions from the different firm situations to each other and clustered comparable descriptions. From these clusters, we extracted empirical indications, wrote memo's and placed these memo's with the new generated indicator into a new column (Glaser & Straus, 1967; p. 112) Then, we extracted all the clusters from this matrix and compiled them into the analysis matrix. Further analysis included a clustering of indicators with underlying uniformity interpreting the varying conditions of the different empirical situations. We generated a term for each cluster through compilation, simplification and rephrasing words used in the empirical indicator memos. In the next analysis stage, we generated a distinct variable memo. This overarching term was generated through inducting and distinguishing until contrasting conditions and theoretical distinctions were identified (Eisenhardt, 1989). Finally, for grounding the concept descriptions of roadmapping activity, and roadmapping performance, we constructed the synthesis matrices based on a majority rule (Miles and Huberman, 1984): We extracted only those clustered variables that were reported on by more than half of the 12 firms. From these determining variables, we constructed the concept definitions (see the following Tables 2 and 3).

4 BUILDING A MODEL OF INNOVATION ROADMAPPING

As a result of the total qualitative inductive analysis we developed the theoretical framework of innovation roadmapping presented in figure 1. This paragraph first explains the framework then provides two overviews of the grounded definitions of the roadmapping constructs (see table 2 and 3), and then describes the interrelations between the constructs with a set of propositions.

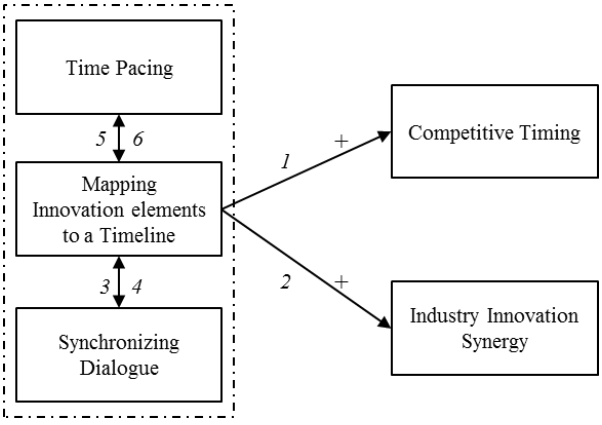

Figure 1. Framework of Innovation Roadmapping

4.1 Innovation Roadmapping framework

As a result of this qualitative research and analysis we were able to induce three activity concepts that are grounded in the roadmapping data. We found that the concepts of 'Mapping Innovation elements to a Timeline', 'Time pacing' and 'Synchronizing dialogue', characterize the activity of roadmapping

Table 2. The Construct of the Roadmapping Activity

Roadmapping Activity			
Definition	Roadmapping is mapping innovation elements to a timeline by a time pacing strategy and a synchronizing dialogue.		
Construct	**Mapping innovation elements to a timeline**	**Time pacing**	**Synchronizing dialogue**
Definition	*Mapping innovation elements to a timeline concerns an activity of identifying, allocating, ordering and interlinking innovation elements of technology foresight, long-term market encounter and product line evolution in a future map with a timeline.*	*Time pacing defines a time interval in reference to the time continuum of the future for launching innovation of new products or services in the future. It creates a rhythm based on predictable time intervals.*	*Synchronizing dialogue is a creative group conversation about the future plans on innovation with the timeline as focal point for creating mutual understanding.*
Evidence quotes	"to help identify product needs, map them into technology alternatives, and develop project plans" – Sandia. "requires that a values-based segmentation be applied. It is this kind of segmentation that results in a cleaner set of product priorities … linking strategy to product plans to technology plans ... Roadmaps explicitly create the linkages ... For each product line, roadmaps link market strategy to product plans to technology plans." – Lucent.	"…a proper balance is maintained in short-range issues versus long-range issues" – Motorola. "all the time-based business strategies of an enterprise can be aligned on a continuous basis in support of the business's goals." –Honeywell. "stronger awareness of how to serve important markets with the right products at the right time" – Philips.	"develop a consensus about a set of needs and the technologies required to satisfy those needs." – Sandia. "a unified approach ... promoted growing commitment to the common decision" – Hoogovens. "the structured dialogue essential to the Foresight process; not be unduly sensitive to the opinions of individual gurus, nor be over-reliant on existing organizational structures and power bases ... ensure discussions are informed, open, and objective ... to help greatly in making this consensus-building process both efficient and effective" – BP.
Link to the extant literature	Related to the construct of the time theory framework (Ancona et al., 2001): Mapping activities on a time continuum varies by three types of mapping time: (a) the allocation of time, (b) the ordering of time and (c) the synchronization of activities mapped on the time continuum. Furthermore, innovation roadmapping relates to the comparison of multiple temporal maps with one another in a synchronizing way.	According to Gersick (1988), time pacing is about managing through regular deadlines – time stones – to which managers synchronize the speed and intensity of their efforts. A pacing strategy defines a time interval in reference to the time continuum of the future for launching new products or services in the future. It creates a rhythm based on predictable time intervals.	According to Schein, a consensus building dialogue starts from a conversation and on a basic choice point of deliberation, a personal evaluation of options, with a choice for suspension by internal listening and accepting differences and building mutual trust. Related to Kappel's (2001) constructs of decision influence with decisions related first to the group's understanding of its strategic position, second to aligning the priorities and persuading senior business and R&D management, and third to synchronizing the midrange business plans and the ongoing coordination decisions with the project management systems.
Differentiation from the literature	In deduction to the innovation context, the generic mapping constructs lead to this new construct. Distinct from deductions of (1) single activity mapping to the continuum; (2) repeated activity mapping of the same activity multiple times on the continuum; (3) single activity transformation mapping of change processes, where one activity changes in character in response to a market (Ancona et al., 2001).	In contrast to the concept of speed, time pacing variables are rhythmic, regular and proactive. Like a metronome, time pacing creates a rhythm for change (Eisenhardt and Brown, 1998). Distinct from event pacing, in which actions are initiated when the right event occurs. Time pacing fosters systematically different patterns of momentum and change (Gersick, 1994).	Deducted from both the consensus building dialogue definition and the synchronizing decision influence. In a synchronizing dialogue the group builds gradually a shared set of meanings about the vision on future innovations related to a certain point in time.

in a distinctive way. These concepts are interrelated in constituting an effective roadmapping organization. We also found that the performance indicators of roadmapping concern an innovation performance of either 'Competitive timing' or 'Industry synergy'. Both indicators relate to strategic effectiveness of innovation efforts of a firm. The first, relates to a competitive timing of innovative

products in the market place, the second relates to the industry synergy of compatible innovations in compatible products in the value chain. Depending on the roadmapping context of a firm, either type of innovation performance was found to be relevant.
In table 2 and 3 the qualitative evidence and results from the multiple case analysis and link and differentiation from the literature is described in more detail.

4.2 Interrelations between Roadmapping Activity and Innovation Performance

As framed in figure 1, the five distinct roadmapping constructs are interrelated. The interrelations across the activity and performance dimensions indicate that roadmapping affects the innovation performance of competitive timing and industry innovation synergy. In the framework, the arrows represent these interrelations. For each interrelation, we have formulated a proposition based on our findings and related theoretical insights.
The first interrelation connects the roadmapping activity to competitive timing performance. Timing the entry is crucial and depends on the entry strategy for a market, which involves, either taking the initiative and setting the rules of the game, or being responsive and reacting flexibly. Thus:

> *Proposition 1: The use of roadmapping in a firm improves the timing of new product introductions in competitive market arenas.*

The second interrelation across the activity and performance dimension indicates that roadmapping affects the synergy of innovation performance in an industry. We conclude that in a situation where roadmapping is used across the boundaries of a firm in a network of industry partners, roadmapping performance is related to establishing innovation synergy, making the industry more competitive through collaboration in allocating technological capabilities. This leads to the second proposition:

> *Proposition 2: Industrial firms using roadmapping achieve higher innovation synergy in industry performance.*

The next interrelations concern the connections between the activity constructs. The framework conceptualizes relations between *synchronizing dialogue* and *mapping innovation elements to a timeline* and between *time pacing* and *mapping innovation elements to a timeline*. These interactions between roadmapping activities lead to more or less effective roadmapping. Roadmapping, as grounded in the experience of the practitioners, specifically relates synchronizing dialogue and mapping innovation elements to a timeline. In the roadmapping activity, the mapping conversations clearly not only cover speech but also interact with the visual map. The roadmap is created during the dialogue by transforming information-rich textual, auditory and visual input into a roadmap. In roadmapping, the visual mapping of the dialogue contributions is crucial. This leads to the following propositions:

> *Proposition 3: The interaction of dialogue and mapping in roadmapping is positively related to a firm's competitive timing of new products.*
>
> *Proposition 4: The interaction of dialogue and mapping in roadmapping between industrial firms is positively related to industry synergy in innovation performance.*

The last interrelation concerns the interrelation between time pacing and mapping innovation elements to a timeline. We found that firms use a roadmap to deploy their strategies into an innovation plan, balancing long- and short-term objectives. In roadmapping, a time pacing strategy interacts with mapping the innovation elements to a timeline. The strategy is connected to a roadmap by the timeline element. The activity of time pacing is therefore related to the activity of mapping. This leads to:

> *Proposition 5: The interaction of pacing and mapping in roadmapping is positively related to the competitive timing of the firm's new products.*
>
> *Proposition 6: The interaction of pacing and mapping in roadmapping between firms is positively related to industry synergy in innovation performance.*

Taken together, the six propositions about the interrelations across the activity and performance dimension of roadmapping and the interrelations between the roadmapping process concepts are the conclusions derived from the axiomatic groundwork of this research. As an appropriate avenue for future research, survey research that tests the propositions related to the connections in the framework will be fruitful.

Table 3. The Constructs of Roadmapping Performance Impact

Roadmapping Innovation Performance		
Construct	**Competitive Timing**	**Industry Innovation Synergy**
Definition	*Competitive timing is the competition-dependent timing of new product introduction in response to the innovation cycles and launch rhythms of rival market players.*	*Industry innovation synergy is the innovation value in an industry network, which is created and captured, over time, by the sum of firms together relative to what it would be separately.*
Evidence quotes	"Improvement of time-to-market and time-to-money thereby achieving a better competitive edge" –Philips. "deal with this increasingly competitive environment ... to better position themselves and their products ... leverage R&D investments" — Sandia.	"einen synergetischen Raum für aktuelle und zukünftige Software-Produktentwicklungen aufzeigen." – Software Systems GmbH. "a certain technology may be too expensive for a single company to support or take too long to develop, given the resources that can be justified ... it is impossible to independently develop all of the required technologies, technology partnerships can provide a way to leverage these limited resources." – Sandia. "sah man nach wie vor eine langfristig positive Entwicklung der gesamten Branche (a positive long term development of the entire branch)" –AAD.
Link to the extant literature	Maidique and Patch (1988) introduced competitive timing as the timing of entry of new products and processes. They emphasized a relational time construct with reference to the competitors' actions in the market environment instead of using an absolute time measure. This was later characterized as "response time." "The longer the elapsed time between entry of the first mover and that of later entrants, the more opportunities becomes available to the first mover to achieve cost and differentiation advantages." Competitive timing is, for example, a situation in which a market leader may intentionally wait until a competitor emerges in order to avoid cannibalization of current products (Conner, 1988). The theory suggests that the length of the competitors' lag depends on the first mover's ability to impede reaction (Porter, 1985). In correspondence with the findings that realizing competitive timing for innovations does not necessarily mean performing as well as possible on time to market in absolute terms, but to be different from the competition (Katila and Chen, 2008).	By collaborating in industry networks, the firm's objectives are to leverage the differences in competences among the firms and create a collective strategy (Bresser and Harl, 1986). Matin and Eisenhardt (2005) define cross-business synergy as: "the value that is created and captured, over time, by the sum of the businesses together relative to what it would be separately" encompassing value that is created by sharing and recombining resources over time in the building of new competitive advantages including the temporal nature of synergies from a resource-based management view.
Differentiation from the literature	Distinguished from entry timing with an absolute time measure such as the construct of first mover advantages (Lieberman and Montgomery, 1988) or second mover advantages with an early imitation response (Katz and Shapiro, 1987).	In contrast to the economic models of value creation that define value with financial variables such as cost savings and revenue enhancements (Matin and Eisenhardt, 2005). We deducted industry innovation synergy in terms of innovation value from the generic cross-business synergies concept (Matin and Eisenhardt, 2005).

5 DISCUSSION

From this multiple case analysis, we synthesized the findings into a framework for innovation roadmapping. Our framework suggests an improved understanding, and it opens up several interesting opportunities for further research. With this initial theory building on roadmapping, we generated a number of important insights. As its concerns a first step in theory building, the framework should not be misinterpreted to imply that roadmapping is the only approach that contributes to competitive timing or industry innovation synergy. We expect that firms use roadmapping in conjunction with other approaches, and that additional positive or negative effects can be related to additional approaches. A possible research direction is to further explore the interrelations of strategic approaches, and extend the framework with other factors.

Future Research and Limitations

The main research opportunity to extend the current findings of theory building is to test the propositions through a large-scale survey. Furthermore, although this research leads to a number of important propositions, it also has its limitations. One such limitation is that we limited our data extraction to the activity and performance of roadmapping. The relationships of roadmapping with other organizational aspects and factors external to the firm are not analyzed here. Furthermore, although the 12 cases were carefully selected and balanced for this systematic analysis, the qualitative findings are based on the documented experiences of practitioners. For further in-depth research, we specifically recommend further enriching the framework with data from additional sources such as interviews and observations and with roadmapping cases that address smaller firms and ventures contexts.

Managerial Implications

Besides an improved understanding of the phenomenon of roadmapping for both scholars and managers, the roadmapping framework also provides particular insights for managers, as this research revealed that roadmapping can be used in a firm context and in an industry context. In a firm context, it affects innovation performance in the marketplace. It contributes to a better competitive timing in a market. Moreover, when an innovation strategy is deployed, the activity of time pacing appears to be critical. Initiating roadmapping includes the initiation of a pacing strategy and a synchronizing dialogue for the mapping activity of the product/market/technology plans. As indicated in this paper, the importance of dialogue in roadmapping should not be underestimated.

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