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Identifying and Exploiting the Inter relationships between Technological and Marketing Capabilities

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This paper deals with a fundamental challenge for decision makers – how to identify which firm capabilities to develop and which ones are no longer important in order to gain and sustain a competitive advantage. We propose an approach that measures technological and marketing capabilities in an integrated fashion, identifies core capabilities, explores their interrelationships and provides guidance for a dynamic technological and marketing strategy. The proposed methodology is illustrated by and applied to the case of Gorenje, a European manufacturer of household appliances, which faces the challenge of reconfiguring its existing capabilities to (re)gain a competitive advantage. The case study identifies two capabilities that integrate research and development with marketing and thereby create additional value. We show how to identify the integrative capabilities and how this integration takes place in Gorenje, while suggesting that Gorenje's strategy should be based on the co-ordinated development of the key core capabilities we identified.

Introduction

For many practitioners in the business community, the key challenge is to identify and develop their firm's core capabilities promptly in order to gain and maintain a competitive edge.[1] A profound understanding of the firm's core technological and marketing capabilities and, in particular, their interrelationships, is crucial as it enables managers to identify which capabilities should be sustained

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and developed and those that will become irrelevant and should therefore be eradicated. This premise raises some important questions with far-reaching practical and theoretical implications: how can firms identify and evaluate which technological and marketing capabilities can constitute a unique set of strategically-important capabilities and gain a competitive advantage? How can firms account for the interrelationships between technological and marketing capabilities to capture the synergic effects that might arise from their improvements? Finally, once identified, how can a firm select the set of core technological and marketing capabilities and co-ordinate their development to improve performance?

This paper offers a methodological tool for identifying and evaluating technological and marketing capabilities in an integrated fashion. Existing methodologies focus on separately measuring both sets of capabilities (their main effects) and usually neglect the synergies between these complementary capabilities (their interaction effects) which can play a crucial role in the innovation process and augment firm performance.[2] The proposed methodology that builds on the resource-based view of the firm upgrades the existing models by addressing the integrated measurement of technological and marketing capabilities.[3] We posit that the interaction effects can be captured by analysing the role that capability holders, who are the sources of marketing, industrial design and technological knowledge, play throughout the innovation process. This enables a firm to examine first how different groups of capability holders interact and to then identify those capabilities that integrate the others in the innovation process.

This comprehensive, albeit pragmatic, methodology is tested in a case study. The firm involved, Gorenje, is one of the largest European household appliances manufacturers and faces the challenge of developing a strategy to build a competitive advantage in its industry. The selected case provides a suitable empirical context for testing since radical technological innovations are impossible on a larger scale in this industry. In this environment, the dynamic development of a firm's interrelated core technological and marketing capabilities provides the main lever for innovations and comprises an important strategic asset of the firm.[4]

The paper has both academic and managerial dimensions. From the academic perspective, the presented methodology makes a twofold contribution. First, it represents a research approach that simultaneously evaluates core technological and marketing capabilities as well as their inter relationships at the firm level. Second, the research indicates which technological and marketing capabilities are complementary and will enable interfunctional synergies. From a practical perspective, the case study shows how firms can use our research methodology to develop a successful business strategy with regard to capability development or availability.

The paper is organised as follows. The first section reviews the existing methodologies used to measure technological and marketing capabilities. In the second section we describe a methodological tool to identify and evaluate core marketing and technological capabilities in an integrated fashion. We apply the tool to the case of Gorenje in the third section. Competitors' strategic moves are also briefly discussed to support the suggestions made in the case. Finally, we discuss the theoretical and practical implications of the proposed approach, address the study's limitations and identify some possibly fruitful avenues for further research.

Technological, marketing and complementary capabilities as sources of a firm's competitive advantage

Recent strategic management literature highlights how firms can build a competitive advantage based on a combination of core technological and marketing capabilities.[5] A firm with strong technological capabilities is capable of using scientific knowledge to develop products and processes promptly that offer new benefits and create value for customers.[6] A firm with strong marketing capabilities is able to use its deep understanding of customer needs to foster the development of new products and organise marketing activities that provide a unique value to consumers.[7] In addition to each of the direct effects discussed above, technological and marketing capabilities operate in an integrated fashion. Their influence on firm performance moves above and beyond the technological

or marketing aspect alone and can affect a variety of organisational outcomes such as increasing customer satisfaction, improving new product success rates, etc.[8]

Business practice offers some examples that illustrate how the absence of complementary capabilities negatively affects company performance. In the early 1990s, the Slovenian ski manufacturer Elan had superior technological and marketing capabilities. In fact, the company was the first in the industry to launch carving skis, a technological innovation that has revolutionised skiing techniques. In addition, Elan had growing customer awareness and loyalty, mainly because the ski champion Ingemar Stenmark had been endorsing the brand and the company had good relations with ski dealers. Although Elan had both sets of capabilities, it failed to reap the benefits of its innovation. The company lacked the complementary capabilities needed to market the new product successfully (i.e., there was no fit between the brand strategy and the product innovation). It was only after its rival Salomon launched carving skis that they gained in popularity. This example shows that firms without well-integrated technological and marketing capabilities may not be able to reap their first-mover advantage.

Firms without well-integrated technological and marketing capabilities may not be able to reap their first-mover advantage

Existing methodologies for measuring technological and marketing capabilities

The existing methodologies (presented in Table 1) frequently focus on either marketing or technological capabilities, disregarding to some degree the impact of their interaction on firm performance. This may, in turn, lead to a loss in value creation.[9] Although most current methodologies aiming at identifying and measuring *technological capabilities* offer well-structured frameworks that build on sophisticated models, they are fairly complex and therefore not easily applicable in practice.[10] Further, they evaluate technological capabilities mainly at the SBU level, which raises the issue of how to assess the contribution of each capability at the firm level. This is crucial for developing a comprehensive technological strategy at this level.[11] The existing methodologies for measuring *marketing capabilities* offer a simple set of guidelines that are therefore easily applied by practitioners. However, they typically measure marketing capabilities one-dimensionally by either evaluating their competitive position or their importance for firm performance.[12] In addition, most of these methodologies focus on an evaluation of general marketing capabilities which might make practitioners overlook some firm/industry-specific marketing capabilities.

There is little value for the firm and the consumer when technological or marketing capabilities are treated in an isolated manner and no attributes of offerings that consumers value are delivered.[13] By evaluating both technological and marketing capabilities simultaneously, a firm can propel and redirect not only the development of its current capabilities but also the development of new dynamic capabilities that create future value.[14] The academic audience still faces the challenge of how to identify and measure the integrative effect of technological and marketing capabilities. It is difficult to confront this challenge since core capability alone is a multifaceted construct and the measurement of an integrative effect demands a rich pattern of cross-discipline communication and learning. The interrelationship between both types of capabilities is also hard to embrace as it intrinsically spreads across multiple functions and multiple business units within the firm or even outside the firm's boundaries.

A new approach to measuring core technological and marketing capabilities

In an attempt to overcome the limitations, we have developed a pragmatic but comprehensive methodology that identifies and measures core technological and marketing capabilities in an integrated fashion. The methodology is more straightforward than existing techniques and easily

Table 1. Existing methodologies for identifying and benchmarking technological and marketing capabilities at the firm level

Technological capabilities	
Authors	**Limitations of the extant methodologies**
A. Gerybadze (1998)	■ Capabilities are defined only at the SBU and not at the firm level ■ The methodology requires managers to define but not to evaluate technological capabilities and does not provide sufficient information to decide on which capabilities to develop and which to do away with
Chiesa and Manzini (1998); Chiesa, Giglioli and Manzini (1999)	■ Technological capabilities are defined but not evaluated (benchmarked) ■ Although the methodology proposes engaging in formal strategic programming and budgeting to successfully develop the firm's capabilities, it does not indicate which capabilities to develop and which to do away with ■ The methodology does not account for the influence of the competitive environment (industry effects) on technological capabilities development
S. T. Walsh and J. D. Linton (2001)	■ The methodology does not encompass firm-specific capabilities as it is based on generic core technological capabilities and does not provide the basis for further capabilities' development
Marketing capabilities	
Authors	**Limitations of the extant methodologies**
Vorhies (1998)	■ The methodology is based exclusively on quantitative data (survey) ■ The set of marketing capabilities is limited and stems from previous theoretical contributions and they are benchmarked one-dimensionally
Vorhiers and Harker (2000)	■ The methodology is based exclusively on quantitative data (survey) ■ The set of marketing capabilities is limited and stems from previous theoretical contributions and they are benchmarked one-dimensionally
Song et al. (2005)	■ Individual marketing capabilities are not measured in detail
Vorhies and Morgan (2005)	■ The methodology is exclusively based on quantitative data (survey) ■ The problem is not approached comprehensively

applicable in practice as it incorporates the application of common methodological and analytical tools. Our approach does not generally differ from the existing tools with respect to *what* it measures, but with respect to *how* it measures the phenomena under investigation. We posit that the proposed methodology better evaluates a firm's portfolio of capabilities because it enables the firm to capture, in a comprehensive and straightforward fashion, not only the individual importance of these capabilities but also their interdependencies. We embraced the integrative effect through a cross-functional overview and a thorough evaluation of the product development process at the firm level. The methodology presumes a review of core technological and marketing capabilities' application in each phase of the innovation process, and the role each capability holder plays in the product development process. This demands the integration of technology and market-driven knowledge.

Our tool for measuring the core technological and marketing capabilities involves several stages (see Figure 1; for practical guidelines see Appendix 1). It starts by *identifying all important technological and marketing capabilities*, first at the individual strategic unit level and then at the firm level. These capabilities are then comprehensively evaluated using an internal and an external evaluation. *The internal evaluation* examines a capability's relative importance for securing firm performance in the near and distant future. *The external evaluation* examines a capability's competitive position relative to that of the firm's leading competitor within the industry, while also exploring general

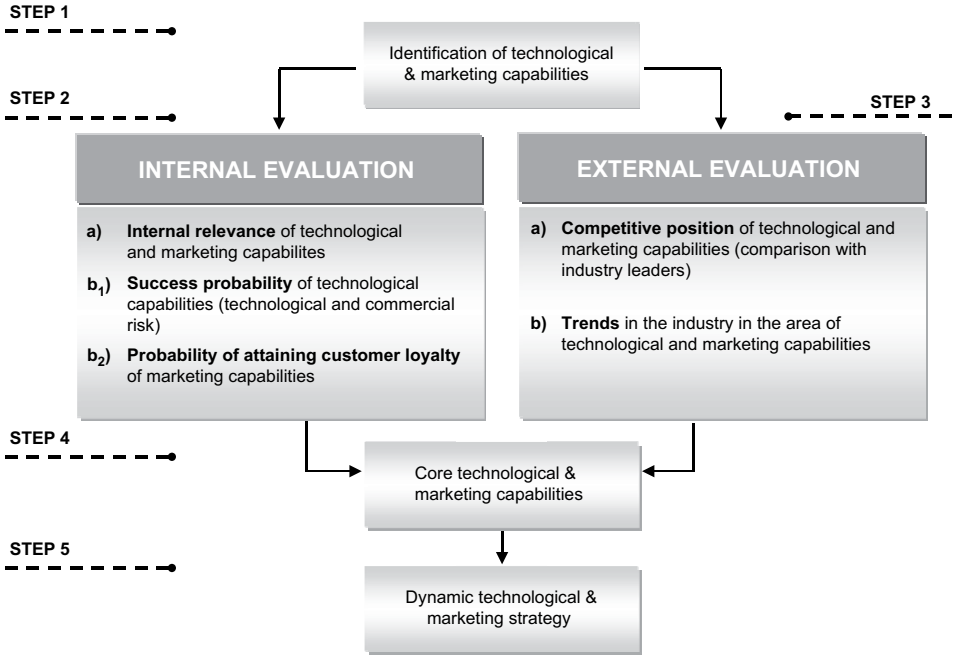

Figure 1. Methodology for measuring core technological and marketing capabilities at the firm level

industry trends that are good predictors of the capability's development potential. Finally, the methodology examines the interrelationships between the two sets of capabilities. The outcome of this analysis is the identification of those key core marketing and technological capabilities that must be synchronically developed and nurtured.

Step 1: Identification of technological and marketing capabilities

The identification of *technological capabilities* starts by partitioning the firm into closed lines of work that share common technological knowledge and processes pertaining to certain groups of products – strategic technological units ("STUs"). The innovation process of each STU is then broken down into smaller processes that are separately examined in order to ascertain the technological knowledge and activities that constitute them. The identification of *marketing capabilities* starts by analysing a comprehensive set of generic marketing capabilities which is adjusted through in-depth interviews with marketing, sales and product management representatives to include firm or industry-specific marketing capabilities. The result is a list of technological and marketing capabilities that positively influence firm performance.

Step 2: Internal evaluation of technological and marketing capabilities

The internal evaluation examines the relative importance of the identified set of technological and marketing capabilities according to two dimensions. The first dimension measures the *internal relevance* of an individual capability for ensuring the SBU's/firm's performance in the near future and is assessed for both sets of capabilities. The second dimension includes the *importance of each capability* for ensuring the firm's performance in the distant future. In the case of technological capabilities, long-term performance is measured by the *probability that a capability will lead to technological and commercial firm success.*[15] This measure captures both the technological and the commercial risk components.[16] In the case of marketing capabilities, long-term performance is measured by the *probability that a capability will lead to increased customer loyalty.*[17] The result is a ranking list of capabilities according to their short and long-term positions for ensuring the firm's performance.

Step 3: External evaluation of technological and marketing capabilities

The external evaluation investigates external factors that affect the development of technological and marketing capabilities: the *competitive position* of a firm's capabilities relative to those of the

leading competitor in the field, and *trends in the wider business environment* that will influence the development of capabilities (e.g., customers' changing lifestyles, consumption patterns, new technologies, innovations etc.).[18]

Step 4: Identification of core technological capabilities, core marketing capabilities and their inter-relationships

Capabilities with the greatest relevance, biggest probability of success/customer loyalty and the best competitive position are identified as *core capabilities*. Management classifies them as either required or key core capabilities. *Required core capabilities* are supported by resources that can be obtained quickly and are not especially interrelated with other core capabilities. They represent a required condition for a firm's successful performance. In contrast, *key core capabilities* are those supported by unique and difficult-to-imitate resources that represent solid foundations for a sustainable competitive advantage. They have a great individual and/or integrated impact on a firm's performance. To identify the capabilities' integrated impact on a firm's performance it is necessary to examine thoroughly the innovation process at the firm level. Specifically, managers have to determine the potential integrative role of each core technological and marketing capability by evaluating the relevance of various capability holders (e.g., product managers, marketers, technologists, development engineers, salespeople and industrial designers) in each phase of the innovation process (e.g., idea generation, business opportunity definition, early product development, final product development and commercialisation). Capability holders are experts in the firm who are the sources of marketing, industrial design and technological information. To determine the relevance of various capability holders, it is necessary first to assess the extent to which each of them contributes marketing, industrial design and technological information in each stage of the innovation process. Then it is important to weight their contributions by the importance each type of information plays in the particular phase of the innovation process.

Step 5: Development of a dynamic technological and marketing strategy

In the final step, management searches for a unique way to co-ordinate and develop core technological and marketing capabilities synchronically to attain a competitive advantage. To accomplish this successfully, it is necessary to take a cross-functional perspective by involving managers and experts from both technological and marketing fields in the process. A dynamic technological and marketing strategy must simultaneously address both the desired technology change, which could fuel innovations in product and service offers, process technologies and/or enabling technologies, and the business model change, which could drive innovation in value proposition, supply chain and target customers. What is sold and delivered to the market, how it is created and delivered to the market, and to whom it is delivered are the logical focal points for innovation from the marketing perspective and should not be discussed separately from technological change. The identified integrative core capabilities should therefore provide an important foundation for formulation of the dynamic technological and marketing strategy. The strategic discussion must also encompass the role of various capabilities in generating incremental, radical or semi-radical innovation (either technology or market-driven). Critical in this last step is management's willingness to cannibalise existing capabilities where these act as an inhibiting factor on firm growth and to develop new ones. (Practical advice on how to implement the proposed methodology is given in Appendix 1).

Application of the proposed methodology to the case of Gorenje

The proposed model was applied to the case of Gorenje, a company operating in the mature household appliances industry, where radical innovations (i.e., disruptive innovations related to product functions which can initiate a technological change in the industry) are uncommon and the dynamic development of both sets of capabilities is thus of vital importance.[19] The technological and marketing strategies of the most important companies in the industry are presented in Exhibit 1.

Exhibit 1
The technological and marketing strategies used by the largest companies in the household appliances industry

- **Bosch Siemens Hausgeräte (BSHG)** builds its product development strategy on basic research (e.g., nanotechnology) and process innovation. In 2004, the company invested 3 per cent of its sales in research; and in 2006 it won the Best Innovator Award for business processes. BSHG's marketing strategy is focused on successfully managing its brand portfolio (two main brands, six special brands and six regional brands). Also, the company places great importance on managing its numerous retail locations in the key markets.
- **Miele** extensively engages in basic research (e.g., nanotechnology) and thus follows a similar innovation strategy to Bosch. However, the company disregards process innovation, which leads to lower cost efficiency and flexibility when transferring activities between SBUs. Miele has built a strong brand name mostly through public relations activities and special point-of-sale locations (up-scale showrooms).
- **Whirlpool** uses its global corporate brand as an important element of regional differentiation. The company manages a broad brand portfolio (12 brands in North America, five brands in Europe, four brands in Latin America and eight brands in Asia). Whirlpool sustains a competitive advantage by investing strongly in mass communication and by managing a wide retail network. Because of its global orientation, the firm can benefit from best practices and innovation transfers. For example, between 2001 and 2004 Whirlpool introduced more than 30 new product innovations.
- **General Electric** builds its innovation strategy on research, especially in the fields of technology and design. Besides developing its core capabilities, the company also phases out unprofitable SBUs.
- **Candy** is a strongly market-orientated company as it focuses on product incremental innovations that increase customer value. Besides internal development, Candy's innovation strategy is also supported by acquisitions. The company's marketing strategy is mainly based on strong advertising and promotional activities.
- **Electrolux** sustains its competitive advantage through an integrated marketing approach. The company successfully integrates market information with product development and leverages it through coherent and consistent marketing. With respect to innovation strategy, it plans to increase investments in R&D to up to 2 per cent of its sales revenue. In addition, Electrolux also streamlines operations, mainly by transferring manufacturing to developing countries. In the last few years, the company has also pursued, with limited success, a co-branding strategy.
- **Indesit** implements an offensive innovation strategy with above-average investments in product R&D. Indesit is the most design-driven company in the industry; innovations are mainly focused on technology and design integration.
- **Gorenje** does not develop basic research in-house, but instead relies on innovations performed by business partners. The innovation strategy is based on process development and on new cutting-edge design. The marketing strategy is based on the extensive use of PR. Also, its brand portfolio, composed by one master and some local brands, allows the company to gain synergy from its advertising efforts.

Gorenje pursues both low-cost and differentiation strategies. The company tries to achieve lower production costs and reap economies of scale by transferring the production of low-end products to developing countries to counter high European labour costs. Gorenje also employs a differentiation strategy that focuses on the development and commercialisation of luxury design-driven products tailored to upscale customer segments.[20] The company is facing the important challenge of knowing

how to sustain its competitive advantage. Identifying which capabilities to develop and which to deploy is a crucial question in this process.

Identification and evaluation of Gorenje's core technological capabilities

In the first step, we identified three strategic technological units (STUs) (cookers & ovens, washers & dryers, and refrigerators & freezers) by conducting in-depth interviews with SBU managers, technologists, development engineers and product managers.[21] Next, we identified the technological capabilities that are essential in each STU's innovation process, leading to a list of 17 technological capabilities (see Appendix 2 for a more detailed description). Most of these capabilities were common to all three STUs, which is beneficial for Gorenje as the units can share best practices and transfer process innovations.

In the second and third steps, the technological capabilities were internally and externally evaluated. With a purposive sample, 22 competent experts (product managers, SBU managers, technologists, development engineers and a marketing manager) selected by the management board (for more details see Appendix 4) were asked to evaluate the set of 17 technological capabilities on a 10-point scale according to three dimensions: the capability's internal relevance, the capability's probability of technological success and the capability's competitive position.[22] Average values for each capability were first calculated for each dimension at the STU level, and then at the firm level by weighting the average values at the STU level with the relative importance of each STU (proportion of the firm's total revenues). Finally, the average values for each capability at the firm level were normalised to provide a better basis for comparison (see Table 2).

The most important capabilities along the first dimension at Gorenje (*a capability's internal relevance*) are assembly, sheet-metal processing, painting and dimensioning. The ranking of the capabilities along the second dimension (*the probability of technological success*) (commercial success was not calculated as the data were unobtainable) shows that the development of painting, design and assembly is critical for achieving a technological edge. Finally, the ranking of the capabilities along the third dimension (*competitive position*) shows that, relative to its competitors, Gorenje scores highly in design, thermo-forming, dimensioning and assembly. Figure 2 presents a map of

Table 2. Normalised values of Gorenje's technological capabilities

Technological capability	Internal relevance	Probability of technological success	Competitive position
Lean production	0.92	0.55	0.82
Design	0.88	**1.00***	**1.00***
Prototyping	0.88	0.76*	0.86
Sheet-metal processing	0.97*	0.83*	0.85
Painting	0.96*	**1.00***	0.88
Acoustic laboratory	0.67	0.46	0.74
Electronics	0.92	0.74	0.81
Thermo-dynamics	0.84	0.59	0.79
Electro-dynamics	0.82	0.47	0.75
Enamelling	0.38	0.86*	0.87
Thermo-forming	0.33	0.71	0.89
Dimensioning	0.95*	0.65	0.89
Injection moulding of plastics	0.72	0.78*	0.86
Laser technology	0.55	0.58	0.81
Nanotechnology	0.23	0.03	0.35
Assembly	**1.00***	0.90*	0.89*
Vacuum charging system	0.36	0.85*	0.87

* has been assigned to those capabilities whose mean value does not statistically differ from the most important one within the investigated dimension (paired sample t-test, $P > 0.05$).

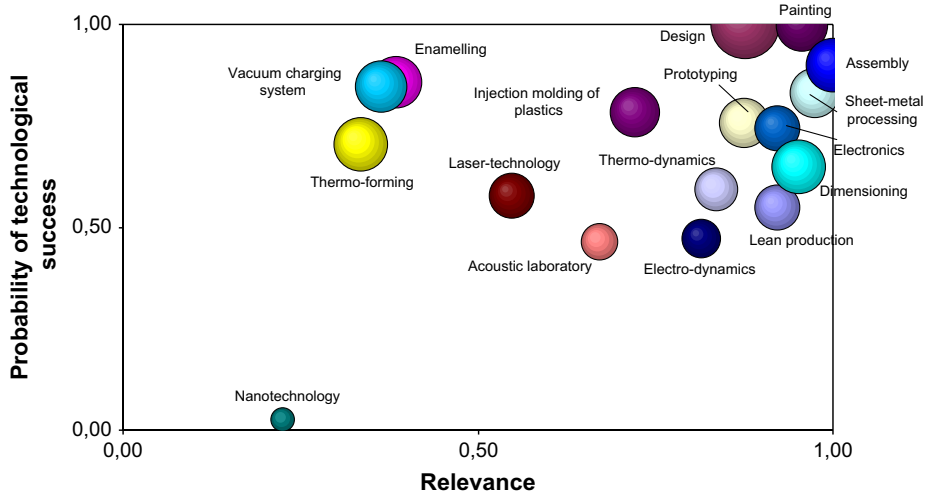

Figure 2. Gorenje's technological capabilities

Gorenje's technological capabilities where the *x*-axis measures a capability's internal relevance and the *y*-axis the probability of technological success. The third dimension, the capability's competitive position, is represented by the size of the circles.

The technological capability map helps identify the *core technological capabilities*, i.e., those capabilities that are the most relevant to the company, have the biggest probability of technological success and provide the company with a superior competitive position. To identify the core technological capabilities, we first selected those with the highest rankings across all three dimensions and then revised the selection in consultation with members of the company's management board. In this way we identified six core technological capabilities: *design*, *painting*, *assembly*, *sheet-metal processing*, *dimensioning* and *electronics*.

Identification and evaluation of Gorenje's core marketing capabilities

Gorenje's marketing capabilities were identified in a similar way. The starting point was the general set of eight marketing capabilities suggested by Vorhies and Morgan (see Appendix 3).[23] The relevance and comprehensiveness of the set were discussed with Gorenje's marketing experts who agreed there was no need to include industry or firm-specific capabilities. We therefore decided to evaluate the eight marketing capabilities described in Appendix 3.

A purposive sample of 24 competent experts selected by a member of the management board was used (see Appendix 4 for more details of the methodology). Each participant was asked to evaluate a set of eight firm-level marketing capabilities on a 10-point scale along the three dimensions. We then computed the average value of each capability in all three dimensions and normalised them to provide a better basis for comparison (Table 3).

The most important capabilities along the first dimension (*a capability's internal relevance*) are pricing and sales management. Marketing communication and product development score highest regarding the second dimension (*the probability of attaining customer loyalty*). The ranking along the third dimension (*competitive position*) suggests that Gorenje, in comparison with its competition, excels in channel management and sales management which are important for ensuring dynamics at the point of sale. A map of Gorenje's marketing capabilities is presented in Figure 3.

Based on the rankings for all three dimensions and our discussion with the management board, we identified the following core marketing capabilities: *sales management, channel management, marketing communication management* and *product development*.

Integration of Core Technological and Marketing Capabilities

Once the core capabilities were identified, it was necessary to account for their complementarities. According to the literature, capabilities that integrate marketing and technology management activities play a crucial role that extends beyond their direct effect on firm performance.[24] To identify the

Table 3. Normalised values of Gorenje's marketing capabilities

Marketing capabilities	Internal relevance	Probability of attaining customer loyalty	Competitive position
Pricing	1.00*	0.87	0.89
Selling	0.99*	0.91	0.97*
Market information management	0.96	0.88	0.82
Marketing planning	0.93	0.83	0.87
Marketing communication	0.92	1.00*	0.87
Marketing implementation	0.92	0.81	0.88
Product development	0.92	0.95*	0.92*
Channel management	0.90	0.90	1.00*

* has been assigned to those capabilities whose mean value does not statistically differ from the most important one within the investigated dimension (paired sample t-test, $P > 0.05$).

integrative effect, we surveyed a sample of 43 marketers, sales personnel, industrial designers, technicians and development engineers who were judged as the most competent by members of the board (see Appendix 4). The participants were asked to evaluate the relevance of capability holders (such as marketers, product managers, salespeople, industrial designers, technologists and development engineers) throughout the innovation process. Specifically, the participants were first asked to evaluate the extent to which individual capability holders contribute their knowledge during the different stages of the innovation process.[25] Next, the participants were asked to evaluate the importance of this information for each phase of the innovation process. Based on this, we were able to assess not only the extent of the contributions of the various holders but also their importance (Figure 4).

The results presented in Figure 4 are supported by the literature and suggest that *product managers* are the most important source of knowledge in the idea generation and business opportunity definition stage. In contrast, *development engineers* and *technologists* play the most important role in the early and final product development stages. In the product commercialisation phase, *marketers, product managers* and *salespeople* are the most important sources of knowledge. The key finding of our analysis is that product managers and industrial designers are important in most phases of the innovation process. Although product managers play a crucial role at the front and back ends of the innovation process, they also co-operate substantially with technologists and engineers during the initial and final product development stages. Similarly, industrial designers co-operate

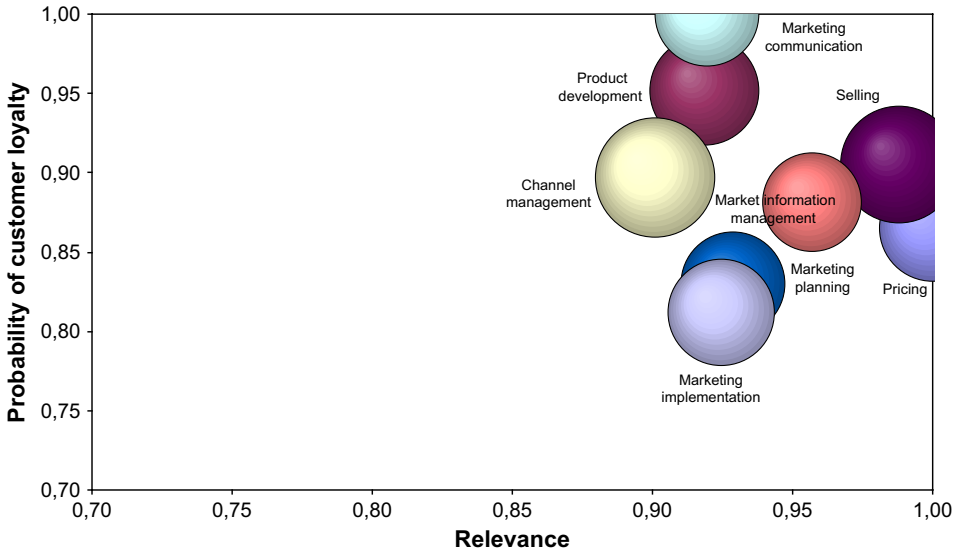

Figure 3. Gorenje's marketing capabilities

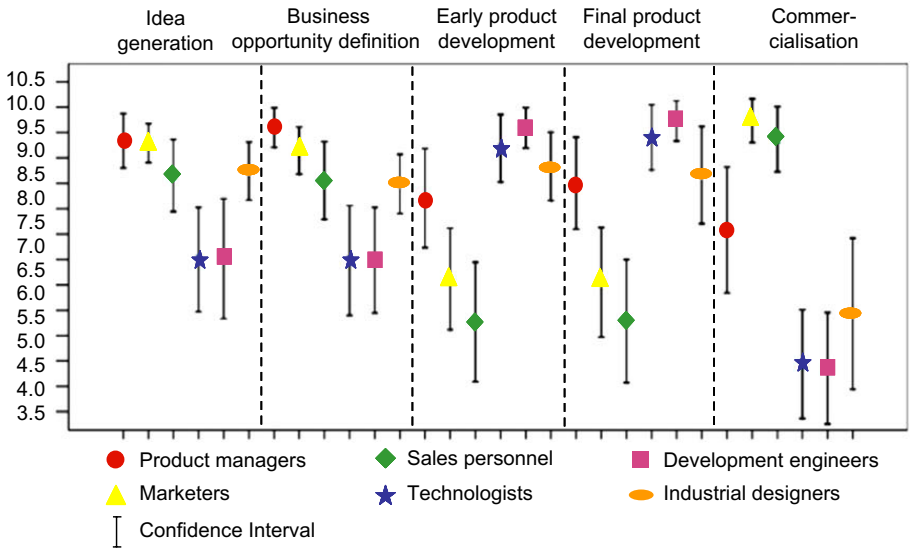

Figure 4. Importance of the different sources of knowledge within the product innovation process at Gorenje (95% confidence interval)

during the early phases of the project mainly with marketers, while during the later phases they work closely with technologists and development engineers. An analysis of variance supports this finding as it shows that the *product managers and designers are consistently present as critical integrators in all stages of the innovation process* and are, therefore, of the utmost importance to a project's integrity (see Appendix 5). As product managers are the main holders of the product development capability, while designers are the main holders of the design capability, we can conclude that these two capabilities play an integrative function at Gorenje and contribute significantly to organisational learning.

Product managers and industrial designers are important in most phases of the innovation process

Based on these findings, we identified the required and the key core capabilities. The *required core technological capabilities* at Gorenje are painting and sheet-metal processing, while the *required core marketing capability* is marketing communication. The *key core technological capabilities* are:

- *Design,* which is an element of brand differentiation that enables household manufacturers to charge a premium price. Gorenje already builds its competitive advantage on design through both internal development and partnerships with renowned industrial designers (e.g., Pininfarina, Öra Ito).
- *Assembly* is crucial for the optimisation of production as it leads to cost efficiencies. Assembly at Gorenje is well optimised, allowing the company to respond quickly to changing customer needs.
- *Dimensioning* although most competitors outsource this capability, Gorenje develops proprietary knowledge in this area. However, it is questionable whether this strategy will pay off as outsourcing proves to be more cost-efficient.
- *Electronics* is a centralised business unit at Gorenje, dealing with the proprietary development of electronic components for household appliances that complement the solutions offered by external suppliers.

Gorenje's *key core marketing capabilities* are:

- *Product development* sorts market information and transfers it to R&D. Here, the company has taken a substantial step forward, especially regarding time-to-market.
- *Sales management* is also crucial as consumers make an increasing number of decisions at the point of sale. Gorenje has a well-structured sales personnel compensation system that motivates its salesforce to provide consumers with extensive explanations about product features.
- *Channel management* is gaining in importance thanks to higher retailer negotiating power. Gorenje is well positioned with respect to this capability as it has been carefully managing relationships with its key intermediaries for decades.

By evaluating the relevance of capability holders in diverse phases of the innovation process, we upgraded the existing methodologies and this enabled us to consider not only the individual impact of each set of capabilities but also their interrelations. This prevented us from underestimating the importance of those capabilities that play an integrative role at the firm level. For example, if we had looked at marketing and technological capabilities separately, we would have classified product development capability as a required core capability and not as a key core capability. This example highlights the benefits of using an integrated approach and identifies the pitfalls of not doing so. Specifically, in the case of Gorenje, the integrated approach enabled us to acknowledge fully and therefore properly evaluate the integrative role played by industrial design and product development.

Implications for Gorenje's strategy

According to our results, the company's management should build a dynamic technological and marketing strategy on the co-ordinated development of the key core capabilities we identified — in technology: design, assembly, dimensioning, and electronics, and in marketing: product development, sales management and channel management. The analysis shows that Gorenje should continue with its niche marketing strategy as supported by continuous incremental innovations. Key to the successful implementation of this strategy is the development of complementary capabilities that enable management to recognise emerging customer desires and translate them quickly into clear product ideas. The company needs to develop its product development and design capabilities further in order to bridge functional boundaries and thereby provide market solutions tailored to customer needs in a consistent and integrated manner. Where the development of key core capabilities is internally impossible, the company should consider the possibility of acquiring complementary capabilities externally.[26] However, the company will have to consider such a move carefully as much research shows that internally-developed resources and capabilities lead to greater innovation than those gained through acquisitions.[27]

Discussion

This paper is designed to address a methodological gap in measuring technological and marketing capabilities in an integrated fashion at the firm level. The failure to value properly the complementary capabilities that create synergic effects can lead to a deficient identification of the key core capabilities, which undermines strategic decision-making. The underlying premise of the paper is that firms obtain and sustain a competitive advantage in the market by both creating a unique set of technological and marketing capabilities and by taking advantage of their complementarities. In response to the existing methodological gap, we offer a new approach that identifies core firm capabilities by also taking their inter-relationships into consideration. This provides important information as to which capabilities to develop and how, and which capabilities to do away with. The research questions investigated in the paper hold important implications for both academic and managerial audiences.

Theoretical implications

The paper's academic contribution is twofold. First, it proposes a methodological tool for the identification and measurement of technological and marketing capabilities in an integrated fashion, and accounts for their complementarities. We believe that the paper upgrades the existing literature by offering a more complete analytical tool to evaluate firm capabilities properly. We substantiate this claim by presenting several arguments (summarised in Table 4):

- The methodology provides more comprehensive and relevant answers to a firm's strategic questions — What are the firm's existing capabilities? Which existing or new capabilities should be built upon to gain a competitive advantage? Which capabilities are irrelevant and should be done away with? Our methodology both: (1) takes into account the inter relationships between technological and marketing capabilities; and (2) evaluates each capability three-dimensionally (according to its internal relevance, probability of technological/marketing success and competitive position).
- The methodology is more robust than existing tools because it enables users to tailor the general set of capabilities to the firm in question and can, therefore, be applied in different environmental contexts. It is suitable for measuring capabilities in firms that have SBUs operating in growing as well as mature industries, allowing them to identify key core capabilities at the firm level.
- The methodological tool is more straightforward than existing tools as it: (1) relies on five well-defined steps; (2) applies standard methods and analytical tools; and (3) does not require complex calculations.

Second, the paper identifies two capabilities — industrial design and product development — that integrate technological and marketing capabilities, thereby creating additional value. Industrial design, a technological capability, is widely acknowledged as being able to bridge marketing and R&D by helping translate consumer needs into products. Indesit, for example, (see Exhibit 1) is very successful in integrating design with other technological capabilities. In contrast, product development, defined as a marketing capability that ensures the design and development of products/services that fulfil consumer needs, has not previously been identified as key to relating these two functions and, thus, facilitating the product innovation process. This result suggests that a series of marketing activities — consumer intelligence, trend observation, product benefits specification and market testing — can improve the deployment of technological capabilities and create additional value in firms.

Although the results are obtained from only one case study and hence cannot be generalised, they raise important research questions that should be addressed further. Nevertheless, the overview of the strategies employed by companies in the household appliances industry reveals that the main competitors successfully integrate technological and marketing capabilities. This integration is crucial in this mature industry, where radical innovations are not customary. There are only a few

Table 4. Implications for academics and practitioners

Implications for academics	Implications for practitioners
The paper provides a **tool** to measure technological and marketing capabilities in an integrated fashion. The key benefits are: ■ **Comprehensiveness** (it incorporates the interaction between the two sets of capabilities and adopts a three-dimensional approach to measurement). ■ **Applicability** to different environmental contexts. ■ **Simplicity** of measurement. The paper identifies two capabilities that might play an integrative function in firms and create greater value — '**integrators**'.	The methodological tool enables managers: ■ To identify firm capabilities systematically and integrally and to evaluate them properly. ■ To pinpoint which capabilities should be developed and which should be deployed. ■ To perform a longitudinal capability analysis (repetitions are easy). The capability measurement process requires the active involvement of technology and marketing experts, which **facilitates strategy implementation** and improves performance.

companies, Bosch Siemens Hausgeräte and Miele, for example, that apply basic research, mainly in the field of nanotechnology. Other competitors engage in process rationalisation and the integration of marketing and technological knowledge in order to differentiate themselves.

The theoretical foundations for capability integration are laid in the resource-based view of the firm. Integrating technological and marketing capabilities should lead to a better performance because it is a complementary rather than a supplementary combination. Such integration reconfigures capabilities, reduces the resource deficiency and generates new applications from those resources.[28] The process of identifying (integrative) key core capabilities is, however, not merely a matter of a technical accomplishment but is also associated with organisational and human cognitive processes. We acknowledge the theories of organisational action and, more recently, some cognitive researchers who investigate the ways that mental models of managers influence processes for identifying key resources and for defining and developing an organisation's capabilities as we design a pragmatic all-encompassing approach to identifying integrative core capabilities.[29] Because in uncertain environments there are cognitive limits on managers' abilities to identify capabilities that will be strategically valuable in the future, the focus must shift from acts of commitment and of pre-emption based on the specific use of resources to understanding the ways managers can cultivate and use flexible capabilities, integrative ones in particular. Managers should consider expert opinions and pay attention to connecting strategy formulation and strategy implementation so that the formulation is coevolving and integrated with the implementation.

Integrating technological and marketing capabilities should lead to a better performance

Managerial implications

Apart from the academic dimension, the paper also has an important managerial facet. First, it offers practitioners new insights into how to measure technological and marketing capabilities in an integrated fashion. Here, the proposed methodological tool brings important benefits for practitioners, which can be summarised as follows (also see Table 4):

- The tool enables managers to identify their firm's capabilities systematically and integrally, and to evaluate them, thereby providing managers with relevant information for strategising about the development and deployment of the firm's capabilities. Our methodology also allows managers to pinpoint those areas that are most critical and deserve priority action.
- The methodology can be applied repeatedly in a firm, thus facilitating longitudinal capability analyses. In fact, the measurement process can be performed internally without the need to hire external consultants. This benefit was widely acknowledged by the Gorenje management team who found the methodological tool to be very pragmatic, simple and with feasible implementation costs. To be more specific, the application of the methodology in Gorenje comprising data collection and analysis was initiated prior to the formal start of the regular strategic planning process and took one month. Careful timing of the project allowed for the inclusion of key core capabilities in the development of the new Gorenje strategy. The costs incurred include 8.5 man-days on the side of internal participants (interviewees and survey participants) and seven man-days on the side of the analysts.
- The proposed methodology requires the active participation of all important holders of technological and marketing capabilities in a firm. The involvement of technology and marketing experts in identifying and measuring capabilities, in turn, substantially facilitates the strategy implementation by increasing the level of understanding and acceptance of the developed strategy.

Second, the use of the methodology has promoted strategic thinking at Gorenje by questioning the need to develop new or to reconfigure existing capabilities. Development or deployment also depends on the capabilities developed by Gorenje's main competitors (see Exhibit 1). Critical to the successful implementation of this approach is decision-makers' willingness to both develop new capabilities – either internally or through acquisition – and to cannibalise existing capabilities. German manufacturers of household appliances generally engage in the internal development of radical new technological knowledge, while others, for example Candy, supplement their capabilities' portfolio through acquisitions. While the majority of companies in the household appliances industry build their competitive advantage on brand management and channel management, others employ radical technological innovations. Differentiation therefore relies on a unique portfolio of technological and marketing capabilities and their effective integration. A methodological tool that promotes the periodic scrutiny of existing capabilities is highly valuable for firms.

The identification of core technological and marketing capabilities was a substantial input for Gorenje's corporate strategy development. Gorenje clearly proclaimed to be a design-driven company, implying that investments were directed into the enhancement of capabilities and knowledge (with an emphasis on industrial design, electronics and marketing communication) that contribute to the development of high-end products. By focusing on core capabilities, the company was able to transform itself from a ''value-for-money'' to ''design-driven'' manufacturer, reaping the benefits of increased sale of higher value-added home appliances. Prior to the methodology application, Gorenje had two design product lines, Old Timer and Pininfarina. Since then, the company introduced Swarovski line in 2005, Pininfarina 2 at the end of 2005 and Ora Ïto line in the 2007. The sale of each of these lines increased substantially (see Table 5).

Through careful development of core capabilities, Gorenje proved to be an internationally recognised award winner in design and innovative solutions (Plus X Award 2007, Superbrand title 2007, nomination for the Le Grand Prix de l'Innovation 2007, The Red Dot Design Award 2005).

Conclusion

The paper presents the application of a new approach to measuring technological and marketing capabilities in an integrated fashion in the case of Gorenje. While the use of a singular case study limits the generalisation of the findings, this case study raises important questions that indicate intriguing avenues for further research. First, it identifies two strategically important ''integrators'' between core technological and marketing capabilities, namely industrial design as a technological capability, and product development as a marketing capability. It would be of great theoretical and practical significance to be able to identify other integrators that create greater value for firms by coordinating existing firm capabilities. There is also the issue of whether breaking the functional

Table 5. Sale of design product lines

Product line	Sale increase (in %)					
	2005	2006	2007			
			I. quarter	II. quarter	III. quarter	IV. quarter
Old Timer	product line introduction	14%		15%		
Pininfarina 2	product line introduction	1672%		139%		
Swarovski	product line introduction	2105%		89%		
Ora Ïto				product line introduction	75%	52%

boundaries when defining capabilities (not just as technological or marketing-related ones) would facilitate the process of identifying key core capabilities and laying the foundations for strategy formulation. Another interesting research question that deserves more attention is to examine what moderates the role played by these two integrators. Our suggestion is that the environmental context may moderate the importance of the two capabilities. Specifically, in mature industries where developments mainly consist of incremental adaptations in general, or product line extensions in particular, and where customers familiar with the product type can express their preferences easily, ''market pull'' is likely to be the preferred route. In such circumstances, product development as a marketing capability could play a leading role. In contrast, in growing industries where customers are mostly either unaware or unable to articulate their needs clearly, the balance shifts towards ''technology push'' as supported by industrial design.[30] The proposed methodology could be further improved, although methodological refinements should not jeopardise its pragmatism and comprehensiveness, which are two of its greatest benefits. In fact, the main motivation for the proposed methodology was to create a user-friendly tool that encompasses the new theoretical findings in the field of strategic management.

Appendix 1. Practical guidelines for measuring technological and marketing capabilities

Step 1: How to identify technological and marketing capabilities

- *For technological capabilities*: break the company up into lines of similar work that share common technological knowledge in related business areas (e.g., SBUs or STUs). Identify key processes within the product development process and then recognise the technological knowledge and activities that constitute them. Consult technologists, development engineers, product managers, shop-floor experts etc.
- *For marketing capabilities*: start from the generic set of marketing capabilities and adjust it to firm or industry specifics. Consult sales personnel, marketers, product managers etc. These capabilities might be unique to a certain group of products or to the firm as a whole. In the former case, the marketing capabilities are measured at the SBU level; in the latter, exclusively at the firm level.
- Determine the relative importance of each SBU/STU, which is used to weight the data at the firm level (W_i). Possible measures: expected revenues, potential market share, profit from sales, value added etc.

The weight (W_i) of an individual SBU/STU can be defined as $W_i = T_i / \sum (T_i)$, where T_i is the expected revenue of a SBU/STU and $\Sigma(T_i)$ the total expected revenue at the firm level.

Strategic tecnologic/buisness unit	**STU_1/SBU_1**	**STU_2/SBU_2**	**STU_3/SBU_3**
Weight(%)	$\boldsymbol{W_1}$ = revenue of STU_1/SPU_1/ total revenues of all STU/SBU	$\boldsymbol{W_2}$ = revenue of STU_2/SBU_2/ total revenues of all STU/SBU	$\boldsymbol{W_3}$ = revenue of STU_3/SBU_3/ total revenues of all STU/SBU

Step 2: How to internally evaluate technological and marketing capabilities

Evaluate each capability according to the following dimensions:

Capabilities' internal relevance in ensuring SBU/firm performance in the near future:

- Determine the importance (M_{ik}) of each capability *ik* for each STU/SBU on a 10-point scale (1 = low and 10 = high) in consultation with technologists, development engineers, product managers, shop-floor experts, sales personnel, marketers, product managers etc.
- Determine the relative importance (I_{ik}) of each capability *ik*.

Relative importance (I_{ik}) is calculated as $I_{ik} = M_{ik} / \sum (M_{ik})$

Capability	**Normative importance of unit**		
	STU_1/SBU_1	**STU_2/SBU_2**	**STU_3/SBU_3**
Capability 1	$I_{STU1,1/SBU1,1} = M_1 \sum M_{1k}$	–	–
Capability 2	$I_{STU1,2/SBU1,2} = M_2 \sum M_{1k}$	–	–
Capability 3	$I_{STU1,3/SBU1,3} = M_3 \sum M_{1k}$	–	–
Capability 4	$I_{STU1,4/SBU1,4} = M_4 \sum M_{1k}$	–	–
Sum of average values	1	1	1

- Determine the internal relevance (R_k) of each capability by applying the weights of all STU/SBUs

Internal relevance of a technological/marketing capability $k = R_k = \sum_i (W_i * I_{ik})$

Relevance of a technological/marketing capabilities

STU_1/SBU_1	**STU_2/SBU_2**	**STU_3/SBU_3**	**Relevance of each capability**
Capability 1 $R_{1,1} = W_1 * I_{STU1,1/SBU1,1}$	$R_{1,2} = W_2 * I_{STU2,1/SBU2,1}$	$R_{1,3} = W_3 * I_{STU3,1/SBU3,1}$	$R_1 = R_{1,1} + R_{1,2} + R_{1,3}$
Capability 2 –	–	–	–
Capability 3 –	–	–	–

Capability's probability of a successful long-term performance

- Measure the probability of the commercial and technological success of each technological capability by first determining the *commercial risk* as a standard deviation of each technological capability's relevance: $R_{com} = \sigma(R_{com,k})$, and then technological risk, which consists of three components: (1) *level of technology progress* (the risk is higher if a company has not yet succeeded in utilising the technology); (2) *difficulty of objectives* (the risk is higher if a technology has not yet been developed to the highest possible level); (3) *resource adequacy* (personal abilities of employees; integration of R&D with other functions, the extent to which other companies have developed technology; difficulty of applying technologies to other products/units; accessibility of equipment, and specialisation of resources). All three components are evaluated on a 10-point scale (1 = low and 10 = high probability of success) in consultation with technologists, development engineers, product managers, shop-floor experts etc.

Probability of a capability's technological success

= (level of technology development * difficulty of objectives * resource adequacy)/1,000

Probability of a technological capability's success

$= 1 - (\text{commercial risk} + \text{technological risk})$

Note: each of the two risks is normalised to 0.5 (each type of risk represents half of the total risk).

- Measure the probability of attaining customer loyalty for each marketing capability by questioning sales personnel, marketers, product managers etc. on a 10-point scale (1 meaning a low and 10 meaning a high probability of success)

Probability of developing customer loyalty (L_{ik}) is calculated as $L_{ik} = C_{ik} / \sum (C_{ik})$

Step 3: How to externally evaluate technological and marketing capabilities

- Measure the competitive position (C_{ik}) of each capability by questioning (on a 10-point scale, with 10 representing a capability level of development achieved by the industry leader) technologists, development engineers, product managers, shop-floor experts for technological capabilities, and sales personnel, marketers and product managers for marketing capabilities.

Competitive position (P_{ik}) is calculated as $P_{ik} = C_{ik} / \sum (C_{ik})$

- Identify general industry trends that are good predictors of the capability's development potential. Initial competitive positions of various capabilities measured by the questionnaire may be adjusted by involving expert opinions (technologists, development engineers, product managers, and shop-floor experts for technological capabilities, and sales personnel, marketers and product managers for marketing capabilities).

Step 4: How to identify core capabilities and their interrelationship

- Identify the technological and marketing core capabilities (i.e., capabilities with the greatest relevance, biggest probability of success/customer loyalty, and the best competitive position) based on the previous analyses.
- Identify the groups of experts that are involved in the product development process and are important sources of knowledge (e.g., product managers, marketers, technologists, development engineers, sales people and industrial designers).
- Decompose the product development process into distinct phases (e.g., idea generation, business opportunity definition, early product development, final product development and commercialisation).
- Evaluate the importance of each source of knowledge on a 10-point scale (with 1 meaning not important and 10 meaning highly important) by questioning technologists, development engineers, product managers, shop-floor experts, sales personnel, marketers and product managers.
- Compute the average importance for every source within each phase. Then compute the standard deviation of the average importance for every source. Finally, identify the sources with the least standard deviation, who are the 'integrators' of marketing and R&D.

For example, the average importance of product managers at Gorenje on a 10-point scale was: 8.8 ($I_{pm,1}$) in the idea gathering stage, 9.0 ($I_{pm,2}$) in the development of marketing definition stage, 7.8 ($I_{pm,3}$) in the initial product development stage, 8.1($I_{pm,4}$) in the final product development stage,

and 6.9 ($I_{pm,5}$) in the commercialisation stage. The average importance of the product managers (I_{pm}) was 7.6. The standard deviation was computed as:

$$\sqrt{\left(I_{pm,i} - I_{pm}\right)^2} = \sqrt{(8.8-7.6)^2+(9.0-7.6)^2+(7.8-7.6)^2+(8.1-7.6)^2+(6.9-7.6)^2} = 1.79.$$

Step 5: How to develop a dynamic technological and marketing strategy

- Perform in-depth interviews with cross-functional managers and board managers about the ability of each capability separately or interdependently to generate substantial future value for customers at a corporate level.
- Review the main findings and discuss future strategic orientation within the top management team. In this stage, it is especially important to decide on which capabilities to develop internally, which externally (though either acquisition or strategic partnerships), and which to cannibalise.

Appendix 2. Technological capabilities of Gorenje

Lean production	Lean production indicates a company's ability to introduce products as quickly as possible and, in the case of Gorenje, we can talk about flexibility which results from modular construction (a common platform for products within the same programme that enables adaptability and cost-effectiveness) and the concurrent development of products. Concurrent development means that all development activities in the development team take place at the same time.
Design	Defined as the ability to form products with respect to congruity between functionality, aesthetics and the technological process.
Prototyping	Prototyping closely depends on technology (stereolithography) and on individuals' manual skills.
Sheet metal processing	This technological capability depends on the suitability of the equipment.
Painting	Knowledge from the field of painting enables the permanence of colours and materials and, at the same time, contributes to the durability of products and their perceived quality.
Acoustics	Acoustics can be defined as the ability to measure, recognise and control noise.
Electronics	The systems that operate by controlling the flow of electrons or other charge carriers. All applications of electronics involve the transmission of either information or power. Capabilities in electronics are mainly focused on providing user-friendly solutions.
Thermo-dynamics	This capability is concerned with control of thermo-dynamic processes (flows of liquids, gases, and heat) and their optimisation.
Electro-dynamics	Includes knowledge connected with control of electromagnetic fields (command of circumstances during washing, accelerations, forces and masses).
Enamelling	Knowledge of enamelling is used in the cookers & ovens unit and refers to the application of enamel to ovens.
Thermo-forming	Thermo-forming is used to reshape extruded plastic plates into internal door cells of freezers and refrigerators.

Appendix 2. (*continued*)

Injection moulding of plastics	Remoulding of plastic granules into plastic semi-products either through extrusion or injection.
Vacuum charging system	The process first includes pumping air and other gases out of the cooling system and later on filling it with a cooling medium.
Dimensioning	Includes the development of component construction firmness (firmness and dynamics of appliances, testing, and testing procedures).
Assembly	Includes the skills needed for the composition of appliance parts.
Laser technology	Knowledge related to the use of lasers for cutting and engraving. Laser technology is mainly used for smaller series that demand specialised and precise functions.
Nanotechnology	The science of manipulating individual atoms and molecules in order to create materials, devices and systems with emphasised physical features – stronger, firmer, more compact and universally efficient.

Appendix 3. Marketing capabilities at Gorenje and their operationalisation

Pricing	Knowledge of competitors' pricing tactics Monitoring competitors' prices Creation of a fast price response to market changes Appropriate price positioning of products
Product development	Ensuring that the technological development of new products is linked to customer needs Design of new products and services according to customer needs Development of new products and services that take advantage of investments in the field of new technologies Trial marketing of new products Timely introduction of new products to the market
Channel management	Formation of long-term contractual relationships with distributors Co-operation with the best distributors in the market Close co-operation with distributors in all phases Provision of high-level quality support services to distributors
Marketing communication	Development and execution of advertising programmes Advertising management and creative skills Public relations management Brand image management Corporate image and reputation management
Sales	Appropriate education and training of sales personnel Sales planning and control Selling skills of salespeople Sales management and sales processes skills Providing effective support to salespeople Obtaining information on buyers and competitors
Marketing research	Using market research skills to develop successful marketing programmes Tracking customer needs and wants Making full use of marketing research information Analysing market information

(*continued on next page*)

Appendix 3. (*continued*)

Planning of marketing strategies and tactics	Marketing planning skills Ability to segment markets, choose target markets and position in target markets Marketing management skills and processes Developing of creative marketing strategies
Implementation of marketing strategies and tactics	Effective allocation of marketing resources Consistent organisation of marketing programme's implementation Fast execution of marketing strategies Monitoring and analysing marketing results

Appendix 4. Application of the methodology to Gorenje

Case selection

Gorenje operates in a mature industry where the development of both sets of capabilities is critical. The company also has a differentiation strategy that builds on both, marketing and technological capabilities.

Data collection and analysis

Step 1: Identification of technological and marketing capabilities

Technological capabilities

1. Identification of STUs	**2. Identification of technological capabilities**
Objective: analysis of the company product development and production process and identification of three STUs *Data collection*: 10 semi-structured personal interviews with selected company representatives from production, R&D, technology and marketing *Selection of interviewees*: purposely selected by a member of the management board *Average duration of an interview*: two hours *Data analysis*: coding responses into categories, qualitative analysis	*Objective*: analysis of fundamental technological knowledge in each phase of the product development process and identification of 17 technological capabilities *Data collection*: 14 semi-structured personal interviews with selected company representatives from production, R&D, technology and marketing *Selection of interviewees*: purposely selected by a member of the management board *Duration of the interview*: one hour *Data analysis*: coding responses into categories, qualitative analysis

Marketing capabilities

Objective: analysis of the marketing activities and assessment of the applicability of the marketing capabilities identified by Vorhies and Morgan (2005) to Gorenje

Data collection: Two semi-structured personal interviews with selected marketing experts

Selection of interviewees: purposely selected by the marketing manager

Duration of the interview: 1.5 hours

Data analysis: coding responses into categories, qualitative analysis

Steps 2 and 3: Internal & external evaluation

Evaluation of technological capabilities' relevance and probability of technological success

Sampling frame: Gorenje R&D experts

Sampling technique and sample size: purposive sample of 22 R&D experts

Research instrument: self-administered questionnaire with five closed-ended questions (10-point scales) and three open-ended questions

Selection of units from sampling frame to sample: purposely selected by the technology & production manager

Survey participation: solicited by management

Data analysis: descriptive statistics

Evaluation of marketing capabilities' relevance and probability of customer loyalty

Sampling frame: Gorenje marketing and sales experts

Sampling technique and sample size: purposive sample of 24 marketing and sales experts

Research instrument: self-administered paper & pencil questionnaire with three close-ended questions (10-point scales)

Selection of units from sampling frame to sample: Participants at Gorenje's annual sales and marketing conference

Survey participation: solicited by management

Data analysis: descriptive statistics

Step 4: Identification of core technological capabilities, marketing capabilities and their interrelationship

Objective: evaluate the importance of different sources of information in each stage of the product development process

Sampling frame: Gorenje R&D, marketing and sales experts

Sampling technique and sample size: purposive sample of 43 marketing, sales and product development experts

Research instrument: self-administered questionnaire with four close-ended questions

Selection of units from sampling frame to sample: purposely selected by a member of the management board

Survey participation: solicited by management

Data analysis: descriptive statistics and inferential statistics (*t*-test)

Step 5: Development of a dynamic technological and marketing strategy

Objective: determine in which capabilities to invest resources to build a competitive advantage

Data collection: semi-structured personal interviews with cross-functional managers and members of the management board

Selection of interviewees: purposely selected based on competencies

Duration of the interview: 1.5 hours

Data analysis: coding responses into categories, qualitative analysis

Appendix 5. Dispersion of each source of knowledge's importance through all stages of the product innovation process

	Overall standard deviation	Overall variation
Product managers	2.12	4.48
Marketers	3.90	15.23
Sales personnel	3.95	15.59
Technologists	3.39	11.52
Development engineers	3.73	13.94
Industrial designers	1.67	2.80

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16. Technological risk entails a probability that a technological capability will not be developed in the planned time period or that it will not achieve the desired level of implementation. Technological risk consists of three components: the level of technology development in a company (the risk is higher if a company has not yet succeeded in utilising the technology); difficulty of achieving goals (the risk is higher if technology in a company is not yet developed to the highest possible level), and adequacy of sources (personnel skills, R&D integration with other functions, the level of technology development of other companies, the difficulty of applying technology to other products/units, accessibility of equipment, and resource specialisation). See Chiesa, Giglioli and Manzini (1999).
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18. J. Prašnikar, Ž. Debeljak and A. Ahčan, Benchmarking as a tool of strategic management, *Total Quality Management & Business Excellence* **16**, 257–277 (2005).
19. An example of a radical innovation is a magnetic refrigerator which is, in comparison with a classic compression refrigerator, more environmentally-friendly since it uses less energy (http://www.eurekalert.org/features/doe/2002-01/dl-nmr061702.php).
20. An example of a company's niche luxury product is the Gorenje Swarovski Touch Fridge, which is encrusted with 7,000 hand-set crystals and controlled via a HYPERLINK http://www.techeblog.com/ \l "#" \t "_blank" touch-screen mounted on its door (http://www.techeblog.com/index.php/tech-gadget/gorenje-swarovski-touch-fridge).
21. In some companies strategic technological units ('STUs') coincide with strategic business units ('SBUs'). The in-depth analysis of Gorenje revealed that the STUs are already organised as SBUs.
22. Purposive sampling (or judgmental sampling) is a form of convenience sampling in which population elements are purposely selected by the researcher due to some characteristic (e.g. they are knowledgeable about the issue of interest). N.K. Malhotra, and D.F. Birks, Marketing research: an applied approach, Pearson Education Limited (2003).
23. We assessed the validity of the scale using Cronbach's Alpha. The values of this validity measure ranged from 0.66 to 0.89 for the evaluation of the first dimension (relevance), from 0.77 to 0.97 for the second dimension (probability of attaining customer loyalty), and from 0.93 to 0.97 for the third dimension (competitive advantage).
24. Chang (1996); Dutta, Narasimhan and Rajiv (1999); Rein (2004).
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